Milwaukee Mathematics Partnership
Year 2 Annual Report
2004 – 2005

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May 2005

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This material is based upon work supported by the National Science Foundation under Grant No. 0314898. Any opinions, findings and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation (NSF).
The Milwaukee Mathematics Partnership (MMP) aims to substantially improve mathematics achievement for the 100,000 students in the Milwaukee Public Schools and to increase students’ success in transitioning to college mathematics. In this second year of the MMP, the University of Wisconsin-Milwaukee, the Milwaukee Public Schools, and the Milwaukee Area Technical College have enhanced their commitment as core partners to this unique collaboration among a large urban district, a four-year urban university, and a two-year technical college. As members of the Milwaukee Partnership Academy (MPA)—a community-wide council of school, university, union, government, business, and community organizations, the MMP has utilized the established structures of the MPA to expand its work in Year 2.

This annual report speaks to only eight months of our work this year, from September 2004 through April 2005. We have accomplished so much, yet we still have another four months of work, amazements, and revelations ahead of us from May through August 2005.

“Focused” and “Powerful” are the two words that we selected to best characterize Year 2 of the MMP. We are moving strategically and in concert on all fronts—the school district, the university, and the technical college. We have a vision, we have new tools, we have broad-based support, and we have the people (e.g., mathematicians, mathematics educators, district math teaching specialists, school-based math teacher leaders, and other school leaders).

It has been a year of remarkable accomplishments as well as challenges and struggles. While this report only addresses eight months of our work in Year 2, we are thankful that we had a full project year and were even able to “kick off” the year with an IHE Mathematics Network Conference in mid-August and a Math Teacher Leader Institute in late August. This is in contrast to the late start in Year 1 of our project (awarded in September 2003) after the start of the school year. Last year required us to continually backtrack and move forward at the same time. This year we have been moving full throttle forward with only an occasional brief rest stop. As W. Edwards Deming states, “There must be consistency in direction” and as Superintendent Andrekopoulos recently stated, “It is important to stay the course.” We have remained steadfast and focused in bringing about our vision of challenging mathematics for all learners (shown in diagram at right).
Implementation Progress of Planned Activities

This section discusses the progress we have made on implementing the activities proposed in our Year 2 implementation plan. The significant activities contributing to realizing our goals were identified in reflective discussions among the partners. From this list, we selected one particularly noteworthy activity to discuss for each of our four goals.

For Goal 1 on the Comprehensive Mathematics Framework, we highlight the focused training of Learning Teams in December 2004 on mathematics alignment and formative classroom assessment. For Goal 2 on Distributed Leadership, we examine “how a little goes a long way” in using the MMP Math Action Plans for leveraging resources and moving schools. We draw attention to our work on the design of a new university course on mathematical problem solving and critical thinking for Goal 3 on the Teacher Learning Continuum. Finally, for Goal 4 on the Student Learning Continuum, we discuss our efforts to increase the success of students transitioning from high school to postsecondary mathematics.

Goal 1 Comprehensive Mathematics Framework

Implement and utilize the comprehensive mathematics framework to lead a collective vision of deep learning and quality teaching of mathematics across the Milwaukee Partnership.

The learning targets and descriptors align together. I can now explain to my staff how the targets and the descriptors fit together. I want my students to be successful in the next grade level. The descriptors provide more specific skills my students should have.

We must learn to make connections—descriptors, targets, curriculum, and depth of knowledge.

How critical it is to take the learning targets, standards, and descriptors and weave them together. I wasn’t clear prior to today just how they worked together.

With the state descriptors, we can see some of the “holes” in our math program.

—Learning Team Members

Goal 1, Objective A, Activity 1. Mathematics Teaching Specialists (MTS) facilitate sessions on aligning the district learning targets in mathematics to the grade level descriptors in mathematics of the new Wisconsin Assessment Framework at professional development sessions for Learning Teams, Math Teacher Leaders (MTL), teachers, and administrators.

Activity: Learning Team Seminar (December 2004)

Beginning in the 2002-03 academic year, each school in the district was to establish a learning team comprised of the principal, a literacy coach, and key teachers. Their initial work focused almost exclusively on literacy. With the establishment of the MMP, a Math Teacher Leader (MTL) was added to each learning team about mid-way through the 2003-04 academic year. Last year a seminar was held for Learning Teams in February 2004 that focused on awareness building of the MMP efforts for mathematics including understanding the comprehensive mathematics framework and the importance of district learning targets in mathematics for identifying and articulating big ideas in mathematics to bring consistency.
across grade levels to a school’s mathematics program. The learning targets had just been released in September 2004 and their purpose and use were still unclear to many teachers and administrators. During this project year, the Learning Team Seminar for mathematics sought to move teams further along in the continuum of their work. (Note: This “continuum” will be discussed in more detail later in this report in the section on Annual Highlights.)

A high point in this year was the MMP sponsored all day seminars for Learning Teams the week of December 6–10 for 143 schools and 594 participants. The seminar, *Maximizing the Potential of Classroom Assessments: Part 1*, provided learning team leaders the opportunity to learn about and struggle with issues regarding Classroom Assessments Based on Standards (CABS). The day began with an overview of the research behind assessment practices based on the work of Rick Stiggins. Attendees then took part in the *Taking a Closer Look at the Wisconsin Mathematics State Assessment Framework* session. In the afternoon, a variety of breakout sessions were offered, including (1) *When do we call a CABS a CABS?* and (2) *Assessing Mathematics Through Writing*.

### Table 1. Schools Attending Learning Team Seminars by Level

<table>
<thead>
<tr>
<th>School Level</th>
<th>Number of Schools in Attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary School (K-5, K-6)</td>
<td>65</td>
</tr>
<tr>
<td>K-7 &amp; K-8</td>
<td>39</td>
</tr>
<tr>
<td>Middle School (6-8, 6-10)</td>
<td>17</td>
</tr>
<tr>
<td>High School (9-12, K-12)</td>
<td>22</td>
</tr>
</tbody>
</table>

### Table 2. Attendance of Schools and Participants for Learning Team Seminars by Day

<table>
<thead>
<tr>
<th>Day</th>
<th>Schools</th>
<th>Participants</th>
<th>Principals &amp; Assistant Principals</th>
<th>Math Teacher Leaders (MTL)</th>
<th>Literacy Coaches</th>
<th>Other Key Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>27</td>
<td>99</td>
<td>16 (8, 8)</td>
<td>16</td>
<td>17</td>
<td>50</td>
</tr>
<tr>
<td>Tuesday</td>
<td>30</td>
<td>128</td>
<td>18 (13, 5)</td>
<td>24</td>
<td>25</td>
<td>61</td>
</tr>
<tr>
<td>Wednesday</td>
<td>35</td>
<td>150</td>
<td>20 (15, 5)</td>
<td>26</td>
<td>28</td>
<td>76</td>
</tr>
<tr>
<td>Thursday</td>
<td>23</td>
<td>102</td>
<td>16 (14, 2)</td>
<td>20</td>
<td>19</td>
<td>47</td>
</tr>
<tr>
<td>Friday</td>
<td>28</td>
<td>115</td>
<td>14 (11, 3)</td>
<td>22</td>
<td>24</td>
<td>55</td>
</tr>
<tr>
<td>Totals</td>
<td>143</td>
<td>594</td>
<td>84 (61, 23)</td>
<td>108</td>
<td>113</td>
<td>289</td>
</tr>
</tbody>
</table>

The most significant session of the day was the roll out discussion encapsulating the alignment of the MPS Learning Targets in mathematics to the Wisconsin State Assessment Framework. All attendees took part in this session together. The session began with a skit written and enacted by the district Math Teaching Specialists portraying a school grade level meeting where teachers were aligning their math program to the targets and state assessment descriptors. This skit exposed leaders to the struggles and issues teachers would be addressing in understanding the alignment or misalignment of their math programs to targets and descriptors.

Following the skit, a question and answer sheet (Q&A) was given to all learning teams to address common issues regarding the new Wisconsin Knowledge and Concepts Examination–Criterion Referenced Test (WKCE). This test will be given for the first time in fall 2005 to all Wisconsin students in grades 3–8 and 10. This Q&A sheet became invaluable as these leaders worked with the staff at their individual school sites. School leaders were also given “alignment worksheets” to engage teachers in discussions on aligning grade level math targets, math programs, and the state assessment framework.
This session built learning team member’s capacity for leadership in mathematics as they listened to information, processed what they heard, and developed their own plans to engage their school staff with the teachings from this session. Because of this session, leaders left better prepared to help teachers in their schools discuss goals for student understanding in relation to the targets and state descriptors.

### Table 3. Evaluation Results for Learning Team Seminars (December 2004)

<table>
<thead>
<tr>
<th>Item</th>
<th>n</th>
<th>Mean</th>
<th>Strongly Agree (5)</th>
<th>Agree (4)</th>
<th>Neutral (3)</th>
<th>Disagree (2)</th>
<th>Strongly Disagree (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have a greater understanding of the role and use of classroom assessments based on standards.</td>
<td>452</td>
<td>4.1</td>
<td>27%</td>
<td>56%</td>
<td>16%</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>I have grown in my capability to have conversations with colleagues about CABS.</td>
<td>453</td>
<td>4.0</td>
<td>24%</td>
<td>54%</td>
<td>20%</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>I gained enough information today to further work on assessment with my Learning Team.</td>
<td>453</td>
<td>4.2</td>
<td>32%</td>
<td>55%</td>
<td>12%</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Today was a valuable day for my learning.</td>
<td>454</td>
<td>4.2</td>
<td>34%</td>
<td>50%</td>
<td>14%</td>
<td>1%</td>
<td>0%</td>
</tr>
</tbody>
</table>

### SUMMARY, CHALLENGES, AND NEXT STEPS

Learning team members left enthusiastic and eager to share this new information with their school staff. As can be expected, this initial level of enthusiasm is not always easy to maintain back at the school site due to everyday school issues. The Math Teaching Specialists continually strived to keep the importance of this alignment at the forefront of monthly Math Teacher Leader meetings. At every meeting, designated time was spent supporting leaders in how to access and use state descriptors, learning targets, and alignment worksheets. Each month, Math Teaching Specialists modeled for Math Teacher Leaders new ways to engage adult learners in thinking about targets and descriptors in the context of mathematics content (e.g., rational numbers and fractions).

**Goal 2 Distributed Leadership**

Institute a distributed mathematics leadership model that engages all partners and is centered on school-based professional learning communities.

_A little bit of money structured through the Action Plans and Mini-grants empowered MTLs to work with their learning teams and offered a venue for schools to build their own embedded professional development plans. I am amazed at the creativity MTLs came up with to make the most out of the money they were allotted. I am also impressed how this resource has helped MTLs evolve into respected resource for their school._

—Math Teaching Specialist

Goal 2, Objective A, Activity 4. Learning Teams will develop MMP Action Plans to ensure that they, as a team, meet regularly with mathematics as a focused agenda topic and to ensure that mathematics is a part of school-embedded professional development for their teachers and staff. The action plans will utilize MMP funds and school funds to support this work.

### Activity: Learning Team Math Action Plans

A driving force to focus the work of mathematics at school sites is the MMP Math Action Plan. The Action Plan required learning teams to sit down and work together to develop a
vision for mathematics in their school. Learning teams along with their Math Teacher Leaders (MTL) and access to their Math Teaching Specialists developed a focused set of strategies and a timeline to support their staff in improving the teaching and learning of mathematics. As noted by one Math Teacher leader, the action plan provided an important leverage to get the school focused on mathematics:

_We [our Learning Team] have completed the first and important step and that is finishing our Action Plan! This has helped us to really get the ball rolling in the right direction. It is seeming to be more accepted that I am now a part of the learning team. Our biggest achievement seems a little simple, but means a lot! The administration is recognizing the importance of focusing on mathematics and is beginning to see how much work we have to do! At times, it seems as if we are turning our wheels doing a lot of talking and not a lot of working. I am excited to go ahead with our action plan and get people in our building really excited about teaching math!_ –Math Teacher Leader

Each learning team with an approved Action Plan could receive the equivalent of 60 meeting hours ($2100) funded by the MMP. (This was an increase from Year 1 of 50 hours.) The amount of money was enough to leverage and focus the work at school sites on mathematics.

The first priority in using these funds was to ensure the Learning Team was able to meet and discuss the mathematics work of the school (e.g., math vision statement, math learning walks, classroom assessments in mathematics, examining student math achievement data). The funds were also used to support teacher professional development in mathematics (e.g., using the MMP protocol to examine student work, grade level meetings to discuss the mathematics embedded in CABS). The money compensated teachers to meet before or after school or substitute teachers were hired to release teachers from their regular classroom responsibilities to engage in professional learning sessions.

In Year 1, the MMP approved 101 Math Action Plans from elementary, middle, and high schools. In Year 2, we have approved 127 Math Action Plans from the targeted schools (n=167), a 27.1% (26/96) increase. This increase clearly shows increased focus in schools on mathematics. Table 4 summarizes the common themes from the activities addressed through the Math Action Plans. It is evident from looking at the themes that the training received by the Learning Teams and the Math Teacher Leaders at their monthly training sessions was being taken back to the schools.

This is significant to the work of the MMP. Math Teacher Leaders are more secure in their learning and knowledge of MMP efforts and are replicating the activities at their school sites. Because of the work of the MMP, you can visit nearly any school in the district and listen in on mathematics-focused collegial conversations at grade level meetings, staff meetings, and professional development training sessions. Through these conversations, you would hear similar themes in teacher talk: (1) _What are the math ideas students should be learning?_ These conversations focus on the grade level learning targets and the state assessment framework. (2) _What is the evidence that students are learning?_ These conversations focus in on using common classroom assessments.
Table 4. Common Themes in Activities from MMP Math Action Plans (n=127 schools)

<table>
<thead>
<tr>
<th>Common Themes</th>
<th>Number of Schools*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Targets in Mathematics — Unpack learning targets, examine development of target ideas across grade levels, and align targets to math programs to identify gaps.</td>
<td>43</td>
</tr>
<tr>
<td>Classroom Assessments for Mathematics Based on Standards (CABS) — Analyze, select, adapt, and create formative assessments to inform classroom practice.</td>
<td>39</td>
</tr>
<tr>
<td>Wisconsin Knowledge and Concepts Examination (WKCE) — Discuss and analyze mathematics items on the state test and identify levels of thinking required from students.</td>
<td>36</td>
</tr>
<tr>
<td>State Mathematics Assessment Framework — Align assessment descriptors, district learning targets, and math programs to identify gaps and priority areas.</td>
<td>24</td>
</tr>
<tr>
<td>School Education Plans — Examine student mathematics achievement data for the school and develop grade level and school-wide strategies to improve student achievement.</td>
<td>17</td>
</tr>
</tbody>
</table>

*Total exceeds number of school plans as some plans addressed more than one theme.

