Milwaukee Mathematics Partnership

Final Impact Report

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Executive Summary

Hanssen Consulting, LLC, in collaboration with the University of Milwaukee-Wisconsin (UWM) is pleased to provide this final evaluation report for the Milwaukee Mathematics Partnership (MMP). This report combines results from the efforts of the internal and external evaluation teams that began in Year 2 of the MMP grant (2004-2005). The combined evaluation is intended to satisfy National Science Foundation requirements that all funded Math and Science Partnership projects conduct a rigorous evaluation of their activities.

This report is organized according to the five key features of Math and Science Partnerships. They are: (1) Partnership Driven; (2) Teacher Quality, Quantity, and Diversity; (3) Challenging Courses and Curricula; (4) Evidence Based Design; and (5) Institutional Change and Sustainability. Each of these report sections highlights the major impacts of the MMP in these areas. At the same time, we report lessons learned from the evaluation and offer recommendations for others contemplating similar evaluation studies.

Student Achievement Results

First, however, it is important to examine changes in student achievement between 2005 and 2010. We examined these data and conducted statistical tests to determine if the proportions of students scoring proficient or advanced on the state standardized mathematics assessment improved from Fall 2005 to Fall 2010. Results showed that Milwaukee Public Schools (MPS) students improved at a higher rate than students in the state of Wisconsin overall, increasing the proportion of students proficient or advanced by 10.4 percentage points compared with 4.4 percentage points for the state. This increase for MPS students was statistically significant \((z=28.38, \ p=.00)\). The results also show that statistically significant increases were seen at Grades 3-8, but not at Grade 10, which showed a slight non-significant decrease.

For another perspective on this improvement, we can look at the proportion of students scoring minimal on the state assessment. Milwaukee Public Schools students showed a greater decrease in the proportion of minimal students from Fall 2005 to Fall 2010, when compared with all students in Wisconsin: -7.4 percentage points to -2.7 percentage points. This decrease for MPS students was statistically significant \((z=-20.95, \ p=.00)\) as were all grade level decreases within MPS with the exception of Grade 10, which showed a small, non-significant increase in the proportion of students scoring minimal.

Partnership Driven

The most significant “partnership driven” aspect of the MMP has been that partnerships have been developed and sustained at multiple levels and amongst multiple stakeholders across the MMP. Two significant partnerships were developed and are being sustained. First, mathematicians and mathematics educators partnered to develop new mathematics courses for pre-service teachers. Second, partnerships were developed between UWM faculty and MPS employees at multiple levels. Both of these partnerships represent significant MMP
impacts. While the roots of these partnerships may have existed prior to the MMP, it is clear that the funding provided by the MMP was crucial for strengthening the partnerships and contributing to their institutionalization.

In addition to the partnerships outlined above, within-school distributed-leadership partnerships were formed. These were primarily characterized by math teachers elevating their level of conversation around mathematics. We observed that multiple teachers reported communicating with many other teachers about mathematics, and that such conversations had been rare prior to the MMP. Also, the introduction of a Mathematics Teacher Leader (MTL) into the school, created a new leadership role for improving mathematics teaching and learning.

**Teacher Quality, Quantity, and Diversity**

The MMP engaged in multiple activities to improve teacher quality and quantity. The MMP did not focus specifically on improving teacher diversity due to the already diverse nature of classroom teachers within the Milwaukee Public Schools. Instead, the MMP adopted three major initiatives. First, UWM offered mathematics courses for MPS teachers. These were mostly college-level courses and, in many cases, teachers earned undergraduate or graduate credit for completion of a course. Second, monthly MTL meetings were designed to enhance the content knowledge, pedagogical knowledge, and leadership skills of MTLs, to enable them to work more effectively with teachers in their schools. Third, the MMP established a more direct pathway for individuals who began their education in the Teacher Education Program (TEP) at the Milwaukee Area Technical College (MATC) and then sought to matriculate in a teacher education program at UWM.

Each of these activities had high impact. Nearly 1,500 unique teachers participated in at least one UWM-MMP course. MTLs received, on average, approximately eight days of focused professional development each year. The TEP pathway produced several teachers and has been institutionalized within MATC and UWM.

**Challenging Courses and Curricula**

The MMP has made substantial impact in addressing the rigor of courses and curricula used within the Milwaukee Public Schools. This has been accomplished primarily through promotion and use of various strategies that mirror best education practices. These include development of learning targets and of Classroom Assessments Based on Standards (CABS). As a result, teachers have become more engaged in instruction and in efforts to improve mathematics teaching and learning in schools.