**SUMMARY, CHALLENGES, AND NEXT STEPS**

The MMP Math Action Plans have provided a leverage for focusing schools on mathematics at elementary, middle, and high school levels. This focus was not just on whatever the school chose to address, but rather the activities had to be in alignment with the comprehensive mathematics framework and the MMP.

_We have been able to get more focused on the MPS Learning Targets and State Descriptors through grade level and cross grade level meetings funded with our MMP Action Plan. Teachers have used the targets and descriptors more knowledgeably while do curriculum mapping work. In the future, we will be using the targets and descriptors to write CABS as well._ — Math Teacher Leader

We encountered three challenges in regards to the action plans: (1) timeline for disseminating the guidelines for the Math Action Plans, (2) the implementation of the Action Plans, and (3) accountability of activities and funds. Notification of continued funding for Year 2 of the MMP delayed the dissemination of the guidelines for the Math Action Plan. In November, when the guidelines were disseminated, learning teams were busy getting paperwork, staff, and students ready for the state accountability test. This year the MMP site visit is occurring before the end of the school year and we are hoping that continued funding will be ensured and the Action Plan Guidelines will be distributed at the first Math Teacher Leader meeting in September. By getting the guidelines to the learning teams early in the school year, school staffs will be ready to continue their work.

The second challenge was implementing the work outlined in the Math Action Plan. It is an ongoing effort by Math Teaching Specialists to discuss a school’s Action Plan while visiting school-based learning teams. Opportunities at Math Teacher Leader meetings are provided for leaders to share their stories—short scenarios of ways a staff may work together such as discussing grade level targets and state descriptors. As math teacher leaders share these scenarios it is a chance for them to reflect on their own work in their schools—the successes, the challenges, and the role of the learning team and math teacher leader. These short scenarios provide ideas for strategies and motivate other leaders to continue to build and sustain the ongoing work of mathematics at school sites.

The third challenge regards accountability of activities and funds. Each Math Teaching Specialist is more closely monitoring and keeping tabs on the implementation of the Action Plans activities in their cohort of schools. A new system of school reimbursement was
developed for substitute teacher coverage. A summary report form was developed to be submitted with payment and reimbursement requests. These new procedures are increasing the accountability, but also increasing time needed to provide this closer monitoring.

Goal 3 Teacher Learning Continuum

Build and sustain the capacity of teachers, from initial preparation through induction and professional growth, to deeply understand mathematics and use that knowledge to improve student achievement.

“This is the best math course I have ever taken! This class really makes you think!”
—UWM undergraduate student

The Problem Solving design team has worked together this past year to create what I would consider an innovative and stimulating course for preservice teachers. We each brought to the table different areas of expertise that contributed to making this course a success.
—Teacher-in-Residence

“We feel like students are changing the way they perceive problem solving and are reflecting on how to apply their learning to their future careers as teachers.” —Design Team

Goal 3, Objective B, Activity 2. Design team revises the mathematics course on mathematical problem solving for prospective teachers and pilots the course in spring 2005.

Activity: Problem Solving Design Team

Starting in 2002 at UWM, we took the extraordinary step of requiring elementary/middle education majors to choose a minor in mathematics or science, along with a second minor in social studies or language/literature, or bilingual education1. In the past, when only one minor was required, most majors chose social studies and fewer than 8% chose mathematics. Prior to the MMP, the requirement was changed, but not the curriculum: to fill the requirements for the math minor, elementary/middle (grades 1-8) pre-service teachers took existing mathematics courses designed for general education or other majors. The MMP is using a “design team” model to develop four new courses specifically for the elementary/middle school mathematics minor, with the aim of enabling prospective teachers to build and deepen the content knowledge needed to teach challenging mathematics.

A significant aspect of our work for the past two years has been the development of the course on “Mathematical Problem Solving and Critical Thinking.” A design team comprised of Dr. Richard O’Malley (mathematics), Dr. Henry Kepner (mathematics education), Kelly Kaiser (mathematics instructor and doctoral student in mathematics education), and Sharonda Harris (Teacher-In-Residence) has worked collaboratively to develop and co-teach this course in Spring 2003 (13 students enrolled) and Spring 2004 (25 students enrolled).

1 In this document, “minor” refers to the minor for elementary education majors awarded by the School of Education and not, for example, to the mathematics minor awarded by the Department of Mathematical Sciences.
COURSE GOALS AND OUTCOMES

This course seeks to build in prospective teachers a strong foundation for the teaching of challenging mathematics. The course was conceived with the MET report (2001, p. 14) statement, “Prospective teachers at all levels need experience justifying conjectures with informal but valid arguments if they are to make mathematical reasoning and proof part of their teaching.” Through problems that are truly problems for the prospective teachers, the course focuses on becoming conversant mathematically and learning what is acceptable evidence in mathematical arguments. Students strive to build acceptable arguments to substantiate their conjectured solutions to such problems. The entire class, including the instructor, participate in evaluating the evidence and arguments proposed and adapting them recursively until the evidence can be accepted by all. Students are challenged to become better problem solvers by solving problems, justifying their solutions and reasoning, and typically adapting their solutions—both in oral class discussions and in written journals with extensive entries for each problem. Students also facilitate small group discussions of problems.

Through course problem solving tasks, students directly experience the five Process Standards from the NCTM Principles and Standards for School Mathematics identifies that highlight ways of acquiring and using mathematical content knowledge: Problem Solving, Reasoning and Proof, Communication, Connections, and Representation.

A projected outcome of the course is to sharpen students’ confidence and abilities in mathematical critical thinking skills through challenging problem-solving experiences and interactive class discussions. The program developers recognize this as pivotal to a more productive disposition leading to increased confidence in mathematical communication needed to continue this process, subsequently, in their own classrooms.

The specific goals of the course are to:

• Engage students in the exploration and discussion of non-routine mathematical problems in depth—initially and through adaptation of arguments based on interactive mathematical conversations.
• Develop students’ confidence in their mathematical understanding of basic concepts.
• Engage students in the process of doing mathematics as well as the product.
• Encourage students to build an awareness and practice of seeking, using and comparing multiple methods of solution.
• Develop student’s ability to express mathematical ideas in a clear concise mathematical language.

CHANGING MATHEMATICAL PARADIGMS

Far too many of our prospective teachers expect any mathematics course to be taught in a teacher-centered format, expect to be “told” how to solve mathematical problems. In addition, they assume that any written work will be mainly algorithmic, and that grades will be based upon summative exams. As they enter the problem-solving course, they are quickly shocked to learn that it will not follow this teacher-centered paradigm. In fact, this course aggressively engages these prospective teachers in rich mathematical discussions as capable problem solvers, and provides them a model for their future teaching.
A Glimpse Into the Class: Operation Cookie

After Professor O’Malley presented the cookie jar problem, he expected students to first restate the problem, review definitions/terms, and describe, step by step, in detail, how the solution could be approached.

There are 15 cookie jars. Each cookie jar is number 1-15 and has the same amount of cookies as its number. For example, cookie jar #1 has 1 cookie, cookie jar #2 has 2 cookies, cookie jar #3 has 3 cookies….cookie jar #15 has 15 cookies. The task is to develop and explain a strategy to get all the cookies from all 15 cookie jars in 4 moves. Problem restriction: In a given move, cookies can be removed from any number of jars, but the number of cookies removed must be the same for each of the selected jars.

After much discussion, the class decided one strategy would be to remove as many cookies as possible in each round. One student mentioned making a chart that would show the jars chosen, the number of jars in the subset, the maximum number of cookies that could be removed from each jar, and the total number of cookies taken from the entire subset. Professor O’Malley took a moment to discuss that the purpose of the chart was to help develop a systematic procedure.

From the chart, students were able to see symmetry and identify that to get the maximum possible number of cookies, one would need to remove eight cookies, which happened to be the median. The class proceeded to remove cookies through a series of “rounds” based on removing the median each time.

The students summarized their observations: the number of cookies removed in each round was half that of the previous round; each round used eight jars; the number of cookies removed each time was the median, and also a power of two and a multiple of eight. The class left wondering whether there were other strategies that would work for 15 jars, whether this strategy would work for other numbers of jars, and whether they could find a general explanation for any number of cookie jars.

The Problem Solving Journal

Unlike typical college course requirements, this course requires each student to maintain an extensive daily journal of classroom activities and discussions. The journals replaced exams as the major method of assessing and facilitating the development of a student’s problem solving and communication. The journal entry for each problem was expected to consist of three sections.

Section I contains Pre-Class work on the problem. Each "before class entry" includes a statement of the problem and the student’s first attempts at understanding the problem: conjectures for solving it, what worked and what didn’t, what was learned from these attempts, and observed connections with previous problems. These form the basis for the class discussion solution where students develop the processes of communication leading to establishing terminology, seeking patterns and conjectures, evaluating varied solution models and challenging each the reasoning proposed.

My first idea was to find out how many cookies there are were in all of the cookie jars. When I added everything together I found there were 120 cookies in all of the 15 cookie jars. I’m not sure how that information helped me but I thought that I would need to know how many
cookies I was dealing with! I then pulled out 120 cubes laid them out according to how many cookies were in each jar.

The instructors note, “We were more interested in their ability to clarify their entire thought process than in the final answer, so students were instructed to include in the journals a detailed description of their process of coming to grips with the problem and any conjectures they may have used in solving the problem.”

Section II of the journal include a summary of the In-Class discussion. The students summarize and rephrase what happened in the class discussions of the problem. For example, what alternative approaches or representations were used? What concepts, definitions, and representations were introduced? Did their understanding increase or did they become more confused? What methods or suggestions made the process clearer?

The discussion in class started off as very confusing to me. The table that was put on the board was very different than how I had approached the problem.... What I noticed us doing in class was coming up with a pattern that was repeatedly used to help get the cookies. . . . The other idea I walked away with was the idea of “rounds” of play in this particular “game.” It was important to document more carefully what was happening in the rounds. During class I tried to follow the rounds and I still don’t quite understand them.

Section III of the journal included Post-Class thinking and reflection. The entry consists of a reflection on the first two sections, some attempts at outlining how the problem could be generalized, and any conjectures the student may have formulated.

I went back to my “build up” strategy and set out to keep better track of my moves. . . . I ended up with a strategy that I understood, though more cumbersome than that from class. Even now when I look back at my notes from class I still have a hard time understanding what was going on though I think in some way it must be connected to what I did.

**SUMMARY, CHALLENGES, AND NEXT STEPS**

The problem-solving design team considers each problem as key to a course objective and has identified a set of key problem characteristics. The immediate challenge of the problem solving design team is to continue finding “good” problems that share one or more of these characteristics and to develop guidelines and models for class interactions.

The challenge to the MMP is to find ways to move instruction of the course to other faculty beyond the design team members. What will happen to the course when the design team is no longer functioning? It is contrary to the pedagogical basis and nature of the course that a rigid codified set of problems be formulated and passed to subsequent instructors. The instructor needs to be as engaged as he/she expects the students to be, and must constantly be monitoring the dynamics of the class to determine what problem the students should be assigned next. Institutionalizing this process will require

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**Key Problem Characteristics**

- Fosters curiosity and attempts at a solution
- Gets students to take ownership
- Solvable using multiple strategies
- Difficult enough that guess and check is not the preferred method
- Should perplex students but be solvable
- Solutions ultimately can be found
- Ultimately leads to elusive “aha” moment
- Capable of multiple solution methods and representations
- Leads to general principles of mathematical ideas and processes
- Leads to use of tables, charts, common notation, and clear terminology to explain, convince, and communicate to others
- Capable of extending to a wider class of problems
more than just the development of printed course materials: selection, mentoring, and supporting of dedicated instructors will be necessary, because the course is centered around the interactions that occur during class sessions, and the extensive feedback that is provided to students on their journal entries.

Course instructors address Standard 1: Worthwhile Mathematical Tasks in the NCTM (1991, p 25) Professional Standards for Teaching Mathematics, in selecting “good” problems. In particular, Standard 1 states the challenge to pose tasks based on sound and significant mathematics, and that engage students’ intellect; develop students’ mathematical understandings and skills; stimulate students to make connections and develop a coherent framework for mathematical ideas; call for problem formulation, problem solving, and mathematical reasoning; promote communication about mathematics; represent mathematics as an on-going human activity; display sensitivity to, and draw on, students’ diverse background experiences and dispositions; and promote the development of all students’ dispositions to do mathematics. Student reflections in their journals can capture their engagement in mathematical problem solving, reasoning, and communication. Explicit reflection on that can occur in this course and in their subsequent mathematics methods course and student teaching unit constructions.

Many, perhaps most, prospective elementary/middle education majors are weak in all five strands of mathematical proficiency as defined in Adding It Up (2001), Understanding, Computing, Applying, Reasoning and Engaging. As a consequence, they have a strongly negative disposition towards mathematics, believing that they cannot do it, or that they do not have the “math gene.” Moreover, if asked to describe what mathematics is, their answers would stress routine numerical and algebraic computations. In the short time that they are in our program, it is vital that they experience a broader and more positive view of mathematics, and that they come to believe that all students, including themselves, can be mathematically proficient. The problem-solving course, by focusing on the process of doing mathematics, show students what mathematics really is: finding patterns, making conjectures, seeing connections and deep structure, and using the understanding engendered by these relationships to solve problems. Student comments show clearly that they come to enjoy this mathematical process during the course, providing them with a productive disposition that will serve them well in future mathematical endeavors—including the remaining requirements of their math minor.

**Goal 4 Student Learning Continuum**

*Ensure that all students from PK-16 have access to, are prepared and supported for, and succeed in, challenging mathematics.*

**Goal 2, Objective C, Activity 2.** The IHE Network plans and delivers opportunities for teachers, guidance counselors, and IHE mathematics faculty to discuss college level mathematics requirements and develop strategies to meet those requirements.

**Activity: Transitioning from High School to Postsecondary Mathematics**

An important component of our work this year has been the concentration on transitions from high school mathematics to mathematics at four-year or two-year institutions of higher education, particularly from the Milwaukee Public Schools (MPS) to the University of
Wisconsin-Milwaukee (UWM) and from MPS to the Milwaukee Area Technical College (MATC). Our goal is to increase the number of freshman placed into mathematics credit courses at the postsecondary level, thus reducing the number of students in remedial or non-credit mathematics courses. Our work in this area has largely been carried out by Drs. Eric Key and Richard O’Malley (UWM Department of Mathematical Sciences) and David Ruszkiewicz (MATC mathematics faculty). This year 29% of all new UWM freshman placed into remedial mathematics courses at UWM (Math 090 and 095). However, when comparing MPS to non-MPS students the situation is much more alarming. Currently 72% (222/309) of MPS students place into remedial mathematics courses at UWM (Math 090 and 095) compared to 25% (880/3465) of new non-MPS freshman. At MATC, the situation is similar with 77% of MPS students placing into remedial mathematics.

**UWM Policy Change**

All incoming freshman at UWM must take the University of Wisconsin (UW) System Mathematics Placement Test. Since placement into UWM math courses is determined solely by this test, our current transition efforts are largely directed towards ensuring that students’ test results accurately reflect their true mathematical knowledge.

For students to be placed appropriately, students and their teachers, as well as guidance counselors, must have access to appropriate and timely information about the test including not only the content of the test, but also testing policies and how to interpret the scores. This latter information has not generally been available to them. For example, new freshmen are allowed to take the test twice, but this fact does not appear to be widely known. In fact, UWM has not previously released test scores in a sufficiently timely fashion for freshmen to prepare for a retake before signing up for classes.

Through the efforts of Drs. Key and O’Malley and the MMP, UWM has just (Spring 2005) changed its policy on notifying students of their test results. Students who have accepted admission by early May will be informed by mid-May if their placements were lower than their high school and ACT records would have predicted. These students will be informed of their options for review and retesting. These options include the Math Placement Enhancement Project at UWM in which students work with ALEKS, an intelligent tutoring system, under the guidance of a UWM instructor, to improve their skills before retaking the test. The change in UWM policy is hugely important (and is something that the Department of Mathematical Sciences has wanted for many years). However, it is still more important that students are properly prepared in high school so that they can successfully and readily pass university/college mathematics placement exams.

**Conference on the UW System Math Placement Examination**

The change in UWM policy is hugely important (and is something that the Department of Mathematical Sciences has wanted for many years). However, it is still important that students are properly prepared in high school so that they can successfully and readily pass university/college mathematics placement exams, and this requires teachers to know and understand the test expectations.

In August 2005, the MMP sponsored an IHE Network Conference for mathematics faculty, mathematics education faculty, K-12 teachers of mathematics, and district mathematics
supervisors from across the state of Wisconsin. Drs. Key and O’Malley led a working group at the conference on transition issues. This led to a full-day conference in October 2005.

The goals of the October conference were to acquaint high school teachers with the University of Wisconsin System Math Placement Examination and to discuss the Accuplacer test used by technical colleges in the state. Participants had an opportunity to take the Early Mathematics Placement Test (EMPT) themselves in the morning and deconstruct it question-by-question in the afternoon. (The EMPT is equivalent to the full placement test with its trigonometry portion reduced somewhat.)

Afternoon discussions also focused on ways these items are addressed by various high school curricula and how we can work together to help students "show what they know." The final discussion of the day reviewed interpretation of student test scores, placement levels, UWM programs to supports students once they have been tested, and collaboration opportunities through the MMP on pilot projects.

The approximately 25 attendees included high school teachers (mostly from the Milwaukee Public Schools), UWM and MATC mathematics faculty, a representative from the UW System, and the UWM Associate Dean from Letters and Sciences.

**HIGH SCHOOL SUPPORT MATERIALS AND PILOT PROJECTS**

Dr. Key and Mr. Ruszkiewicz are working in several ways to collaborate with and support high school teachers. First, they have prepared two books of *Placement Test Practice Problems* that contain sample problems modeled on the UW System Mathematics Placement Test and the Accuplacer (available from the MMP website: www.uwm.edu/Org/MMP/_activities/transition.html). Book I contains chapters on arithmetic, basic algebra, intuitive geometry, algebra, and advanced algebra, while Book II contains geometry, trigonometry, and statistics. These items are intended to be used by teachers as warm-up exercises throughout the school year to review the objectives of the two tests, with the aim of increasing alignment between students’ knowledge (as inferred from high school courses) and college placement.

Second, they are working to obtain permission to place complete sample tests online. Currently, MATC has developed their own short sample arithmetic and algebra tests that students can access online (www.matc.edu/student/newstudent/admissions.html). UWM also encourages students to access these sample tests for practice items.

Third, Dr. Key is currently running a pilot program with an algebra teacher at Rufus King High School, and Mr. Ruszkiewicz is running a similar program for the Accuplacer at Bradley Tech High School. Partly as a result of this pilot project, Bradley Tech High School placed at the top of MPS schools in Accuplacer results this year. For example, Key has helped to administer the EMPT to three classes at Rufus King, and has worked through the problems with the students, emphasizing the fundamental mathematical principles relevant to each problem. He also spent one session explaining the structure of the ACT.
At Bradley Tech High School, Ruszkiewicz has worked with Laura Maly, the department chair, and other mathematics teachers to identify “warm-ups” for specific courses. The intent is to avoid overlap and to ensure that by the end of the seven semester required math sequence, all students should be ready for any standardized college placement test: (e.g., UW System, Accuplacer, ACT). With the completion of the second book of practice problems on geometry, trigonometry, and statistics objectives, these warm-ups will also be injected into the appropriate places of the Contemporary Mathematics “Core Plus” Curriculum.

**SUMMARY, CHALLENGES, AND NEXT STEPS**

This effort is in its beginning stages. During the next year, the project will broadly disseminate notification of the major change in student notification of scores at UWM and expand the distribution of information on the test: format, content, scoring, re-take policies. All MPS high schools will have the opportunity to engage with mathematics faculty representatives to examine a sample test and participate in professional development addressing student preparation for the UW Placement Test and Accuplacer. This work will build on the two books prepared in Year 2 by Key and Ruszkiewicz and district leaders dealing with junior and senior level mathematics courses. Additionally, next year efforts will be made to better connect with MPS guidance counselors.

One challenge that we will face in our transition work next year is finding a replacement for Dr. Richard O’Malley, who is retiring. O’Malley has taken a lead role in the transition initiative and has been instrumental in analyzing some of our placement data. His loss will be intensely felt as we expand our attempts to prepare high school students for the UW System Math Placement Test and the Accuplacer. Our current pilot projects at Rufus King and Bradley Tech are time-intensive in their present form. It will be necessary to identify and train high school teachers who can implement similar projects in their own schools.

**Progress on Deliverables**

This section of our annual report draws attention to the progress we have made toward reaching our Year 2 benchmarks. Our deliverables and benchmarks are aligned to the project goals and objectives and provide indications of advancement toward the outcomes of the Milwaukee Mathematics Partnership (MMP). The most significant deliverables and benchmarks attained during this past year were identified by the partners. Here we discuss and present evidence of attainment for one noteworthy deliverable for each of our four project goals.

For Goal 1 on the Comprehensive Mathematics Framework, we highlight the focused training of Learning Teams in December 2004 on mathematics alignment and formative classroom assessment. For Goal 2 on Distributed Leadership, we examine “how a little goes a long way” in using the MMP Math Action Plans for leveraging resources and moving schools. We draw attention to our work on the design of a new university course on mathematical problem solving and critical thinking for Goal 3 on the Teacher Learning Continuum. Finally, for Goal 4 on the Student Learning Continuum, we discuss our efforts to increase the success of students transitioning from high school to postsecondary mathematics.
Goal 1 Comprehensive Mathematics Framework

Implement and utilize the comprehensive mathematics framework to lead a collective vision of deep learning and quality teaching of mathematics across the Milwaukee Partnership.

A little bit of information shared with the MTLs about the WKCE, ignited a year long discussion in schools as to how the CMF can assist teachers in developing rich, rigorous math lessons. It also sparked the need for in-depth study of communication and reasoning skills and using effective questions to facilitate student learning. This brought schools together as learning communities.

—Math Teaching Specialist

Know thy test. Know thy math program. Know thy self. Know thy students.

—Henry Kranendonk, Mathematics Curriculum Specialist

Benchmark: Alignment Activities—Teachers Take the WKCE

School alignment activities during the 2004–2005 school year were off shoots generated from the knowledge leaders gained during the Math Teacher Leader Institute held August 24 and 25, 2004. The institute was attended by 126 Math Teacher Leaders at all levels, elementary, middle, and high school. The objectives for the day were to: (1) understand the structure and format of the state test, Wisconsin Knowledge and Concepts Examination (WKCE), given at grades four, eight, and ten in mathematics; (2) generate a foundation for alignment activities of student expectations to state standards and testing of mathematical processes, number and operations, geometry, measurement, statistics and probability, and algebraic relationships; and (3) move mathematics instruction to higher levels of thinking.

Currently, students in Wisconsin are tested at Grades 4, 8, and 10 on the WKCE. State testing occurs in November of each year. The WKCE is developed by CTB/McGraw-Hill and is based upon their Terra Nova multiple assessments examination. The test covers all of the Wisconsin standards in mathematics and includes selected response items at all three grade levels and includes constructed response items in grades 4 and 8. Beginning in fall 2005, all students will be tested at grades 3–8 and grade 10 and all grade level tests will include both selected and constructed response items.

The first day of the institute centered on “The WKCE – Leaving No Child Behind: Facing Our Challenges.” As Henry Kranendonk stated, “Carefully examining the test through the eyes of our own teaching and through the preparation of our students begins to place the test in perspective. We need to remind ourselves that high stake tests are NOT the only instrument to measure student achievement, but we also need to face the realities that these tests are challenges we must address.” The day was divided into four sections: pre-session, taking the test, post-session, and conclusion.

Pre-Session: What do I currently know about the WKCE?

To put the day in perspective, Math Teacher Leaders were asked to examine the test through the eyes of their own teaching and through the preparation of their students. Furthermore, Math Teacher Leaders were invited to reflect on their current understandings and perceptions of the test. Observations and reflections indicated that while Math Teacher Leaders had some
knowledge about the WKCE, many had never seen the test. Although somewhat alarming, it was noted that many Math Teacher Leaders teach grade levels that are not currently tested by the state. Recognizing that many Math Teacher leaders were not apprised of test expectations, it can be assumed that many of the teachers at their own schools were also not knowledgeable about what students were expected to know and be able to do on the WKCE. Discussions pursued on the importance of raising student achievement, knowing the WKCE test, and relationship to current classroom practices. Leaders were asked to consider how specific standards and objectives, for example, measured on the fourth grade test, were addressed at the previous grade levels being kindergarten, first, second, and third.

**TAKING THE WKCE: HOW ARE MATHEMATICS CONTENT AND PROCESS INTERWEAVED?**

Math Teacher Leaders teaching kindergarten through grade three took the fourth grade WKCE. Those leaders teaching grades four through seven took the eighth grade WKCE. Leaders teaching grades eight through twelve took the tenth grade WKCE. Each grade band group (K-3, 4-7, and 8-12) was then engaged in both small and large group discussions following the test. It is worth mentioning that this grouping structure has been fortuitous. In particular, it began a series of continued articulation discussions between eighth grade teachers of mathematics and high school mathematics teachers. Because the test is given in the fall, eighth grade teachers are really preparing their students for the tenth grade WKCE, a test none had ever seen. This day set the groundwork for some conversations that were held throughout the year and which will be formalized and enhanced further next year.

In retrospect, having the teacher leaders take the test and discuss it was empowering. The learning from this day was more influential than we could have ever anticipated. The test become a site of practice that allowed teachers to not only became familiar with the mathematics content and mathematical processes assessed on the WKCE, but to see the connection to their curriculum and their teaching by examining the specific items. As a result, Math Teacher Leaders began to think more deeply about the mathematics, the alignment with the state standards, and the Comprehensive Mathematics Framework. Evaluations indicated that some leaders realized they lacked mathematics content knowledge.

Many leaders were surprised at not only the types of problems in the mathematics section, but at the rigor of the tasks. Along with the teacher leaders, university and college faculty attending the institute took the test. One university mathematics professor remarked that he was surprised at the difficulty as well as the number of items students were expected to solve within the given time limit. He also noted that a few questions and solution choices seemed a bit ambiguous and that it did not contain as much algebraic manipulation as he expected.

**POST-SESSION: HOW DOES MY SCHOOL’S MATHEMATICS PROGRAM SUPPORT STUDENT ACHIEVEMENT IN MATHEMATICS AS MEASURED BY THIS TEST?**

During the post session, Math Teacher Leaders engaged in discussions about the test and test items. In addition, leaders were introduced to a Thinking Skills Framework which classifies test items according to the primary thinking skill involved. The levels progress from lower to higher levels of thinking: (1) gather information, (2) organize information, (3) analyze information, (4) generate ideas, (5) synthesize elements, and (6) evaluate outcomes.
For the leaders, this was, perhaps, the most revealing part of the session. As leaders discussed the test and the expectations with regard to the thinking classification skills and reflected on their teaching practices, they discovered that their practices tended to reside in the areas of gather and organize information. Generally, about 60% of the items on the WKCE are at higher levels of reasoning (levels 3 through 6). A misconception in the district and with parents is that the test is “recall of information and procedures.” That being the case, the leaders were asked to consider the implications of their findings on students’ learning. What level of thinking were their students held accountable for in the classroom? What level of thinking were students held accountable for throughout their school? It was an insight that left a pit in the stomach; the misalignment between classroom practice and what students were being held accountable for on the state test.

**SUMMARY, CHALLENGES, AND NEXT STEPS**

The teacher leaders were challenged to think deeply about three components emphasized throughout the day—knowing the test, knowing the mathematics program at their schools, and knowing the students. At the conclusion of the day the challenge was loud and clear—How do we engage all teachers with experiences resulting in similar learnings?

This day in August did indeed ignite similar experiences for teachers across the district and throughout the year. Because of the Math Teacher Leader Institute, there has been a surge of schools requesting the WKCE workshop be conducted at their school site for their teachers. Data from the Department of Assessment and Accountability indicates that there have been approximately 80 WKCE workshops throughout the district so far this academic year. At more than half of the workshops (n=45), school staffs have been involved in taking the mathematics section of the WKCE. In the previous school year (2003-2004), there were only about 5 workshops pertaining to the WKCE. The discussions that have been pursued at school sites because of the Math Teacher Leaders taking the test and using the “levels of thinking” tool to examine sample test items has been phenomenal and has been a gateway for schools to work with alignment of MPS learning targets, Mathematics State Assessment Framework, and school mathematics programs.

**Goal 2 Distributed Leadership**

Institute a distributed mathematics leadership model that engages all partners and is centered on school-based professional learning communities.

*We now have bi-weekly grade level meetings focusing on math. Professional development is embedded in these whole staff meetings. We have staff meetings around professional development in math, testing, and math problem solving processes. Individual staff members have a better understanding of what good math teaching and learning looks and sounds like.*

—Math Teacher Leader
Bringing mathematics to the forefront—math is an area that is constantly discussed in our building. Teachers are sharing ideas, asking about professional development, interested in gaining knowledge. Everyone is more aware of their responsibilities and expectations. Collaborative growth in knowledge—In a school with grade levels K-8 and only one teacher at each grade the need for knowledge of all content across grades is essential. Teachers are working together to show how knowledge is developed and built.  
—Math Teacher Leader

Goal 2, Objective B, Deliverable 2. Teacher leaders facilitate professional development in mathematics.  
(Benchmark: MTS reports, MTL logs, and documents reveal level of facilitation.)