**Evidence Based Design**

Since the inception of the MMP, a primary focus of the evaluation efforts has been to determine the impact of the MMP on increasing student achievement in mathematics. We have tried many different modeling approaches with many different metrics. Different modeling approaches were used as our understanding of hierarchical linear modeling grew.
Different metrics were used as our understanding of what really seemed to be making an impact in the district grew. We believed, and were able to demonstrate through our evaluation efforts, that the MMP did make a difference in the district, in terms of influencing the teaching and learning of mathematics.

**Institutional Change and Sustainability**

The MMP was successful in implementing several key institutional changes which are being sustained beyond the conclusion of the original MMP funding. First, and perhaps most significant, was the creation of the Mathematics Teacher Leader (MTL) and Mathematics Teaching Specialist (MTS) roles within the Milwaukee Public Schools. These roles were instrumental in providing ongoing support for improving mathematics teaching and learning in schools. Second, the MMP secured additional funding from the State of Wisconsin, which has helped sustain those roles. Finally, the creation of new math courses for pre-service teachers at UWM and MATC has fundamentally changed the preparation for students electing a mathematics minor as part of their teacher preparation program. This has resulted in pre-service teachers who demonstrate similar math content knowledge to that of Math Teacher Leaders.
Introduction

Hanssen Consulting, LLC in collaboration with the University of Milwaukee-Wisconsin (UWM) is pleased to provide this final evaluation report for the Milwaukee Mathematics Partnership (MMP). This report combines results from the efforts of the internal and external evaluation teams that began in Year 2 of the MMP grant. The combined evaluation is intended to satisfy National Science Foundation (NSF) requirements that all funded Math and Science Partnership projects conduct a rigorous evaluation of their activities.

The evaluation of MMP has been guided by the evaluation plan submitted to NSF and dated December 23, 2005, and builds on the activities and results from evaluations conducted in Years 2-7. The evaluation plan outlines two broad objectives for the MMP evaluation. They are

1. to help the MMP better serve its constituents and improve its effectiveness toward reaching stated goals and objectives, and

2. to serve the broader mathematics education community by documenting accomplishments and disseminating critical findings based on project activities.

This Final Impact Report is structured differently than reports from past years. The report is structured according to the five key features of the Math and Science Partnership Program: (1) partnership driven; (2) teacher quality, quantity, and diversity; (3) challenging courses and curricula; (4) evidence based design; and (5) institutional change and sustainability.

Within each of these sections, we will tell the story of MMP impact as shown by evaluation data collected in past years. These data were collected and structured according to the evaluation logic model described below.

Overview of Evaluation Activities

Figure 1 depicts the logic model for the MMP evaluation. Both internal and external evaluation teams were significant contributors to this report. The internal evaluation focuses on district-wide indicators of MMP impact by refining and implementing the annual online MMP survey and linking the results of that survey to student achievement results. The external evaluation continues to focus on quantitative and qualitative measures of MMP impact in the Milwaukee Public Schools (MPS).

Data contributing to past evaluation reports, and synthesized in this report, were collected using the logic model as an organizer. For example, teacher content and pedagogical knowledge was assessed using the Mathematical Knowledge for Teaching measures. These data are most useful when discussing the MSP feature “Teacher Quality, Quantity, and Diversity.”
Organization of this Report

This report is organized according to the five key features of Math and Science Partnerships. They are: (1) Partnership Driven, (2) Teacher Quality, Quantity, and Diversity, (3) Challenging Courses and Curricula, (4) Evidence Based Design, and (5) Institutional Change and Sustainability. Each of these report sections highlights the major impacts of the MMP in these areas. In some cases, data that were gathered, analyzed, and reported in previous evaluation reports is synthesized here. For example, under the evidence based design section, we summarize the different models and strategies used to link MMP variables to student achievement. In other cases, as with the section under institutionalization of pre-service mathematics content courses, data not yet reported as part of the evaluation is used. Overall, our goal is to report on the impacts of the MMP. At the same time, we report lessons learned from the evaluation and offer recommendations for others contemplating similar evaluation studies.
Section I: Partnership Driven

The most significant “partnership driven” aspect of the MMP has been that partnerships have been developed and sustained at multiple levels and amongst multiple stakeholders across the MMP. Two significant partnerships are discussed below. First, mathematicians and math educators partnered to develop new mathematics courses for pre-service teachers. Second, partnerships were developed between UWM faculty and MPS employees at multiple levels.

In addition, to the partnerships outlined above, within-school distributed-leadership partnerships were formed. These evolved over time, and have perhaps been eroded in recent years by the emergence of the math teacher leader as the key actor for mathematics improvement in schools.

Mathematicians and Mathematics Educators at UWM

“...the MMP worked because it represented real [disciplinary] faculty working shoulder to shoulder with real teachers...”

Collaboration between disciplinary and education faculty has been a central tenet of the Math and Science Partnership Program. This has been accomplished at UWM but, in addition, math department faculty members have also been directly involved with classroom teachers and prospective teachers through a variety of mechanisms.

First, this occurred though the development of four math focus courses at UWM. Teams consisting of mathematicians, math educators, and teachers-in-residence developed courses that serve as the core mathematics instruction component for pre-service teachers electing a minor in mathematics in the elementary/middle school teacher preparation program. This has made a significant impact at UWM because, as one stakeholder indicated, “the faculty who developed the courses are no longer teaching them...they are part of the regular curriculum.”

An additional impact of the creation of the course development teams was to strengthen the relationship between faculty in mathematics and faculty in math education. One stakeholder indicated that there was a relationship before [the MMP] but it has been strengthened. “There have always been members of the faculty interested in math education and student learning [but there was never a catalyst to make that happen]. We are just scratching the surface about how to make this work but [the MMP] was a creative strategy to get ‘real’ faculty engaged in these issues.”

Still, this represents challenges for some math faculty. One stakeholder expressed concern that one faculty member was “not really doing math research anymore” but pointed out that others were “balancing [their work with math education with] math research.”
Partnerships Between UWM faculty and MPS Employees

... [the MMP] is a live partnership...it is not just on paper...

The core MMP partnership is that which exists between UWM and MPS. The MMP has been instrumental in creating this partnership. This partnership exists on several levels—institutional, functional, and personal/individual.

At the institutional level, the central components of the partnership are clear. First, there is a significant financial interaction that takes place. UWM was the primary grant recipient and compensated MPS for its effort in executing the planned MMP activities. Second, there is direct interaction between executive level leaders on each side of the partnership, which ensures that the MMP strategy and direction is consistent with the needs and expectations of both institutions. As primary funding shifts from UWM to MPS, it is likely that the nature of this relationship will change. However, the effect of the MMP over 8 years has been that a new institution—The MMP—has emerged, which operates somewhat autonomously from either UWM or MPS. This new institution has fundamentally taken charge of how math will be taught and assessed by teachers within MPS; since its impact has been positive to date, there is little political capital that can challenge its de-facto authority in these matters.

The district Math Teaching Specialists (MTS) work closely with UWM faculty on a variety of activities such as developing and teaching courses, planning and delivering the Math Teacher Leader (MTL) meeting content, and drawing on UWM faculty to help them in their work with schools. One MTS indicated that “it is really a benefit to our work to be able to call on Kevin [McLeod, MMP Co-PI] to help us with a particular challenge in a school…he is always willing to help.”

In contrast, one MPS official indicated that the “relationship with UWM has become too inbred. There is a great level of expertise that exists but there is some conflict of interest.” This stakeholder hoped that in the future, more Milwaukee universities would be involved with the MMP but agreed that there was a “void of math leadership within MPS” and that UWM “filled that void.”

The institutional and functional partnerships have given rise to numerous individual collaborations and partnerships that did not exist prior to the MMP. As indicated above, the relationships between UWM faculty and the MTSs are particularly strong. These relationships have been created out of the constant work that takes place to teach courses, and prepare for the monthly MTL meetings. As one MTS stated, “UWM faculty are very accessible; for example, we had Kevin in a 2nd grade classroom helping with a lesson.”

This level of collaboration and partnership is indicative of the MMP, but it has not been all one-sided. As one stakeholder indicated, “we have learned a lot from each other...on both ends...UWM really needs us (MPS) for the research end of things...MMP connects the academic and practical worlds.”
In addition to the MPS-UWM partnership, there are others operating as well. While important, however, they are less visible than the core MMP partnership. It is impossible to capture all of the different partnerships that exist, but the following provides a good representative sample.

- **MATC-MPS-UWM.** MATC is the third core partner, but in the latter years of the MMP, following the implementation of the 275-76 course sequence, has assumed a reduced role. MATC involvement is likely to be reinvigorated with the increased emphasis on transition to college that is currently underway.

- **The IHE Partners.** Notwithstanding the concern of MPS that the MMP is primarily driven by UWM, faculty from other universities have been involved in the MMP through the IHE network. At one time, the Milwaukee Partnership Academy (MPA) had instituted a math committee that included faculty from Marquette, Alverno College, Cardinal Stritch University, and Mount Mary College.

- **Course Development Teams.** This work represented collaboration between teachers, math faculty, and math education faculty and led to the development of 5 new courses at UWM (the four focus area courses and the secondary mathematics education capstone course), and 2 revised courses (the introductory math sequence (MATH 175/176)); a parallel sequence of introductory courses was also instituted at MATC as MAT 275/276.

- **State of Wisconsin Involvement.** A new partnership emerged between the Department of Public Instruction and MPS via funding for the released MTL model.

- **MTLs, Teachers, and Students.** For some, this is the fundamental MMP partnership because without teachers and students, there really would be no purpose for the MMP. It is hard to disagree with this sentiment.