Benchmark: School-based Embedded Professional Development in Mathematics

During Year 1 initial information about the work of the MMP was spreading across the district. Math Teaching Specialists guided by the Math Curriculum Specialist worked hard to reach math teacher leaders, teachers, and administrators. However, in a large urban district it takes many meetings to engage all audiences. Not only did it take time to get the message out but to make the goals of the MMP “real” to all audiences. From the Milwaukee Partnership Academy to the district central office staff to school administrators/staff to classroom teachers, the message had to be sustained, of high quality, and data-driven to prove to everyone that this work is about raising MPS student achievement and that resources are available to do the work together.

The hard work from our first year was more at the awareness and informational stage—spreading the message of our vision of mathematics teaching and learning to Math Teacher Leaders, learning teams, and classroom teachers who began to think about how this information affected them and classroom practice. Concurrently, Math Teacher Leaders were developing knowledge and skills along with confidence in this new role as they developed a deeper understanding about their important work as mathematics leaders in their school.

This year the Math Teacher Leaders were ready to make a difference in their schools. Guided by the support of the Math Teaching Specialists and with access to monetary resources offered through the MMP, they pushed their learning team to provide opportunities for teachers to learn the mathematics in the learning targets, to understand the alignment of State Assessment Framework to the Targets, and to use student work to examine student learning.

Topics of Focus

The embedded professional development occurring at the school sites is emulating the work that Math Teacher Leaders engaged in during their monthly trainings. Table 5 lists the topics of greatest emphasis that were addressed during their monthly trainings. Each MTL was asked to indicate, “Of the topics emphasized this year, which have become a focus of work in your school?” The greatest emphases across schools were the unpacking of the mathematics learning targets and the examination of items on the state test for levels of thinking. The next greatest emphases were a focus on the new Wisconsin Mathematics Assessment Framework and on ways to improve students’ oral and written mathematical communication.

An unintended consequence resulted from our work at the MTL meetings on rational numbers. The purpose of the content sessions were to deepen the mathematical knowledge of the MTLs and they
were not directed to take this information directly back to their learning teams and schools as was the case with many of the other topics. Yet, MTLs reported engaged learning teams, groups of teachers, and even parents in deeper conversations of rational numbers.

Table 5. Topics of Focus for School-based Professional Development (number of schools)

<table>
<thead>
<tr>
<th>Topic</th>
<th>n</th>
<th>Not Yet</th>
<th>Beginning Conversations</th>
<th>Some Emphasis (e.g., grade level)</th>
<th>School-Wide, Major Emphasis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unpacking Math Learning Targets</td>
<td>109</td>
<td>7</td>
<td>16</td>
<td>42</td>
<td>43</td>
</tr>
<tr>
<td>Wisconsin Mathematics Assessment Framework and Descriptors</td>
<td>108</td>
<td>9</td>
<td>25</td>
<td>44</td>
<td>30</td>
</tr>
<tr>
<td>Administration of WKCE and examination of math items for levels of thinking</td>
<td>109</td>
<td>19</td>
<td>18</td>
<td>32</td>
<td>40</td>
</tr>
<tr>
<td>Math classroom assessments based on standards (CABS)</td>
<td>105</td>
<td>12</td>
<td>25</td>
<td>37</td>
<td>31</td>
</tr>
<tr>
<td>Protocol for examining student work in math</td>
<td>109</td>
<td>37</td>
<td>38</td>
<td>27</td>
<td>7</td>
</tr>
<tr>
<td>Rational Numbers (Fractions)</td>
<td>108</td>
<td>37</td>
<td>34</td>
<td>29</td>
<td>5</td>
</tr>
<tr>
<td>Oral and written mathematical communication</td>
<td>104</td>
<td>9</td>
<td>27</td>
<td>42</td>
<td>26</td>
</tr>
</tbody>
</table>

**SUMMARY, CHALLENGES, AND NEXT STEPS**

From conversations with their Math Teaching Specialists and from their monthly training sessions, we have noticed a marked increase in the opportunities MTLs are given to facilitate and support embedded professional development at their schools. Each MTL is keeping a facilitation log. This data will be gathered at the end of the school year and summarized this summer. Preliminary review of logs from fall 2004 indicates a remarkable amount of embedded professional development in mathematics in most schools across the district. A review of 71 schools reported a total of 419 events in which teacher leaders facilitated school-based professional development in mathematics. The mean number of events per school was 5.8 and the number of events ranged from 1 to 22. A review of the MMP Math Action Plans (127 approved plans) and the MMP Mini-Grants (59 schools awarded) also clearly show a heightened level of teacher learning in mathematics throughout the district.

Based on all the activities occurring at the school sites it is evident that Math Teacher Leaders, for the most part, are thriving in their roles and are feeling confident to carry out the work and message of the MMP.

**Goal 3 Teacher Learning Continuum**

*Build and sustain the capacity of teachers, from initial preparation through induction and professional growth, to deeply understand mathematics and use that knowledge to improve student achievement.*

*I will try to let the kids “struggle” a bit more as they work. Through this class, I truly found out how many questions I ask the kids and how directed or leading my questions are. I need to pull back a bit.*

*I now take more time to have children explain in complete sentences their strategies. In turn, this helps their writing.*
I have learned to give students think time and allow them to effectively communicate what they want to say by asking good questions.

I am finding success in using the Think Aloud process with my students.

Taking a lesson back into the classroom with goals in mind was very helpful. I was able to focus on that goal or end result while teaching. This kept me on task as I taught.

—Teachers enrolled in Communication and Reasoning in Mathematics course

Goal 3, Objective C, Deliverable 2. Teachers grow professionally through school-based professional learning, university courses, and online work on mathematics content, content-related pedagogy, and leadership for mathematics. (Benchmark: 75% of schools report school-based professional development in mathematics; 50% of schools have teachers who participate in MMP district-wide events including university courses.)

Benchmark: UWM Courses—Communication and Reasoning in Mathematics

District wide events and university coursework for teachers ignited a fever of interest that spread from school to school. Some of the topics that sparked this interest encompassed the following activities; support seminars for beginning teachers, workshops specific to the Investigations in Number, Data, and Space and Connected Mathematics curricular programs, study groups on graphing calculators, assessment pilots, and university courses. These professional development activities were well attended with over 1200 participations at MMP events as teachers and administrators engaged in learning mathematics content aligned with the Comprehensive Mathematics Framework, learning targets, and descriptors from the State Mathematics Assessment Framework.

ALARMING DATA FOR FOCUSING ON MATHEMATICAL COMMUNICATION & PROBLEM SOLVING

One of the events that spurred significant attention arose from the ongoing discussions of students inability to do well on the constructed response questions on the Wisconsin Knowledge and Concepts Examination (WKCE). In particular, we used what we called “Alarming Data” to deliberately focus the district leaders on the crisis the data revealed. The data indicated that approximately 67% of our students in grades 4 and 8 would either leave answers blank or received “0” points for constructed response items on the state test. Given that approximately half of the points are earned from the constructed response items, teachers and administrators gasped as they realized the future impact of this data. This data was also discussed with the Superintendent during a mathematics update session with him.

As news of this data spread, schools more closely examined their own students achievement on the constructed response items. In the past, these item analysis reports on the constructed response items were more generally ignored as the data is more difficult to interpret than it is for the selected response items. Administrators and teachers through the district recognized a significant need to work together and learn ways to develop students’ abilities to problem solve and express their mathematical reasoning both orally and in writing.

University Course on Communication and Reasoning in Mathematics

Through the MMP, a new UWM course was established and offered on Communication and Reasoning in Mathematics, Part 1. The course addressed two of the Wisconsin Model Academic Standards—Standard A: Mathematical Processes and Standard B: Number Operations and Relationships.
The course was developed and facilitated by a Math Teaching Specialist and a Literacy Specialist adapting common reading strategies called, *Think A Loud and Think–Pair–Share*. Participants engaged in mathematics content while practicing these strategies as part of their coursework and also in their classrooms. The insight teachers gained from practicing these strategies in their classroom came through clearly in weekly journal entries. Comments shared often reflected that their classrooms had been more teacher-centered. These new strategies shifted classroom practice to a student-centered, student thinking community as evidenced through the sharing of student work.

The first *Communication and Reasoning Course* was offered in the summer of 2004. In the fall 2004, Math Teacher Leaders distributed course information flyers to teachers at their school sites. Teachers completed a preliminary registration and over 75 teachers expressed an interest in this course. To accommodate the needs of teachers in the area of number and mathematical processes it was necessary to offer two sections entitled, *Communication and Reasoning Part 1* concurrently. The challenge was to find instructors to teach this additional section. The Math Teaching Specialist and the Literacy Coach who taught the course in the summer again taught one of the fall sections.

To ensure consistency of course content and rigor, one approach in meeting this challenge was to videotape all class sessions to be studied by other recognized district leaders in both literacy and mathematics. These videotapes have become an invaluable resource for the other leaders who will be facilitating future courses on this topic. From this we learned more about using video as a venue to reach and developed leaders as course instructors. Additional, the videotapes provided the district with the opportunity to answer the needs of the teachers in a timely manner and also ensure consistency of the university course.

Because the course proved to be so successful and at the request of the participants, a follow-up course was developed focusing on written communication. This “Part 2” course guided teachers in using writing strategies in mathematics such as *Think–Pair–Write, Group Revision Process, and Student Work Protocol*.

**SUMMARY, CHALLENGES, AND NEXT STEPS**

The response to the *Communication and Reasoning in Mathematics* course far exceeded our expectations. Approximately 200 MPS teachers and administrators have enrolled in the courses so far (see Tables 6 and 7) and we get regular inquiries about when it will be offered again. Two more sections of the Part 1 course are being offered this summer with plans to offer additional sections of both Part 1 and Part 2 next year.

While the Communication and Reasoning courses have certainly been a center piece of the university courses offered through the MMP, we have also offered other university courses for teachers. Tables 6 shows the courses offered during our first project year. We offered seven course sections with 157 participations from 74 different schools and waived approximately $45,000 worth of tuition. The courses offered so far during our current project
year are shown in Table 7. We have offered seven course sections with 182 participations from 73 different schools and waived approximately $42,000 worth of tuition.

Table 6. UWM-MMP Professional Development Courses from 2003–2004

<table>
<thead>
<tr>
<th>Course or MMP district event</th>
<th>Number of Participants</th>
<th>Number of Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructional Leadership in Mathematics (579-102) Spring 2004</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>Lenses on Learning: Instructional Leadership in Mathematics (579-176) Summer 2004</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Number and Computation Development Kindergarten (560-184) Summer 2004</td>
<td>17</td>
<td>14</td>
</tr>
<tr>
<td>Number and Computation Development Grades 1-2 (560-182) Summer 2004</td>
<td>24</td>
<td>18</td>
</tr>
<tr>
<td>Number and Computation Development Grades 3-5 (560-183) Summer 2004</td>
<td>23</td>
<td>16</td>
</tr>
<tr>
<td>Communication and Reasoning in Mathematics (560-195) Summer 2004</td>
<td>28</td>
<td>21</td>
</tr>
<tr>
<td>Data Analysis and Algebraic Reasoning (560-196) Summer 2004</td>
<td>35</td>
<td>28</td>
</tr>
<tr>
<td>Statistics and Algebra for all Students with Technology: Part 2 (579-197) Summer 2004</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>Total Participations</td>
<td>157</td>
<td>117</td>
</tr>
<tr>
<td>Number of Distinct Schools across Courses</td>
<td>74</td>
<td></td>
</tr>
</tbody>
</table>

In addition to the MMP sponsored courses, we have also obtained funding through the Wisconsin ESEA Improving Teacher Quality program to run programs to develop MPS teacher leaders for elementary school mathematics. These two projects, also directed by Dr. DeAnn Huinker, are complementary to the MMP. In fact, these projects have allowed us to further develop teacher leadership beyond the MMP cadre of Math Teacher Leaders.

Table 7. UWM-MMP Professional Development Courses from 2004–2005

<table>
<thead>
<tr>
<th>Course or MMP district event</th>
<th>Number of Participants</th>
<th>Number of Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementing Data Analysis and Probability Learning Targets in Milwaukee Public Schools (560-101) Fall 2004</td>
<td>21</td>
<td>17</td>
</tr>
<tr>
<td>Communication and Reasoning in Mathematics Part I (560-102 &amp; 104) Fall 2004 (560-103 &amp; 104) Spring 2005</td>
<td>124</td>
<td>60</td>
</tr>
<tr>
<td>Communication and Reasoning in Mathematics Part II (560-103) Fall 2004 (560-102) Spring 2005</td>
<td>37</td>
<td>21</td>
</tr>
<tr>
<td>Total Participations</td>
<td>182</td>
<td>98</td>
</tr>
<tr>
<td>Number of Distinct Schools across Courses</td>
<td>73</td>
<td></td>
</tr>
</tbody>
</table>

As we look ahead to summer 2005, we are currently planning on offering the courses and institutes listed in Table 9. The first seven listings are university courses for elementary and middle school teachers. The two institutes are targeted for high school teachers. As noted, we have received another complementary grant from the Wisconsin ESEA Improving Teacher Quality program.

Table 8. ESEA Sponsored Professional Development Courses 2003–2005

<table>
<thead>
<tr>
<th>Course or MMP district event</th>
<th>Number of Participants</th>
<th>Number of Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics Mentoring and Leadership (2003-04)</td>
<td>29</td>
<td>18</td>
</tr>
<tr>
<td>Coaching and Leadership in Mathematics (2004-05)</td>
<td>38</td>
<td>17</td>
</tr>
<tr>
<td>Total Participations</td>
<td>67</td>
<td>35</td>
</tr>
<tr>
<td>Number of Distinct schools across courses</td>
<td>31</td>
<td></td>
</tr>
</tbody>
</table>
and Science Partnership program. The MMP is also providing support for the Math Fellowship program. In fact, this new program is enabling the MMP to take the design team courses we are developing for our preservice teacher preparation program and offer them to in-service teachers in MPS. The Math Fellowship program is just now currently recruiting participants—grades 5–9 mathematics teachers of students in the City of Milwaukee. The goal of this program is to increase the number of highly qualified middle grades teachers of mathematics as defined by NCLB. The program will offer our sequence of four MMP design team courses (problem solving, geometry, probability and statistics, and algebraic structures). In addition, the participants may also elect to complete courses in intermediate algebra and calculus in order to fulfill the requirements of a mathematics minor for elementary/middle school education and receive both a university transcript designation and be eligible for additional teaching licensure endorsements. The Math Fellows program is being directed by Mr. Henry Kranendonk, Dr. Kevin McLeod, and Dr. DeAnn Huinker, thereof the MMP Co-Principal Investigators, thus ensuring alignment and connections across the two programs.