- **Mathematics Educators and Mathematicians.** Faculty from both areas are collaborating and mathematicians, in particular, are even more engaged in teaching and learning.

- **Milwaukee Partnership Academy (MPA).** The MPA is less visible as an MMP actor but retains some involvement through its implementation team and math committee. A potential future role is for the MPA to foster connections to the workplace and real world experiences for students.

Clearly the MMP is partnership driven. Its core partners—UWM and MPS—have essentially created a semi-autonomous entity which guides virtually every aspect of the teaching and learning of mathematics in MPS. Embedded in the MMP are the myriad of organizational, functional, and individual relationships that must exist for the partnership to be successful in achieving its goals of improved math teaching and learning in Milwaukee.
Distributed Leadership in Schools

...[a key factor for sustaining the MMP] is to continue the conversation around mathematics at all levels in a school building...once we start talking, we will continue that conversation...

Distributed leadership in schools has been a critical element of the MMP and is a key factor in its vision of partnership. Our principal strategy for evaluating distributed leadership in schools was to examine the nature of school-based networks by using Social Network Analysis (SNA) to gain an understanding of the nature of collaborative relationships pertaining to the teaching and learning of mathematics in a given school. For the purpose of the analysis, collaboration was defined as communication about mathematics, on the assumption that communication is both a key element of collaboration in its own right, and often the first step leading to more meaningful collaborative efforts (e.g., working together on a project, planning mathematics lessons, or developing a school-wide learning plan for mathematics).

There are two important metrics generated from SNA analysis. The first is “density” which indicates the extent of cross communication in a network. Density is expressed as a percentage, with 100% indicating that everyone in a network talks to everyone else (a highly uncommon phenomenon). We are interested not only in the relative density at any one point in time, but in seeing whether network density changes over time. We can also choose to look at the entire network, which will include both school staff and other people (such as MTSs), or just at the subnetwork consisting of school staff only. Generally, “in-school” density will be higher than “overall density.” Figure 2 displays density metrics for 5 years of social network analysis work collected from schools across the district.

![Figure 2: Social Network Analysis Density Metric Trends](image-url)
As shown in the figure, density remained relatively stable over the 5-year period. In contrast, in-school density declined significantly and, by 2009-10, was nearly equal to density. We believe that the reason for this was the emergence of the math teacher leader (MTL) as a central actor in the school, which meant that teachers did not have to cross communicate at the same level as in earlier years. This assertion is supported by the in-degree metric, which is discussed below.

The in-degree metric is a reflection of the number of people responding to the SNA survey who named a particular person. This statistic is calculated for everyone named in the data set. Because we can identify the MTL within a school network, we can isolate this measure as an indication of the importance of the MTL within that school. For the purposes of this report, we also isolated the MTS assigned to a particular school so that the importance of this key actor could also be evaluated. Figure 3 displays in-degree metrics for the 5-year study period for schools across the district.

Two key findings are evident from these data. First, the MTL in-degree metric is consistently higher than the MTS metric. This is likely due to the fact that the MTS is an outside member of the network; i.e., they are not part of the school staff and thus would not be known to many members of the staff. Second, from 2007-08 to 2009-10, the MTL in-degree metric rose dramatically. We believe that this is a reflection of the released MTL model which was instituted during the 2007-08 school year and which placed the focus for math communication on the MTL, rather than leaving this as a shared responsibility amongst all teachers.

To further highlight these findings, another sociogram is presented in Figure 4. A sociogram is a graphical depiction of a network based on the data collected from an SNA survey. In
these sociograms, the MTL is indicated as a yellow diamond; staff members in the school are colored red; people outside the school are colored green, and the MTS assigned to the school is a blue triangle.

This sociogram from Spring 2009 highlights many of the issues discussed. First, the MTL is in a central location on the sociogram, which indicates a central, and important, role in leading mathematics in the school. The MTL in-degree metric for this school is 18.3, which is high but below average for that year. This is due to the large number of staff members on the right side of the sociogram who did not name that individual as someone with whom they communicate about mathematics.

Furthermore, the position of the MTS indicates that staff members in this school are not in direct communication with the MTS. This would not be problematic, except that there is no direct line of communication between the MTL and the MTS. Thus, the MTS in-degree measure of 1.1, which is below the average, is not surprising.

The sociogram in Figure 5 from Spring 2010 depicts a high-density network. This network, while relatively small, is characterized by the strong intercommunication of staff members in
the school, which results in an in-school density metric of 11.3%, above the average for the year. As with the previous example, the MTL is a central figure, but now the MTS is also named by multiple individuals, indicating relatively high in-degree measures for this school.

![Figure 5: Example Sociogram—High Density Network](image)

**Lessons Learned**

Evaluating partnerships is a difficult task. Throughout the evaluation of the MMP, we were challenged by ever-changing stakeholders, especially at the school level, and an ever-changing political and contextual environment that hampered our ability to decipher the partnership attributes of the MMP. If we learned one critical lesson from these efforts, it would be to establish a list of key stakeholder roles—and then to interview, at least once annually, the key individuals who were serving in these roles. Key roles could include Math Teaching Specialists, the District Math Curriculum Specialist, the District Superintendent, and other key District leaders. This, though, may have been met with resistance as new people assuming old roles may not understand the importance of these efforts and may not have the same level of buy-in as their predecessors. As it were, we did have regular contact with many stakeholders throughout the evaluation period but we did not take a systematic
approach to gathering their perspectives because we chose to emphasize other evaluation activities such as school-based observations and social network analysis data collection.

Amongst our other lessons learned, a few important ones stand out. First, it is best to administer the SNA survey during a facilitated session with all school staff present. In later years of the evaluation we used an online tool which depended on the MTL to facilitate data collection. This, we believe, was not as effective in gathering complete data, though it did enable us to gather data from many more schools than would have been possible using facilitated sessions.

Secondly, our use of SNA to evaluate distributed leadership in schools was largely speculative in that we did not have a strong sense of the hypotheses or research questions that would be answered by using SNA. While we believe that the use of this methodology was successful in monitoring changes in distributed leadership within schools, more value may have been derived by having pre-determined research questions and hypotheses that would be answered using the methodology.

**Recommendations**

The following recommendations are offered based on the work evaluating the partnership driven elements of the MMP.

- Plan and conduct interviews with key partnership stakeholders on an annual basis. This will enable establishment of a baseline of partnership characteristics and then a regular updating of those perspectives. These interviews might focus on the following key questions:
  - Who are your key partners in implementing project strategies?
  - What partnerships existed prior to your involvement in the project that helped contribute to project goals and objectives?
  - What new partnerships have been established during and as part of your work on the project?
  - What is needed to sustain these key partnerships?

- Pre-determine research questions before embarking on the use of SNA for evaluating distributed leadership. This will enable a more direct response to the question of what changes occur, and why, as related to the impact of future grants on developing collaborative networks. These research questions might include:
  - What has been the impact of the grant/project on establishing new leadership roles within schools?
  - How have existing roles changed throughout the project, e.g., has the principal role changed within schools?
  - What roles outside of schools appear most important for supporting the work within schools?
  - How have communication patterns within schools changed during the course of the project?
• Utilize facilitated sessions when administering SNA surveys. Whether data are collected online or using paper and pencil is immaterial to the participant. What is critical is ensuring as complete a data set as is possible. This is best done by administering this type of survey in a full staff meeting, with a knowledgeable facilitator providing guidance and answering questions.
Section II: Teacher Quality, Quantity, and Diversity

The MMP engaged in multiple activities to improve teacher quality and quantity. The MMP did not focus specifically on improving teacher diversity due to the already diverse nature of classroom teachers within the Milwaukee Public Schools. Instead, the MMP adopted three major initiatives. First, UWM offered mathematics courses for MPS teachers. These were mostly college-level courses and, in many cases, teachers earned undergraduate or graduate credit for completion of a course. Second, monthly MTL meetings were designed to enhance the content knowledge, pedagogical knowledge, and leadership skills of MTLs, to enable them to work more effectively with teachers in their schools. Third, the MMP established a more direct pathway for individuals who began their education in the Teacher Education Program (TEP) at the Milwaukee Area Technical College (MATC) and then sought to matriculate in a teacher education program at UWM. Each of these initiatives is discussed below.

UWM Courses for Classroom Teachers

The MMP began offering UWM college courses for MPS teachers in Spring 2004. Between then and Summer 2010, 1,484 different teachers took at least one course, with two teachers taking a total of 10 courses each. In that first semester, 14 participants earned a total of 14 credit hours. The number of credit hours earned peaked in Summer 2008 with 270 participants earning a total of 373 credit hours. Figure 6 depicts the total number of credit hours earned by participating teachers by semester.

Figure 6: Credit Hours Earned by MPS Teachers Through UWM Courses
A closer look at these data conveys the depth and breadth of teacher involvement in UWM courses. As stated above, two teachers took 10 courses each. Table 1 indicates the number of teachers who took 1 or more courses throughout the program as well as the number of credits earned by teachers. The majority of teachers took 1 or 2 courses, with fewer taking 3 or more courses (Mean=1.85 courses, SD=1.32). Similarly, most teachers earned between 1 and 3 credit hours for their participation, with fewer teachers earning 4 or more credit hours (Mean=2.45 credit hours, SD=1.85).