Table 9. UWM-MMP Summer 2005 Courses and Institutes

<table>
<thead>
<tr>
<th>MMP Courses or Institutes</th>
<th>Credits</th>
<th>Anticipated Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developing Mathematical Ideas: Working with Data</td>
<td>2</td>
<td>June 21-24, June 28-30, July 1</td>
</tr>
<tr>
<td>Number and Computation Development Kindergarten</td>
<td>1</td>
<td>June 20-23</td>
</tr>
<tr>
<td>Number and Computation Development Grades 1-2</td>
<td>1</td>
<td>June 28-July 1, July 5-8,</td>
</tr>
<tr>
<td>Number and Computation Development Grades 3-5</td>
<td>1</td>
<td>June 20-23</td>
</tr>
<tr>
<td>Communication and Reasoning Part 1</td>
<td>1</td>
<td>June 27-30</td>
</tr>
<tr>
<td>Communication and Reasoning Part 1</td>
<td>1</td>
<td>Beginning July 1</td>
</tr>
<tr>
<td>Teaching Fraction Concepts and Computation</td>
<td>1</td>
<td>July 11-14 &amp; July 18-21</td>
</tr>
<tr>
<td>High School Classroom Assessment in Mathematics Institute</td>
<td>Stipend</td>
<td>August 15-18</td>
</tr>
<tr>
<td>Math Content in Project Based Settings for Small High Schools</td>
<td>Stipend</td>
<td>Dates to TBD</td>
</tr>
<tr>
<td>Distributed Leadership for Mathematics (Note: Majority of funding for this course for MPS teachers is from a Wisconsin ESEA Improving Teacher Quality Grant.)</td>
<td>2</td>
<td>June 20-24, 27-29</td>
</tr>
<tr>
<td>Mathematical Problem Solving and Critical Thinking (2-3 sections) (Note: Majority of funding for this course is from the Wisconsin DPI Mathematics and Science Partnership program.)</td>
<td>3</td>
<td>TBD</td>
</tr>
<tr>
<td>Geometry for Elementary Education Majors (Note: Majority of funding for this course is from the Wisconsin DPI Mathematics and Science Partnership program.)</td>
<td>3</td>
<td>TBD</td>
</tr>
</tbody>
</table>

Goal 4 Student Learning Continuum

Ensure that all students from PK-16 have access to, are prepared and supported for, and succeed in, challenging mathematics.

Goal 4, Objective A, Deliverable 1. Student mathematics achievement of the learning targets is monitored through utilization of mathematics performance assessments. (Benchmark: 30 schools engage in the K-8 Assessment Pilot and 10 schools engage in the High School Proficiency Pilot)

Benchmark: Mathematics Assessment Pilots

The Milwaukee Mathematics Partnership (MMP) identified classroom assessments as a major priority in its Year 2 implementation plan. The learning targets define the mathematics students need to know and be able to do, but we feel strongly that performance assessments focus teaching and define learning.
One focus on assessment was the formulation of three grade band (high school, grades 6-8, and grades 3-5) assessment committees. The three committees were organized to address the complex issues of developing and effectively implementing classroom assessments. These committees were considered “pilots” as they were to identify and/or generate classroom assessments aligned to the learning targets, pilot the assessments in their classrooms, and ultimately emerge with model assessments for dissemination throughout the district.

Each committee of assessment leaders was involved in a study of the research surrounding classroom assessments as developed by Richard Stiggins (Assessment Training Institute) and the Balanced Assessment for Mathematics Project (Michigan State–Berkeley–Shell Center).

**HIGH SCHOOL ASSESSMENT PILOT**

Each high school was encouraged to identify a teacher to be a member of the High School Assessment Pilot committee. This group, representing 12 high schools, began meeting in fall 2004 and continued to meet monthly using substitute teacher release time throughout the academic year.

The high school pilot focused on the mathematical expectations identified in the foundation level (essentially grades 9 and 10) learning targets of mathematics. These targets address algebra, geometry, and probability and statistics. Most high school mathematics programs incorporate these targets within their algebra and geometry courses. However, several high schools use curriculum materials (e.g., Core Plus) that have an emphasis on the integration of mathematical strands.

Together, the committee produced classroom assessments that addressed some of the major challenges of the various mathematics programs in the district. Although school mathematics program were not considered the primary direction of the assessments, for practical reasons, the assessments complimented the mathematics program. Assessments identified a range of formats (short answer, constructed response, and multiple choice). The specifications of a Foundation Level 1 or Level 2 learning target and the assessment descriptors outlined by the Wisconsin Mathematics Assessment Framework were identified for each assessment item.

The thinking classification levels that indicate the type of thinking students demonstrate in working with the assessments became a significant evaluation tool in developing and reviewing assessments. The assessments were field tested at varied high schools and student work was continually analyzed to provide information for improving instruction as well as the assessments.

The goal of the committee was to use the assessments as a formative tool in instruction and is on schedule to develop a *Resource Guide for High School Classroom Assessments in Mathematics*. This resource guide will be presented to high schools as a model of assessment.

The committee has also identified several challenges for continued study and development. One struggle is the use of assessments as formative information to improve instruction. A second need is guidelines for and examples of appropriate feedback to students. Another area is the establishment of parameters for gauging mathematical proficiency. The ongoing dedication of the High School Assessment Pilot committee continues to generate possible options for mapping a student’s progress toward mathematics proficiency.
MIDDLE GRADES ASSESSMENT PILOT

The Middle Grades Assessment Pilot committee consists of 25 teachers of grades 6-8 math representing a variety of school settings from traditional middle schools to K-8 Montessori schools. The pilot committee was facilitated by three Math Teaching Specialists. The goal of the committee was to create a set of model classroom assessments that aligned with the MPS learning targets in mathematics.

In the beginning, teachers struggled to locate assessments that met all the elements of the identified grade-level learning target. In general, teachers viewed the assessment as a test that came at the end of a unit of study. Many teachers felt the perfect assessment existed, but needed to be found. This thinking led facilitators to focus discussions around the two forms of assessments and their purposes. This re-focusing of the work began with a short reading from the *Principles and Standards for School Mathematics* (NCTM, 2000) on the assessment principle. The committee then began a more thorough examination and study of research-based articles on the work of Rick Stiggins. Often, these discussions ensued around the differences of formative and summative assessment.

It was then that the committee members realized that finding a test to meet all the elements of learning targets would be difficult, if not impossible. The breadth of the target provided an obstacle when composing an assessment to measure depth of student understanding. This lesson learned led the group to delve deeper into the targets to identify key content components and to build a variety of quality tasks to document student learning.

In order to clarify quality tasks, the chapter on “Designing and Selecting Problem-Based Tasks” (Van de Walle, 2003) was used as a basis of discussion. This reading helped to build a background of understanding as the group proceeded to search for and identify tasks.

Maintaining consistent attendance at these after school meetings was one challenge we faced with the middle school pilot. Although nearly 25 people indicated initial interest, it was difficult to coordinate common meeting times to accommodate all participants. Thus, members often floated in and out of different meetings. The consistency of work completed and the lack of unity of the group slowed the efficiency of the committee.

Another challenge resulted from allowing each grade-level group to select a learning target of choice. As the group decreased in size, the sharing of specific assessments proved difficult as the assessments focused on different learning targets. Despite these struggles, the accomplishments of this small group proved quite large. Middle grade teachers came together to discuss, argue, and identify the important learning outcomes students need to achieve. Facilitators recognized the importance of the committee’s continued work, as well as the need to diversify members to be more inclusive of other schools.

ELEMENTARY ASSESSMENT PILOT

The Elementary Assessment Pilot committee was comprised of 52 teachers of grades 3–5 representing 26 schools. The committee was facilitated by two Math Teaching Specialists and two Teachers-in-Residence. The committee members were released from their classrooms one day per month beginning in February to set direction for the district in using classroom assessments to monitor and improve student achievement. The goals of this committee were to (1) examine assessment practice beliefs, (2) construct and refine...
classroom assessment models, and (3) provide feedback from field-testing classroom assessments.

**Examine Assessment Practice Beliefs.** Each monthly meeting began with an engaging professional reading activity on current assessment research and classroom practices. After reading the article, lively debate ensued as teachers compared the articles with their belief systems. One article that spurred much discourse for committee members *Working Inside the Black Box: Assessment for Learning in the Classroom* by Paul Black and others.

**Construct and Refine Classroom Assessment Models.** Math Teaching Specialists created the first assessment to “jump start” the committee’s work. The subsequent monthly assessments were constructed and revised by committee members, Math Teaching Specialists, and Teachers-in-Residence. Three assessments were written for each grade (grades 3–5) focusing on constructed response questions. The assessments caused participants to seek alignment between assessment tasks, targets, state assessment descriptors, and a school’s math program. Many leaders saw connections in the alignment to their mathematics program whereas many others noted insights on what mathematical ideas were not aligned to their school math programs. These discussions supported teacher understanding of the mathematics content embedded in both the targets and descriptors. Often in discussions of items for the classroom assessment tasks, an essential tool called “Levels of Thinking” was used. This became a significant instrument for these assessment leaders to use in embedded professional development with other grade level teachers at their school sites.

**Field Test the Assessment Tasks.** As schools requested to be part of this Assessment Pilot, they also agreed to support these assessment leaders in working with other grade level teachers at least two hours per month. The goal of these school-based meetings was to build capacity for assessment practices at the school sites. For example, after a fourth grade assessment leader attended a monthly meeting, he/she would meet with other fourth grade teachers to discuss the alignment of a classroom assessment with targets, descriptors, and their math program. Teaching practices to deepen student mathematical understanding were often shared amongst grade level teachers. Following this first school-based meeting, these fourth grade teachers would continue to teach lessons and then hold their second after school monthly meeting. At the second meeting, student work from the classroom assessment would be discussed using the MMP Protocol for Collaboratively Examining Student Work. The committee has found the protocol to be a powerful tool that engages teachers in discussions about evidence of student learning and next steps for classroom teaching.

Although the MMP protocol is emerging as a powerful tool that has the potential to align classroom practices with targets and state descriptors, we are still in the beginning stages of using the protocol at school sites. Currently the MMP is producing a video of teachers using the protocol to examine and discuss student work. These videos will be a catalyst that will support teachers to think deeply about the mathematics while examining student work and will also emphasize how teachers should collaboratively agree on expectations for students as they learn and develop mathematical ideas.

**Summary, Challenges, and Next Steps**

Committee members are truly on a journey to understand the purposes of classroom assessments. This journey is both personal, as it challenges their belief systems, and
professional, as it influences their practice. Making the paradigm shift from chapter tests and summative assessments to a more informed formative assessment approach is a challenge that takes time. Teachers have always used chapter tests as summative assessments; using assessments to inform classroom practice and student understanding is a paradigm shift. This paradigm shift continues to be a key issue at every meeting. Sustaining this journey will take purposeful and well thought out efforts by everyone involved. Each assessment leader entered at various levels of understanding about the purposes of assessment, now they all are coming to consensus about targets, state assessment descriptors, mathematical ideas, and classroom lessons. A breakthrough for these leaders has been a movement from following a math book lesson by lesson to making their teaching intentional by focusing on targets and monitoring student learning. Ideas that we have struggled with and will continue to learn about throughout next year are: (1) discussing and analyzing student work, (2) providing feedback to students to focus and improve their work, and (3) engaging students in models of proficient work. It is our intention that assessment leaders continue to grapple with these challenges, learn from each other, and concurrently engage colleagues at their school sites on using formative assessment to impact teaching and learning.

Quantitative Outcomes and Annual Benchmarks

We have spent most of our school year studying and aligning the state standards, MPS Learning Targets, and State descriptors. This has resulted in better instruction that is goal-oriented. Our path has become more clearly defined, thus improving our students’ learning, as measured by classroom assessments. We are continuing to work on improving students’ communication and reasoning skills. It has been helpful to look at student work during our MTL training. Student’s thinking is improving as well as their level of engagement in mathematics work. — Math Teacher Leader

In this section, we discuss the data on the quantitative outcomes and annual benchmarks that are important for monitoring the impact of the MMP. This analysis and interpretation of “what the data is revealing to us” is at a preliminary stage. This year we have sought and still struggle to define our baseline data and outcomes more clearly and will continue these efforts over the summer. Some of the challenges we face include changes in state and district testing, access and retrieval of existing data in ways it can be linked to our outcomes, lack of existing instruments, and creation of new data collection procedures. Since we are in the midst of collecting and beginning analysis of our Year 2 data, the discussion here focuses on the current status of our efforts. We will draw attention to any preliminary indicators of our progress and projections of potential impact. Details will be given of measures we are using to gather data on teacher learning and project impact. We will also discuss how the data is informing, or how we anticipate it will inform, the on-going work of our partnership. This discussion will address three areas: (1) Teacher quantity, quality, and diversity, (2) Student mathematics achievement in grades K–12, and (3) Transitioning to college mathematics.
Teacher Quality, Quantity, and Diversity

Goal 3 addresses teacher quality, quantity, and diversity. The preliminary data shows that UWM is making significant strides in increasing the percent and numbers of prospective elementary teachers declaring a minor in mathematics with 40% of the teacher candidates (students accepted into the teacher education program) and 36% of pre-admission students declaring a minor in mathematics. Additional data indicates preliminary information on secondary mathematics teacher recruitment, and on district policy to phase out provisionally licensed teachers in mathematics (individuals with a BA who are admitted to a teacher licensure program).

Our work in this area involves both pre-service and in-service teachers. The largest sample size, and the clearest data, comes from K-8 teachers. Elementary education majors at UWM are now (since 2002) required to choose either a mathematics or science minor. Prior to this requirement, only 9% of elementary education majors chose to take a math minor. This year, 15% of elementary education graduates had a math minor, and 36% of pre-admission teacher candidates have already declared a math minor. The corresponding figure for pre-admission candidates last year was 38%, so this figure appears stable, and suggests that within two years almost 40% of UWM elementary education completers will have a mathematics minor.

The changes MATC made in its math courses and math graduation requirements this year have produced a dramatic change in the number of graduates in its CUTEP program. Prior to this year, only 20 (1.72%) of CUTEP students graduated with an A.A. degree. This year, the CUTEP program expects to graduate 35 students with A.A degrees, of whom 9 will have completed MATH 275/6; 4 of these will enter UWM in Fall, 2005 as math focus students with junior standing. This year’s results appear to justify our hope that CUTEP will feed a diverse pool of teacher candidates to UWM.