Table 1: Number of UWM Courses Taken by MPS Teachers

<table>
<thead>
<tr>
<th>Number of Courses</th>
<th>Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>854</td>
</tr>
<tr>
<td>2</td>
<td>306</td>
</tr>
<tr>
<td>3</td>
<td>169</td>
</tr>
<tr>
<td>4-9</td>
<td>153</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Credit Hours Earned</th>
<th>Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>1,198</td>
</tr>
<tr>
<td>4-6</td>
<td>224</td>
</tr>
<tr>
<td>7-9</td>
<td>51</td>
</tr>
<tr>
<td>10-12</td>
<td>8</td>
</tr>
<tr>
<td>13+</td>
<td>3</td>
</tr>
</tbody>
</table>

These data convey a significant impact of the MMP in improving teacher quality. It is significant that nearly 1,500 teachers participated in courses and earned college credit. This impact also represents a significant investment by the MMP both in terms of time for instructors and money for materials and for tuition remissions.

The data also shows the depth and breadth of UWM course participation across the district. First, 173 different schools had at least one teacher participate in an MMP course. Table 2 shows the number of teachers, by school, who participated in UWM courses as well as the number of combined credit hours earned by all teachers by school. These results indicate that of the 173 schools, the majority sent between 1 and 10 teachers to at least one UWM course, with 9 schools sending 21 or more teachers to at least one course (Mean=8.42 teachers, SD=6.02). In general, while the relationship is not perfect, schools sending more teachers had a higher total number of credit hours earned (Mean=20.36 credit hours, SD=16.18).

Table 2: Teachers Participating and Credits Earned by School in UWM Courses

<table>
<thead>
<tr>
<th>Number of Teachers Per School</th>
<th>Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td>68</td>
</tr>
<tr>
<td>6-10</td>
<td>50</td>
</tr>
<tr>
<td>11-15</td>
<td>32</td>
</tr>
<tr>
<td>16-20</td>
<td>14</td>
</tr>
<tr>
<td>21+</td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Credit Hours Earned Per School</th>
<th>Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-6</td>
<td>43</td>
</tr>
<tr>
<td>7-18</td>
<td>47</td>
</tr>
<tr>
<td>19-27</td>
<td>41</td>
</tr>
<tr>
<td>28-40</td>
<td>31</td>
</tr>
<tr>
<td>50+</td>
<td>11</td>
</tr>
</tbody>
</table>
**Monthly MTL Training**

MTL training was designed to improve the content knowledge of MTLs and to provide them with knowledge and skills to enhance their ability to work with teachers in their schools. The primary vehicle for working with the MTLs was monthly MTL meetings. As with the UWM courses, MTL meetings represented a significant investment on the part of the MMP. Each meeting relied on a team of MTSs and UWM faculty to develop and deliver the planned curriculum. As shown in Figure 7, school attendance at MTL meetings was strong throughout the project.

![Figure 7: Number of Schools Attending MTL Meetings](image)

These data show that over 150 schools regularly attended MTL meetings. The number of schools attending was highest in 2005-2006 and 2010-2011.

Figure 8 depicts the average attendance by at least one individual from a school for schools that attended MTL meetings. These data reflect only the schools that attended meetings and do not reflect schools that never attended a meeting. As shown, attendance at MTL meetings grew during the course of the project. From 2004-2005 through 2007-2008, schools attended approximately two-thirds of the scheduled meetings. Attendance grew beginning in 2008-2009 and held steady at 80 percent on average, through 2010-2011. This is likely due to the
implementation of the released-MTL strategy which likely alleviated conflicts between MTL teaching responsibilities and professional development opportunities.

An important objective of the MTL training was to improve teacher content knowledge. Each year, MTLs took an assessment of Mathematical Knowledge for Teaching (MKT). Table 3 displays results from MTL MKT assessments for each project year. As shown, MTLs made content knowledge gains within each school year. For example, in 2004-2005, MTL knowledge of Number and Operations improved as indicated by an increase in their scores on the MKT assessment from 0.17 to 0.59. This similar pattern was observed in 2005-2006 for Algebra and 2006-2007 for Geometry. This is important because these are the years in which the particular content strand was the focus of MTL training.

**Table 3: MTL MKT Assessment Results**

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Pre-Test</td>
<td>Post-Test</td>
<td>Pre-Test</td>
<td>Post-Test</td>
<td>Pre-Test</td>
<td>Post-Test</td>
</tr>
<tr>
<td>Number &amp; Operations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>.17</td>
<td>.59</td>
<td>.21</td>
<td>.29</td>
<td>.35</td>
<td>.39</td>
</tr>
<tr>
<td>N</td>
<td>78</td>
<td>78</td>
<td>185</td>
<td>166</td>
<td>129</td>
<td>134</td>
</tr>
<tr>
<td>SD</td>
<td>1.07</td>
<td>1.27</td>
<td>.77</td>
<td>.84</td>
<td>.78</td>
<td>.85</td>
</tr>
<tr>
<td>Algebra</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>.02</td>
<td>.32</td>
<td>.39</td>
<td>.54</td>
<td>.68</td>
<td>.37</td>
</tr>
<tr>
<td>N</td>
<td>107</td>
<td>107</td>
<td>185</td>
<td>166</td>
<td>129</td>
<td>134</td>
</tr>
<tr>
<td>SD</td>
<td>.69</td>
<td>.68</td>
<td>.71</td>
<td>.73</td>
<td>.75</td>
<td>.62</td>
</tr>
<tr>
<td>Geometry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>-.10</td>
<td>.34</td>
<td>.33</td>
<td>.50</td>
<td>-1.25</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>79</td>
<td>79</td>
<td>185</td>
<td>166</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>.78</td>
<td>.81</td>
<td>.88</td>
<td>.81</td>
<td>.36</td>
<td></td>
</tr>
</tbody>
</table>

Note: The MKT assessment was not administered in 2007-2008.
Beginning in 2008-2009, MTLs were asked to complete a pre and post MKT assessment that covered all three content strands. In 2009-2010 and 2011, they completed only a post-assessment. As shown by these results, MKT scores generally improved with the exception of a drop in scores from 2009-2010 to 2010-2011 in algebra and geometry. This is likely due to the assessment not being keyed to the specific content taught during that year.

**TEP Pathway From MATC to UWM**

...the MMP has had a great impact on MATC through the 275/76 course sequence developed in collaboration with UWM...these courses are institutionalized and have been a great asset to the TEP program...

The Teacher Education Program (TEP) is intended to provide a pathway from MATC to UWM for students interested in pursuing a career in teaching. The MMP made a substantial impact on this program by designing a mathematics course sequence (MAT 275/6) for use at MATC that, if completed, would directly transfer to UWM, enabling matriculating students to bypass this requirement. The following discussion examines the TEP program with the goal of determining the different paths taken by TEP participants once they enroll in the 275/76 mathematics course sequence. In a perfect world and within the context of the MMP, one might hope that a student completed the TEP program, matriculated at UWM in the school of education, elected a math minor, and went on to teach in MPS. Just as valuable, though, is the multitude of other paths taken by students—many resulting in teaching certification.

Our sample was 269 TEP participants who took one or both of the introductory math courses at MATC (MAT 275 and 276). Of those 269 whose names were provided by MATC, we were able to identify 65 who enrolled at UWM using information from the UWM registrar.

Figure 9 shows the paths followed by TEP students. It is clear that the TEP program has made significant contributions in easing transitions to four-year colleges and universities. Overall, 81 students in our sample transitioned to a four-year college (see red boxes), 65 of those attended UWM. TEP has also contributed in a variety of educational areas. At UWM, 29 students studied elementary/middle education and 36 students studied educational studies, secondary education, or early childhood education. Furthermore, TEP has made a positive impact in providing a pathway for new teachers. Overall, 31 TEP students in the sample became certified teachers. Of these, 4 received a math endorsement on their certificate.
At the same time, we were able to track one individual who became a math teacher in MPS by following the direct program path. This means that the individual moved from MATC’s TEP program to UWM’s Teacher Education program, selected a math minor, completed the program, was granted a teaching license in the state of Wisconsin, and began teaching at MPS. These are important accomplishments. Overall, the TEP program has had a positive impact on easing transitions to four-year colleges, and providing a pathway to teacher education.

**Lessons Learned**

The most important lesson learned through this evaluation is that there is a tremendous reliance on data collected by third parties. For example, we relied on MTL attendance data collected by MTSS; we relied on enrollment data collected by MATC faculty; we relied on UWM course enrollment data tracked by MMP program staff; and we relied on enrollment data generated from UWM registration databases. The challenge for the evaluator is to integrate these data in a way that makes sense and analyze the data in order to answer key evaluation questions. We were successful at this task to varying degrees, but the detriment of this approach is that we were often unable to ask and answer questions with the level of specificity that might have provided greater value. For example, MTL attendance data were tracked by MTSSs, the primary goal of which was to ensure proper reimbursement to schools for sub-release time. These data were compiled in spreadsheets for that purpose, which
served virtually no evaluative purpose except to mark attendance. Thus, we were limited in the questions we could ask and answer based on these data.