Student Mathematics Achievement in K-12

The primary indicator used for monitoring students’ achievement is the Wisconsin Knowledge and Concepts Examination (WKCE). During Year 1, the administration of the WKCE was in November 2003. None of the MMP initiatives (including the identification of schools’ Math Teacher Leaders or the district’s Math Teaching Specialists) was in place. The initiatives outlined in the MMP proposal began in January 2004. With the primary leadership in place at each school between January and March, 2004, the first real focus of the MMP inservices was to build an understanding of the WKCE. The first monthly MTL meetings were designed to match the district’s learning targets to the Wisconsin Academic Standards, as a part of the curriculum process necessary for schools to organize their instruction for the WKCE. These sessions centered on the district’s learning targets as the means for organizing our message, and moved teachers from an awareness level to an acceptance of the targets as an articulation of a school’s mathematics instruction. Evidence of this movement is supported by the MTL survey in which a Year 1 to Year 2 comparison of a school’s status was administered. In this survey, most schools indicated an increase of 1 or 2 levels on a continuum that indicates the primary focus of the MMP goals. The survey was administered near the end of the Year 2 MTL meetings (April 20th) and MTL responses indicated a rather consistent understanding of the benchmarks stated in the learning team continuum.
During the summer of 2004, approximately 80% of the MTLs and High School Department Chairs started Year 2 of the MMP by taking the WKCE examination at appropriate grade levels, and analyzing the content and process standards within the assessments. The impact from MTLs taking the WKCE was far greater than anticipated. Not only did MTLs clear up their misconceptions about the test’s expectations for students, but also the urgent need for their entire staff to have the same experience became clear. This brought new attention to the work of MTSs and MTLs in their schools during the 2004–2005 academic year. This single district-wide in-service session led to over 80 schools organizing similar WKCE awareness sessions for their entire staff. If the teachers were going to value the learning targets, and attach importance to the alignment of the state assessment descriptors and math programs, it was the job of the MMP to focus everyone’s attention on the WKCE. The awareness these professional development sessions generated should in no way be seen as a type of “test preparation” activity. In fact, MTL summary reports indicated that their schools were required to develop a deeper awareness of the alignment process, both between and across grade levels. MTLs also reported how the process led to discussions on what types of classroom assessments were needed to more accurately assess a school’s mathematics instruction. As a ripple effect of the WKCE sessions, schools moved from a more focused understanding of the WKCE to a process of using formative classroom assessments. Several schools have added analysis of students’ work samples as a way to understand expectations in assessments of students’ thinking processes and mathematics content knowledge.

In Year 2, administration of the WKCE was held in November 2004. While administration is in Year 2, we view these results as a measure of performance for Year 1, 2003-2004. Schools will analyze the results of this administration of the WKCE in May and June of 2005. Given the timeline of this assessment (the beginning of Year 2), and the resulting time of the analysis of the data, the MMP will not be able to use the WKCE to evaluate its work for this report.

A preliminary analysis of the assessment, however, was used (and will continue to be used) to examine school and district patterns. The Division of Research and Accountability provided a preliminary summary of a district overview in March 2005 as measured by the Terra Nova. In this overview, a similar message to that which we observed in the original proposal was echoed, namely that students’ computing achievement is the highest area of the categories analyzed. Problem solving, reasoning, and communication remain the primary areas that need to be addressed (as shown in Figure 1). The focus of the MMP work with the schools and MTLs is related to these areas and continues to counteract the pressure that primary attention should be given to computation as the most critical deficiency of students.
The preliminary 2004 WKCE results indicate some improved achievement levels at the 8th and 10th grade (shown in Figure 2). The 4th grade achievement levels went down. Changes in the achievement levels should not be explained, however, by the initiatives of the MMP as our work was not sufficiently developed to impact the schools’ instruction at that time. However, we continue to promote the message of our comprehensive vision of mathematics as a necessary process to impact student achievement levels. The data from the WKCE clearly supports this response.
Another data summary that we analyzed, listed schools that posted the highest gains in the categories of high attainment and high value-added. This list provided the MMP leadership with a way to determine whether or not any possible association could be observed between a school’s participation in the MMP initiatives, and student achievement. In most cases, the schools most involved, as measured by participation in the MMP initiatives, appeared on the list. However, given the timing of the WKCE, these results should not be used as evidence that the work of the MMP contributed to this result. This is an area we intend to examine and track more closely in Years 3–5.

Transitioning to College Mathematics

Our primary indicator of successful transition to college mathematics is the percentage of MPS students who test into credit-bearing mathematics courses at a two- or four-year institution of higher education. We actually choose to record the percentage testing into remedial, i.e. non-credit, courses at UWM and MATC. Table 10 gives the remedial percentages for both MPS and non-MPS students for the last two academic years. Given that the MMP started work late in 2003, and that very little of our work in our first year could be expected to have an impact on college placement, we suggest that this is really baseline data.

<table>
<thead>
<tr>
<th></th>
<th>2003-2004</th>
<th>2004-2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPS students</td>
<td>72%</td>
<td>77%</td>
</tr>
<tr>
<td>Non-MPS students</td>
<td>41%</td>
<td>19%</td>
</tr>
<tr>
<td>UWM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPS students</td>
<td>72%</td>
<td>72%</td>
</tr>
<tr>
<td>Non-MPS students</td>
<td>26%</td>
<td>25%</td>
</tr>
</tbody>
</table>

We might try to look at results on the 10th grade WKCE test, or the ACT, as possible predictors of future student college placement. Since we have worked at the “foundation levels” grades 9 and 10 this year, it is possible we might have had an effect on these scores. Unfortunately, as shown in the Table 11, the WKCE does not send a clear message. The table shows the percentage of MPS students who tested proficient on the test, for the last 3 years.

<table>
<thead>
<tr>
<th></th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Wisconsin students</td>
<td>69</td>
<td>69</td>
<td>69</td>
</tr>
<tr>
<td>All MPS students</td>
<td>28</td>
<td>29</td>
<td>31</td>
</tr>
<tr>
<td>White</td>
<td>55</td>
<td>57</td>
<td>43</td>
</tr>
<tr>
<td>African-American</td>
<td>19</td>
<td>21</td>
<td>27</td>
</tr>
<tr>
<td>Hispanic</td>
<td>30</td>
<td>28</td>
<td>33</td>
</tr>
<tr>
<td>Asian</td>
<td>33</td>
<td>44</td>
<td>37</td>
</tr>
<tr>
<td>Native American</td>
<td>50</td>
<td>39</td>
<td>31</td>
</tr>
<tr>
<td>ELL</td>
<td>18</td>
<td>23</td>
<td>22</td>
</tr>
</tbody>
</table>

The data from 2002 and 2003 must again be considered as the benchmark, but there is nevertheless an indication that MPS is slowly closing the achievement gap with the rest of the state. The achievement gaps between ethnic groups in MPS mostly decreased between the 2003 and 2004 tests, a period of time which coincides with the first year of activity of the MMP, but unfortunately this decrease is partly due to a decline in the performance of white
students. Performance of African-American and Hispanic students did increase significantly, however, and it is particularly gratifying to observe that the proficiency rate of African-American students increased both from 2002 to 2003 and again from 2003 to 3004.

The only word to describe recent ACT results is “disappointing.” As of 2003, the 5-year average of MPS students’ ACT scores was 18.1; the 2004 average score was 17.6. This decline occurred despite the fact that percentages of students in various racial groups who took the test did not change significantly in 2004 from previous years. (Data from the 2005 ACT is not yet available.)

While there were slight increases in numbers of students taking AP or IB examinations, we have not aggressively addressed this goal to this point. We are planning strategies to increase MPS teacher preparation and student support opportunities related to upper-level math coursework in the high schools. In April, we conducted an AP-Calculus examination review for about 30 students, AP-Calculus teachers, and teachers anticipating teaching AP-Calculus or its prerequisites. We are planning a sequence of professional development opportunities for teachers teaching AP/IB and pre-AP/IB courses, as well as Saturday camps for students in AP-Calculus and AP-Statistics courses. During the first wave of the project, our high school focus was on the Foundations Years— the freshman and sophomore course levels—based on the crisis of student performance at the ninth-grade level, and the high-stakes high school testing in Wisconsin in November of the sophomore year.

In this section, we point out some of the distinctive accomplishments and major learnings of this past year. We had a discussion on what we would want to “shout from the roof tops” and realized it has been a “powerful” year for mathematics across the Partnership.

Through our reflections, we selected five areas as most prominent during this second year of the project. What emerged as striking was that the highlights did not center on one of the partners, but rather, substantial work and evidence of sustainability and institutional commitment and change is occurring at the university, at the technical college, and in the school district. It is important to note that in each highlight, the power is in both the players involved as well as in its impact. By the players, we refer to the collaboration among partners from UWM, MATC, and MPS. In some highlights the pervasiveness of the partnership collaboration is obvious and in others it is more subtle, but still essential.

What follows is an elaboration of our “top five” highlights from this second year of the Milwaukee Mathematics Partnership (MMP). To summarize, our highlights include:

• The Math Teacher Leaders emerged as true leaders in their schools for mathematics.
• The school-based learning teams took responsibility for mathematics.
• Sites of practice were used to deepen the mathematical knowledge of teachers, math teacher leaders, educational assistants, and administrators.
• Parallel courses on the fundamental ideas of elementary school mathematics became a reality at UWM and MATC.

• Policy changes were implemented at MATC that will lead to increased quantity, quality, and diversity of prospective teacher candidates in mathematics.

**Math Teacher Leaders Emerge as True Leaders in Their Schools**

*From a teacher with a title to a teacher as a school-based leader.*

Last year with the establishment of the MMP, a Math Teacher Leader (MTL) was added to each learning team about mid-way through the 2003-04 academic year. They were given a title, but most treaded lightly in their new role as they explored the territory and as the Learning Team wondered what to do with this new member and with the request to focus more on mathematics. In Year 2, the MMP has 123 elementary, 20 middle, and 43 high school Math Teacher Leaders.

In our second year of the MMP, Math Teacher Leaders flourished into school-based leaders serving as a link between their schools, the district, and the Institutes for Higher Education (IHE), namely UWM and MATC. The MMP understands and acknowledges the critical importance of building and sustaining the knowledge, tools, and skills that Math Teacher Leaders require to engage their colleagues in examining classroom practices in mathematics.

The following short scenario shows how a MTL planned to engage her staff in the same activities that helped her understand purposeful teaching and learning in a mathematics classroom. Shared by a Math Teaching Specialist, it aims to exemplify the leadership role that is evolving for this Math Teacher Leader in her school.

*Following a Math Teacher Leader Meeting, Serrita asked me if I could meet with her to review her plan for implementing the recently award MMP Math Mini Grant. She was to facilitate a committee of teachers assigned to write classroom assessments for mathematics.*

*Her plan was sketched on a piece of paper and outlined the main points of her upcoming meeting. It was clear she had put a lot of time into preparing for this work. According to her outline, Serrita planned to engage the teachers in the following: (1) analyze student data from the Terra Nova to reveal students’ struggle with geometry across grade levels, (2) review Terra Nova sample questions on geometry, (3) study geometry targets and descriptors across grade levels, (4) examine district model CABS and teachers’ CABS, (5) share CABS clarification statements and levels of thinking tools from MTL meetings, and (6) discuss and agree upon three ideas in geometry before beginning to write classroom assessments.*

*In helping teachers define a need based on student achievement and then working to increase their knowledge base, Serrita had begun to facilitate teacher learning at her own school. Serrita’s work with her colleagues directly resembles the Math Teaching Specialists’ work with the district cadre of Math Teacher Leaders.*

Because of the work of the MMP, Math Teaching Leaders are growing in their knowledge of mathematics content and effective teaching and assessment practices and gaining confidence and skills in working with their school learning teams to support embedded professional development at their school sites. Many of the MTLs are flourishing into school-based leaders. What has enabled this Math Teacher Leader to go from a teacher with a title to a teacher as a leader?
KNOWLEDGE

The MMP recognized that MTLs needed to deepen their knowledge in order to become confident in supporting the work of mathematics at their individual school sites. At all MMP math teacher leader meetings, the themes are always the same—mathematics content, MPS learning targets and state mathematics assessment descriptors, student data from state assessments, and formative use of classroom assessments. Not only are MTLs developing this knowledge, data reveals they have simulated a significant amount of the work sessions from the MTL training at their school sites; in theory, the ripple effect.

TOOLS

It is clear that the tools shared with the MTLs enable them to focus on and improve mathematics in their schools. These tools ensure consistency across the district and build MTL confidence in working with their learning teams, with grade level groups, and at staff meetings. Instead of an MTL sharing notes or nebulous ideas, these tools provide a structure to learn and communicate information. Some of these tools include: thinking levels to examine mathematical tasks, alignment sheets on the MPS targets and state math descriptors, MMP protocol for examining student work, and math content tools (e.g., conceptual thought patterns for comparing fractions).

SKILLS

Knowledge and tools can be irrelevant without the crucial skills to interact with and engage teachers in professional development in mathematics. Throughout year one and continuing into year two, these leaders learned coaching skills (e.g., listening patterns, paraphrasing, effective questioning) through modeling and practice in content- and role-focused activities. As a Math Teaching Specialist facilitated debriefing discussions, skills such as paraphrasing or probing were emphasized. Even the MMP protocol used at a Math Teacher Leader meeting to examine student work allowed leaders to practice both listening and paraphrasing skills as they facilitated the group discussion.

SUMMARY, CHALLENGES, AND NEXT STEPS

The combination of knowledge, tools, and skills have allowed Math Teacher Leaders to grow in their ability to support embedded professional development, and thus, they are flourishing into school-based leaders. As W. Edwards Deming said, "A system is a network of interdependent components that work together to try to accomplish the aim of the system. A system must have an aim. Without the aim, there is no system." Because of the MMP, Math Teacher Leaders have an aim—increased student proficiency as defined by the Comprehensive Mathematics Framework and the learning targets in mathematics. Because of the MMP, they are also developing the knowledge and skills to use MMP tools in working together to raise student achievement in mathematics.
Learning Teams Take Responsibility for Mathematics

A ripple effect occurs as the MMP trains the Math Teacher Leader, the Math Teacher Leader informs the school-based Learning Team, and the Learning Team engages the entire school staff on issues related to improving the teaching and learning of mathematics.

Our learning team is beginning to do some heavy work with mathematics. We have discussed the need for consistency throughout our school in the teaching and learning of mathematics. We are also having someone come in to our next staff meeting to help us analyze our math test results to see what our specific strengths and needs are. This will drive our work this spring.

— Math Teacher Leader

We meet weekly. We have a template we use for our agenda. Math is always on it. We also dedicate one meeting each month to mathematics. We have grade level meetings twice every three weeks. Mathematics is going to be our April focus, specifically to address the topic of how to improve constructed response in mathematics and going over student work to discuss samples using a rubric. We have also completed our action plan which included an opportunity to create CABS. We have also applied for a $3000 grant from the MMP which focuses on assessment and using data to improve instruction and monitor student growth over a course of a year.

— Math Teacher Leader

The Learning Team is the primary decision making body in a school that addresses curricular issues and student achievement. Last year, because of the MMP, nearly all schools designated a Math Teacher Leader (MTL) to be the voice for mathematics on the learning team. Now, the principal, literacy coach, and the MTL are the mandatory members of school-based learning teams. Beyond these three central leaders, learning teams also include other key teachers such as grade level representatives.

DISTRIBUTED LEADERSHIP FOR MATHEMATICS AT THE SCHOOL LEVEL

From the start, it was realized that the Math Teacher Leader alone, as one single person, could not address all the needs for mathematics within a school. It was our vision and belief that it would be vital to connect the MTL to the structure of a learning team and to engage the entire learning team in bringing about change for mathematics within a school.

As the voice for mathematics on the learning team, the MTL acts as a liaison between the school and the district by informing the learning team of MMP initiatives such as the development of a Math Action Plan, prompting teacher learning and alignment efforts by taking the mathematics section of the WKCE, and professional development opportunities (e.g., workshops, courses, and district assessment committees). The learning team then decides how to proceed with the information. For example, the MTL engages in activities at the MTL meeting using student achievement data to define strengths and weaknesses in students’ mathematical content knowledge. The MTL then shares the information with the learning team and the team decides the MTL should meet with teachers at their grade level meeting to discuss the data. Next the MTL and the school’s Math Teaching Specialist share more information at a staff meeting. Following these meetings teachers collaboratively work after school to discuss the information and how it impacts classroom practice. The discussions were started by the MTL but supported and implemented by actions from the Learning Team.
RESOURCES FOR SCHOOL FOCUS: MMP MATH ACTION PLAN AND MINI-GRAINS

As noted earlier, schools were provided the opportunity to develop a Learning Team Math Action Plan. Of our 167 target schools, 127 (76%) of them submitted approved plans. The primary purpose of the action plan was to support the mathematics work of the learning team. This Action Plan provided each school with compensation for 60 hours of professional development. Many schools compensated teachers for collaboratively studying the district learning targets, State Mathematics Assessment Framework, and classroom assessments. For many schools this amount of money was just enough to get the conversations moving forward in order to engage teachers in thinking about student learning in mathematics.

Through the MMP Mini Grants, 59 schools received awards ranging from $1000 to $3000. The mini-grants centered on teacher’s learning in school-based professional learning communities. Projects focused on one of the following: (1) Improving teachers’ mathematical content knowledge or (2) Using classroom assessments based on standards to improve classroom practice. Prior to schools applying for the Math Mini Grant several planning sessions occurred at the school level. Teachers provided input either on what content they wanted to study or designated the Target for CABS development. Schools awarded the mini grant will be posting a 1–3 page summary on the MMP Web site (www.mmp.uwm.edu) at the end of this school year. Another opportunity for sharing the highlights of the project’s work will occur at the June MTL meeting. This sharing is intentional to inform and learn from each other and to provide motivation for the work of mathematics in the district.

CONTINUUM OF WORK FOR LEARNING TEAMS

One of the most powerful unanticipated events this year involved the development of a “Continuum of Work” for Learning Teams in mathematics (see Figure 3). The continuum is becoming a guide for conversations with administrators, as well as with Math Teacher Leaders and Learning Teams. This continuum is a tool that supports conversations amongst leaning team members and provides insight into needed school-based professional learning in mathematics. As teachers talk to teachers, and administrators to administrators ideas about professional development fly across the district. This continuum provides a tool “to put order” to the professional learning needed at a school level. If one school hears about another school writing and implementing CABS they think they should be doing the same. Teachers are not ready to write or use CABS if they have not worked with the mathematics in the Targets and State Descriptors.

Just recently, meetings were held with district Leadership Specialists and with principals to review the Continuum. District Specialists also shared the new tool, School Self-Assessment and Guide: Learning Team Continuum of Work for Mathematics. This new tool articulated approximately six questions for each stage of the continuum. As learning teams use the tool and discuss the answers to the questions it will help them self assess their work. The purpose of the guide is to help a learning team figure out where they are and to help them move their staff to the next stage. By answering the questions at each stage on the continuum, learning teams are able to define the professional development their teachers need and can align their school educational plan with this work. Next year this guide will help define the work of the School’s Learning Team Math Action Plan. It was evident from the discussion of these administrators that this document would be used for the intended purpose of its design. This tools for school leaders will be a centerpiece for framing and focusing the work at the school level next year.
Figure 3. MMP Learning Team Continuum of Work

At the Math Teacher Leader meeting in April, we asked each Math Teacher Leader to reflect on the work within their school along this continuum. They were asked to indicate (1) Where was your school at the end of the 2003-04 school year (Year 1 of the MMP)? and (2) Where is your school now towards the end of 2004–05 (Year 2 of the MMP)? The results are shown in Table 12. From the perspective of the MTLs, you can see substantial movement along the continuum. An analysis of the increment increases, 60 schools moved one increment along the continuum, most from Awareness to Unpacking of the learning targets and 32 schools reporting moving two increments, most from Awareness to Designing CABS.

Table 12. Learning Teams Continuum of Work Number of Schools at Each Stage of Continuum

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Awareness of Learning Targets</th>
<th>Unpack &amp; Align Targets to State Framework</th>
<th>CABS Level 1: Designing CABS</th>
<th>CABS Level 2: Examining Student work</th>
<th>CABS Level 3: Formative Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1 2003-04</td>
<td>101</td>
<td>38</td>
<td>53</td>
<td>9</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Year 2 2004-05</td>
<td>103</td>
<td>9</td>
<td>20</td>
<td>53</td>
<td>21</td>
<td>2</td>
</tr>
</tbody>
</table>

**SUMMARY, CHALLENGES, AND NEXT STEPS**

The strong and collaborative focus toward improving mathematics is a separate journey for each school. We anticipated that the MTLs would focus learning teams on mathematics teaching and learning at their regular meetings, but we did not anticipate the extent that learning teams would come to expect and look forward to the contributions of the MTL. We also found learning teams supporting MTLs as they grew in their leadership roles at their schools. Now, MTLs attend MMP monthly training sessions knowing they will be expected to report back on information and activities with their learning teams. A ripple effect occurs as the MMP trains the MTL, the MTL informs the learning team, and the learning team engages the entire school staff on issues related to the teaching and learning of mathematics.
We have gained great momentum this year in having most Learning Teams realize that it is their responsibility to monitor and drive improvement in mathematics teaching throughout the school leading to improved student achievement. Prior to this year, the focus was clearly on reading. However, student achievement in mathematics is low and is lower than reading across all grade levels. Schools have taken the first important step and that is taking ownership of the issue of raising student achievement in mathematics. Next year we will need to be even more focused and strategic in supporting the Math Teacher Leaders as the leverage to move Learning Teams further along the continuum of work.

**Mathematical Knowledge Deepening through Sites of Practice**

*Teachers can certainly learn subject matter, as well as knowledge of children, learning, and pedagogy, in a variety of courses and workshops. But the use of such knowledge to teach depends on knowledge that cannot be learned entirely either in advance or outside of practice.*

—Ball & Cohen (1999, p. 12)

In Year 2 the MMP was determined to move beyond learning targets as posters on classroom walls to targets as mathematical ideas that students were required to learn. This would be the beginning of another journey. We realized that teachers in Year 1 had a surface understanding of the learning targets, the intention in Year 2 was to deepen teachers’ understanding of the mathematics in the learning targets. The challenge was “How could this be accomplished?” Our approach was generally not direct teaching of the mathematics content. Rather, we continuously found avenues to focus teachers’ attention on the learning targets in relation to their daily work as teachers.

In essence, we were situating their professional learning in the *practice of teaching* (Ball & Cohen, 1999). In this view, the everyday work of teaching becomes the object of on-going investigation and thoughtful inquiry. Rather than learning content and theories and applying them to instructional practice, teachers are developing an understanding of subject matter, of pedagogy, and of students through inquiry into and collaboration on tasks that are part of their mathematical teaching practice (Smith, 2000).

In reflecting back on this year and critically analyzing our work, we identified eight sites of practice that seemed most influential in deepening teachers’ understanding of the mathematics embedded in the learning targets (See Figure 4).

<table>
<thead>
<tr>
<th>Unpacking the learning targets</th>
<th>“Big Ideas” in mathematics</th>
<th>Classroom assessments based on standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alignment of the targets to the state descriptors</td>
<td>Deepening the understanding of the mathematics in the learning targets</td>
<td>Mathematical processes of communication and reasoning</td>
</tr>
<tr>
<td>Levels of Thinking</td>
<td>Video Images of math classrooms and the mathematical work of teachers</td>
<td>Protocol for collaboratively looking at student work</td>
</tr>
</tbody>
</table>

Figure 4. Sites of Practice for Developing Mathematical Knowledge
1. Unpacking the Learning Targets focused discussions on the mathematics students were to know and be able to do. In these conversations, teachers clarified for one another the meaning of specific mathematical concepts and provided examples of mathematical strategies or sought out the knowledge from individuals or reference materials.

2. Alignment of the Targets to the State Descriptors is an ongoing effort as teachers use district worksheets to support discussions between targets, state descriptors, and math programs. The level of detail specified in the state descriptors spurred collegial conversations to clarify mathematical concepts and to gain more specificity and a better understanding of the mathematical content.

3. *Levels of Thinking* is a tool Math Teacher Leaders and teachers in the district use as they examine items from the WKCE according to levels of thinking. This tool is used frequently in discussions regarding the development of mathematical ideas and level of knowledge (e.g., gather information, organize information, apply and analyze, generate and synthesize) required by students in becoming proficient with a learning target.

4. Emphasis on the “Big Ideas” in mathematics is based upon the work of Randy Charles. As opportunities arise, we use big mathematical ideas to draw discussions to a deeper mathematical level. For example, at MTL meetings we placed focus on equivalence and algorithms as we studied rational numbers. A “big ideas” series of Saturday morning workshops was developed for high school teachers. A math education seminar at the university for the teachers-in-residence, mathematics faculty, mathematics graduate students, and mathematics educators has been examining ideas of inverse and linearity.

5. Classroom Assessments Based on Standards (CABS) is igniting discussions of the mathematical ideas embedded in the learning targets as teachers are selecting, adapting, and identifying performance assessments to use in their classrooms. In particular, the linking of specific tasks to specific targets and descriptors has led to much debate and discussion and the need for clarification of mathematical concepts and procedures, as well as mathematical processes of proof and representation.

6. Beginning in fall 2005, 20% of the points on the new Wisconsin state test will evaluate students ability with mathematical processes at all tested grade levels (grades 3–8 and 10). Additionally, we know from current and past analysis of state test results that students do poorly in this area. These discussions have led to a huge focus on the mathematical processes of communication and reasoning. Teachers have been engaged in deepening their mathematical content knowledge of, for example, number and operations while engaging in tasks and learning strategies to support students’ problem solving skills using both oral and written communication.

7. Based on protocol models for examining student work, the MMP developed its own “Protocol for Collaboratively Looking at Student Work.” It is closely modeled after the Collaborative Assessment Conference protocol from Harvard Project Zero. This structured process is used by teachers to look together at student work on mathematical tasks. In these conversations, the discussions often drift toward clarification of the mathematical content as teachers analyze what students do and do not understand.

8. Video images provide another site of practice. Use of video of math classrooms, as well as video of teachers engaged in coaching conversations, have led to discussions of
mathematical content. We have just recently captured video of groups of teachers using the protocol discussed above and have images of teachers discussing the mathematics in the student work and its relation to the learning targets.

**SUMMARY, CHALLENGES, AND NEXT STEPS**

Developing content knowledge of teachers, out of context of classroom practice, can be easily forgotten and not transferred to their teaching practice. Engaging teachers in sites of mathematical practice fosters critical analysis and reflection while connecting mathematics content and pedagogy.

However, using sites of practice to deepen teacher’s mathematical content knowledge presents several challenges that we will continue to consider in planning for our continued work. We wonder if we are able to make a deep enough impact on teachers’ mathematical content knowledge without a more direct approach. We are wondering whether and how we can infuse more focus and emphasis on content knowledge throughout our work. We are finding the emphasis on “big ideas” very productive. This year has really just been a dabbling into the work of Randy Charles and we plan to formalize its role further in the MMP next year. In particular, Dr. Kevin McLeod (Co-PI) from the UWM Department of Mathematical Sciences is the one who has been pushing this emphasis on big ideas. It is emerging as a productive area in which to blend the expertise of mathematicians with the work of teachers as we further examine emphasis and use of sites of practice to deepen teachers’ mathematical content knowledge.

**MATC-UWM Parallel Courses a Reality**

Collaboration and coordination of courses across two-year and four-year institutions of higher education benefiting prospective teachers.

Particularly noteworthy for the MMP this year is the realization of parallel courses on the fundamental ideas of elementary school mathematics at the University of Wisconsin-Milwaukee (UWM) and the Milwaukee Area Technical College (MATC). While UWM has offered Math 175/176, Mathematical Explorations for Elementary Teachers I/II, for many years, these courses did not exist at MATC. Students transferring from MATC’s Collaborative Urban Teacher Education Program (CUTEP) to a four-year program in early childhood or elementary/middle education were disadvantaged, behind in coursework, and at risk of not completing their certification. This is particularly salient because MATC is a potential major source of increased diversity of teacher candidates in the area.

This year, MATC offered the two fundamental ideas courses for their students, Math 275/276, Mathematical Explorations for Elementary Teachers I/II.
**Explorations for Elementary Teachers I/II**, paralleling the UWM courses 175/6. These courses were taught by Dave Ruszkiewicz and Tom Geil. MATC Math 275 was taught for the first time in Fall 2004 and MATC Math 276 was taught in Spring 2005. UWM has also formally accepted the MATC courses as equivalent to its own, and in fact the first transfer students arrived at UWM at the start of this semester, having transfer credit for Math 175.

**PARALLELISM AND COLLABORATION**

The highlight in this story is not just the fact that the courses are already a reality with multiple sections being offered at MATC. Rather, it is the strength of the collaboration between the instructors in the two institutions: the courses are fully aligned between the two institutions, an alignment which will continue as the courses are further developed by a cross-institutional design team. The team includes Gary Luck (UWM mathematics and Math 175/176 coordinator), David Ruszkiewicz (MATC mathematics), Dr. Henry Kepner (UWM mathematics/mathematics education), Tom Geil (MATC mathematics), and Meghan Steinmeyer (UWM mathematics education).

A brief history of our collaboration will help to illustrate both how we were able to move up our trajectory, and our confidence that the courses are parallel. As we were writing our MSP proposal, Tom Geil began to meet with Dr. Robert Moore, the UWM 175/176 course coordinator at that time. Tom attended some of Dr. Moore’s courses during the 2002-2003 academic year, with the hope of bringing these two courses to life at MATC. With the awarding of the MMP grant, MATC hired David Ruszkiewicz, who attended a section of Math 175 taught by Henry Kepner in summer 2003. Then Dr. Kepner, Mr. Geil, and Mr. Ruszkiewicz wrote the required course outline summaries, which were submitted in spring 2004 to the Wisconsin College System and were approved.

UWM then hired a new Math 175/176 course coordinator, Gary Luck. In Fall 2004, Gary and David took a team teaching approach. They team taught a section of Math 175 at UWM, and a parallel section of Math 275 at MATC. Since Gary was hired, they have met regularly (weekly or more) to plan and reflect. This continuous dialogue has centered on the identification of essential mathematical ideas as well as on the curriculum and methodology occurring at both institutions.

**COURSE LEARNING ENVIRONMENT: “GREAT WRONG ANSWER”**

The Math 175/176 courses at UWM on fundamental ideas of elementary school mathematics have been challenging over the years from several perspectives. Students see the content of these courses as involving trivial mathematics that they already know, and do not understand why they have to take them. Many mathematics faculty would prefer not to teach the courses, for similar reasons, but the point is largely moot, since the staffing shortage in the department means that faculty are required to teach other courses. On the other hand, the mathematics department chair struggles with finding teaching assistants to teach course sections, as they believe 175/176 to be more difficult to teach than introductory calculus sections or college algebra. The syllabi and content coverage of the courses has been an ongoing issue, as faculty and instructors struggle with “covering” too much material.

Through the MMP and sustained attention to these courses in recent years, we are beginning to make headway into changing the perspectives of students, faculty, and teaching assistants.
by changing both the content and curriculum expectations and the course learning environment. This year has seen a surge in changing these perspectives through the design team, but much work remains to be accomplished.

After watching Gary teach and talking with David, it is very clear that they want to change the image of these courses and make them both rigorous and meaningful. They want to see a consistent and coherent sequence of topics and teaching in all sections. I believe that students will be entering the School of Education consistently with a richer mathematical experience than ever before.

--Design Team member

When students walked into class on the first few days, they sat in rows and prepared to work individually. Gary continually pushed them work in groups and share strategies as they were given tasks. The class discussion went from, “I agree with the student in the red shirt” to “I am intrigued with Stacy’s thinking, could she explain her solution again?” Students felt safe enough to share conjectures that they weren’t sure would be correct. One of Gary’s famous lines is, “Great wrong answer!” When asked, one student commented, “This is the first math class I have been a part of where we use our mistakes as teaching tools. Mr. Luck puts a positive spin on our misconceptions so that the class learns from both successful strategies as well as those strategies that are not.” Another student commented, “This is the most collaborative math class I have ever been a part of at UWM. We share and learn from each other.” MATC is experiencing similar success.

Gary has met regularly with the UWM teaching assistants (TA) for these courses. These meetings have two purposes. First, to ensure TAs fully understand that the purpose is to impart the deep understanding of elementary mathematics needed by future teachers. Second, to lighten the TAs workload (and thus counter the impression that these courses are a particularly time-consuming assignment) by suggesting activities they might try in class. Ideally, each one-hour meeting will save the TAs at least one hour of preparation time.

SUMMARY, CHALLENGES, AND NEXT STEPS

Every step in the design team process has come with challenges. Due to scheduling conflicts, Gary and David were unable to team teach at both colleges in spring 2005 as they had in fall 2004. However, they continue to meet on a weekly basis to discuss the curriculum and student learning. They are working toward Fall and Spring course schedules across institutions that are more conducive to the team teaching and collaboration approach.

Another ongoing challenge is identification of the essential mathematical ideas for the course. The design team is working toward putting together a master outline of the evolving revisions in course content. In particular, geometry and statistics need to be re-examined next year. The current text (Sybilla Beckmann’s book Mathematics for Elementary Teachers) is strong in its ability to address number and computation but is weak in the content areas of geometry, probability, and statistics. Luck, Ruszkiewicz, and Kepner will reflect on and revise the two courses this summer based on detailed examination of the lessons developed, student performance in key areas, and alignment with Wisconsin state standards.

This course development has been actively integrated into the course planning of the Math Minor courses and the initial revision of the two mathematics methods courses, Currins 331 Teaching Mathematics: Elementary and Currins 332 Teaching Mathematics: Middle Grades.
In the multiple design team planning sessions, Kepner and Luck contribute continual questions about the placement of key mathematical topics and their multiple connections, examples, and use of samples of student work showing misconceptions across the sequence of mathematical experiences. Steinmeyer and Kepner, primary instructors 331 and 332 respectively, are already adapting these course materials anticipating Math 175/176 developments. During this semester, the placements of key concepts—particularly their depth of study—and several lessons have been moved across courses in seeking an appropriate development over the students’ progress toward teacher certification.

Staffing the multiple sections of UWM’s MATH 175/6 (often 12-14 sections per year of each course) continues to be a challenge, and there is a great need to increase the training and support of TAs and ad hoc instructors. With TAs in particular, no sooner have they begun to feel more comfortable with the course content and learning environment, than they graduate and leave. We have begun to video tape Gary, David, and Tom Geil teaching these courses and will be exploring ways to use video with instructors of these courses next year. We have also applied to the College of Letters and Science to be allowed to hire a second long-term instructor, in addition to Gary. This will reduce the turnover of instructors, and should also allow us to increase the mentoring of the TAs who teach the remaining sections.

**MATC Policy Changes Benefit CUTEP**

*Alignment of the mathematics requirement for graduation to other institutions, new courses for prospective teachers, and new supports lead to increases in the quantity, quality, and diversity of teacher candidates.*

The Milwaukee Area Technical College (MATC) has made significant strides this year in instituting policy changes that are benefiting prospective teachers in the Cooperative Urban Teacher Education Program (CUTEP). This two-year program at the technical college is, in essence, a recruitment mechanism that engages individuals in considering teaching as a profession and prepares them for transfer to a four-year teacher certification program. UWM, along with a few other institutions, have an automatic acceptance policy for students who have graduated from this two-year program. MATC is the largest technical college in the Midwest and has a very diverse student population with about 21% of its freshman class from the Milwaukee Public Schools (MPS).

**MATHEMATICS REQUIREMENT CHANGE**

At MATC, the mathematics requirement of the Associate of Arts (A.A.) degree was changed from College Algebra (Math 201) to Intermediate Algebra (Math 200) in order to be consistent with the two other colleges in the Wisconsin Technical College System that offer the A.A. degree (effective January 2005). Students can also complete the requirement through completion of the new Math 275/276 courses for prospective PK-8 teachers on the fundamental ideas of elementary school mathematics.

**INCREASED GRADUATION RATE FOR CUTEP STUDENTS**

The mathematics change is expected to have a significant effect on students in the CUTEP program. Prior to 2005, the vast majority of CUTEP students left without receiving a degree due to the fact that they could transfer to other institutions with just Intermediate Algebra.
The low graduation rate among CUTEP students has long been a source of concern at MATC. Since January 2001, CUTEP has enrolled 1,078 students, but only 20 (1.86%) actually received an A.A. degree. In spring 2005, 35 CUTEP students will receive an A.A. degree, a 175% increase over the four year graduate total or, even more significantly, a 1300% increase over the semester average of 2.5 graduates. Even more significant in relation to the goals of the MMP, 26 of these graduates who are in the secondary education track will meet the math requirement with Intermediate Algebra. The remaining nine students who are in the PK-8 education track will be the first in the CUTEP program to fulfill the math requirement by completing the Math 275/276 sequence. Finally, at UWM, there is the opportunity to encourage the CUTEP students to enhance their mathematics skills with additional courses because they will not have to spend their junior year taking UWM Math 175/176 when most other UWM students completed the courses as freshmen or sophomores.

**INCREASED MATHEMATICS INTEREST OF CUTEP STUDENTS**

The MMP has provided the vision, the resources, and the cross-institutional support to create a presence and focus on mathematics in CUTEP. Led by David Ruszkiewicz and Tom Geil, there is an increasing number of students expressing an interest in a mathematics focus at either the PK-8 or 6-12 levels. This May, eight CUTEP students attended the Wisconsin Mathematics Council annual conference in Green Lake, Wisconsin. This is a first for the CUTEP program. In addition, faculty and staff from UWM met and spent time with these students to strengthen the connections across institutions and to support a smoother transition to the UWM teacher preparation program.

**MPS MATH INTERNSHIPS**

The MMP has also established an internship program in mathematics for CUTEP students. The interns are placed in Milwaukee Public School classrooms, with potential internship sites being identified through the MMP, often at Steering Committee meetings. The interns support the cooperating teacher as a teaching assistant during mathematics instruction, working up to 10 hours per week in hands-on activities with elementary and secondary students. As the MATC Math Coordinator, David Ruszkiewicz conducts regular site visits to work with the interns and their sponsoring teachers in mathematics instruction. Periodic meetings are also held with the interns, both individually and in groups. As of April 2005, nine CUTEP students had been placed in MPS K-8 classrooms, and two others in MPS high schools. Through the internships, and the group and individual support, we hope to nurture prospective teachers in pursuing mathematics as their content area of concentration.

**NEW SUPPORTS**

An unique linkage between UWM and MATC has been the hiring of four UWM elementary/middle mathematics focus students to work as mentors for CUTEP students. These mentors work as teaching assistants in the Math 275/276 classes and also as math tutors in the CUTEP office. Their presence in the classroom gives the instructors the ability to conduct multiple classroom activities using cooperative learning strategies and helps to ensure that each of the student work groups in the classroom receives regular support. The mentors receive training at MATC prior to working in the classroom, and meet periodically with David Ruszkiewicz and Tom Geil. This relationship has been of great value to
instructors, mentors, and students. Through the efforts of the MMP, MATC has made sure that all CUTEP students are aware of the mathematics support available to them. At a time when MATC has had to make across-the-board cuts in tutors for its Academic Support Centers, CUTEP students are fortunate to receive an unprecedented amount of mathematics support under the auspices of the MMP.

A continuing challenge in supporting students is the importance of good advising. At MATC, students are encouraged, but not required, to see an advisor before registering for classes. In recent years, CUTEP has taken steps to resolve this problem through new student orientation sessions in which students are assigned to a CUTEP advisor – an instructor who has been trained on the specific requirements of the CUTEP program. These orientations have given David Ruszkiewicz and Tom Geil, both CUTEP math advisors, the opportunity to meet new students and inform them of tutoring services and internships, as well as to recruit potential Math Focus students. A more recent change to the advising system is that, beginning in Fall 2005, the Accuplacer (math placement) scores of all incoming students will be evaluated by David and Tom. Students with higher math placement scores will be assigned to them as advisees, with the goal of nurturing future Math Focus students. While it is a common arrangement in four-year schools to have students be advised by instructors in their major field, this type of advising has never previously occurred in the Liberal Arts and Sciences Division (of which CUTEP is a part) at MATC.

SUMMARY, CHALLENGES, AND NEXT STEPS

This year has provided unique dimensions to the partnership among MATC, UWM, and MATC and opportunities to connect in many different ways that would have been more difficult (if not nearly impossible) to accomplish prior to the development of the MMP. The MMP has resulted in numerous and substantial institutional changes at MATC. It has made possible the development of the Math 275/276 sequence, which is helping CUTEP PK-8 students to take career-appropriate mathematics at MATC, and to graduate from MATC with an A.A. degree. It has allowed MATC to hire tutors from UWM to assist Math 275/276 instructors and students both inside and outside of the classroom. It has given several CUTEP students the opportunity to get first-hand experience in a mathematics classroom through internships in MPS. It has allowed MATC to hire a Math Coordinator, who has the time available to participate in a variety of activities relevant to the education of prospective mathematics teachers. Finally, and perhaps most importantly, it has resulted in many valuable collaborative relationships between MATC and UWM instructors that have not only been very productive but have also helped to bridge a gap that has traditionally existed between these two institutions.

A major challenge for UWM, starting next year with the transfer of the first large cohort of CUTEP students from MATC, will be to provide these students with strong guidance and mentoring within the context of a large 4-year university. The first issue will be to identify and track CUTEP students, and we are already exploring ways to do this; for example by adding a field to their online student record. It will also be crucial to ensure that they are enrolled in appropriate math courses in the Fall, so that they do not lose the momentum they gained by taking Math 275/276 at MATC, and we will need to expand the tutoring services that we have piloted in Math 175/176 to the focus area courses.
Closing Comments

In this, the first full year of operation of the MMP, we feel we have made significant progress in each of our goals. An awareness of the Comprehensive Mathematics Framework has been established amongst MPS teachers, principals, and administrators. Our model of distributed leadership for mathematics is being implemented across the district. We are impacting the teacher and student learning continua. We would like to close with some summary comments enlightening the impact of these activities on the people and institutions involved in our work.

The work of the MMP in Year 2 has generated a tremendous amount of personal growth and ongoing self-reflection for project staff, mathematics faculty, and school leaders. In part, this is the result of an unprecedented degree of collaboration by mathematicians, teachers, and mathematics educators in jointly planning a full range of project courses, staff development sessions, and seminars. In working together on a constant basis, mathematicians and mathematics educators are learning to speak each other’s languages. Mathematicians are even starting to meet and talk with teachers of all grade levels, and appreciate the practical difficulties they face in trying to teach challenging mathematics. Conversely, teachers are beginning to realize that they can talk to mathematicians, and that mathematicians might be able to help them over some of these difficulties. We look forward to strengthening this leg of the teacher/mathematics educator/mathematician triangle in future years.

Teachers’ increased confidence in talking to university mathematicians is just one symptom of their increased comfort with the discussion of mathematical ideas and confidence in their own mathematical abilities. MTLs in particular are demonstrating more confidence in their mathematics content knowledge at the monthly MTL seminars, along with more accurate reflection on their own areas of concern or weakness. Through the structural supports of the School Education Plan, Math Action Plans, and proposals for mini-grants, they are also getting, and keeping, mathematics as an item of discussion in school leadership meetings and within faculty professional development. For urban schools, with a full range of financial, staff, and disruption issues, the Math Teacher Leaders’ increasing effectiveness in holding mathematics as a priority item of discussion and action has been a strong area of growth in Year 2.

Turning to institutional change, we can see evidence of the impact of the MMP at each of the lead institutions—Milwaukee Area Technical College (MATC), University of Wisconsin-Milwaukee (UWM), and Milwaukee Public Schools (MPS).

At MATC, we have the creation of two courses specifically designed for the preparation of teachers, based on MET recommendations, and their parallel delivery with UWM courses. This is a remarkable example of collaboration between a technical college and a four-year campus. A further outcome of this collaboration was the change in Associate Degree requirements.

At UWM, eight faculty members of the Department of Mathematical Sciences are involved in collaborative course design and instruction or transition issues, and participate in on-going seminars with teachers and mathematics educators. This commitment of mathematics faculty is supported by the College of Letters and Science. The development of courses for the mathematics minor is impacting both pre-service and in-service teachers (e.g., the Math
Fellowship Program) in elementary and middle grades. The impact is also being seen as several mathematics faculty have started to revise courses for mathematics majors where prospective secondary teachers are a key audience. The significant review of the mathematics placement process, including the timely release of placement test scores, is promising to ease the high school-university transition.

Evidence of institutional change and sustainability at MPS centers on the school learning teams, which are starting to take on their expected role in planning and guiding the school’s teaching and learning. This is a far-reaching cultural shift in the district, and is being largely driven by the professional development activities initiated by the MMP.

In fact, it could be argued that the MMP professional development is the premier, if not the only significant, professional development occurring in the district. While this is in part due to district financial difficulties, the focused leadership of the mathematics professional development and the collaboration with institutions of higher education are essential keys to its power and credibility. We have always been confident that through our activities, in professional development and other areas, the MMP was going to have an impact on student learning in mathematics, but it seems that through the cultural changes we are driving, we may actually affect school, teacher, and student performance far more broadly.
References