**Recommendations**

Our primary recommendation as related to this component of the evaluation is to ensure that data collected by third parties which will be used for evaluation purposes, is collected in such a way that key evaluation questions can be asked and answered. We understand this will not always be possible, especially when extracting data from existing databases. However, steps can be taken to promote the collection of data for joint purposes. For example, throughout the evaluation, the simple inclusion of a school site ID associated with any MMP participant was a valuable asset. This allowed us to conduct analyses by school and to link different data sets according to school sites. Similarly, the inclusion of a teacher ID number would provide the same flexibility at the teacher level. In many cases we were successful in obtaining teacher IDs, but in others we were not, limiting the analyses we were able to conduct.

The associated challenge, especially with the collection of teacher IDs, is privacy and confidentiality. The evaluation team must establish credibility by demonstrating over time that individual data will not be reported in a way that would identify a specific individual. This is critical to gaining cooperation for all parties involved. Fortunately, this evaluation was successful in that area but this is still worth recommending due to its importance.
Section III: Challenging Courses and Curricula

The MMP has made substantial impact in addressing the rigor of courses and curricula used within the Milwaukee Public Schools. This has been accomplished primarily through promotion and use of various strategies that mirror best education practices. These include development of learning targets and of Classroom Assessments Based on Standards (CABS). As a result, teachers have become more engaged in instruction and in efforts to improve mathematics teaching and learning in schools. This section discusses these strategies and changes based on evidence collected through the annual MMP Online Survey.

Engagement Amongst MPS Teachers

A central premise of the MMP has been that greater engagement of teachers in improving mathematics teaching and learning will lead to more rigorous courses and use of curricula in everyday learning. The annual MMP Online Survey measured teacher engagement with the objective of tracking changes in teacher engagement over time. The following results are taken from the annual survey administered in Spring 2005 through Spring 2008.\(^1\) Overall engagement is a composite variable created from 17 survey items. These items address various elements, such as the extent to which teachers are using CABS, aligning curriculum to learning targets, engaging in use of WKCE data to guide instruction, and talking about teaching and learning with other math teachers. Figure 10 indicates that overall engagement of MPS teachers grew significantly from 2004-05 to 2007-08 (t=9.82, df=96, p< 0.001) throughout the program.

![Figure 10: Overall Engagement Trend](image)

\(^1\) The MMP Online survey was substantially changed for the 2008-2009 school year to coincide with the first year of MMP Phase II data collection. Thus, more recent data for these specific metrics are not available.
This represents a significant impact of the MMP. Elevating the conversation around mathematics was a major aim of the MMP; these data show that this occurred over the time of the grant. It is difficult to measure the contribution of this increased engagement to developing challenging courses and curricula, but it is likely that increased engagement by teachers in the activities described above had a positive impact in this area.

**Implementation of MMP Strategies**

In addition to overall engagement, the MMP promoted specific strategies that were intended to lead to more challenging courses and curricula. The adoption of some of these strategies was also measured using the MMP Online Survey. The following specifically discusses the use of learning targets and CABS as critical strategies for enhancing the rigor of instruction.

**Learning Targets**

The MMP initiated a strong focus on aligning school curricula with state learning targets during its first year. Significant energy was applied to this effort, with professional development designed to help MTLs, MTSs, and classroom teachers understand what it meant to align curriculum with learning targets. The MMP Online Survey measured this effort over time through two scales. First, the survey asked how frequently teachers at a school engaged in activities designed to align their curriculum to learning targets. Second, the survey asked how aligned a school’s curriculum is to standards and learning targets. Figure 11 indicates the trends in responses to these survey scales and indicates that over time, teachers became more engaged in activities to align their curriculum to targets, but that overall, they felt their curriculum was aligned. These results are somewhat contradictory but clearly, in the early years of the MMP, there was substantial activity directed at aligning curriculum to targets. This represents a significant impact of the MMP.

![Figure 11: Trends in Aligning Curriculum to Targets](image-url)
CABS

Developing Classroom Assessments Based on Standards (CABS) was an important MMP strategy. Furthermore, encouraging schools to adopt common CABS within grade levels became a significant indicator of the extent to which MMP ideas and principles were making their way into schools. The MMP Online Survey measured the extent to which teachers were engaged in activities designed around CABS or student work samples. The results indicate that teachers dramatically increased their effort in this area in the early years of the grant and that this effort continued to increase (albeit at a slower pace) throughout the grant. This represents a significant impact of the MMP in helping schools work towards developing more rigorous courses and curricula ($t=13.45$, $df=96$, $p<0.001$). Figure 12 displays this trend.

![Figure 12: Engagement with CABS Trend](image)

Overall, it is clear that the MMP has been successful in promoting strategies aimed at helping schools develop challenging courses and curricula. All survey trends point to increased use of the MMP strategies aimed at this objective.

**Lessons Learned**

Despite the evidence of impact presented above, evaluating the extent to which the MMP promoted the adoption of challenging courses and curriculum was the weakest portion of the evaluation. There were several reasons for this. First, there was a general lack of understanding and experience as to how to evaluate the extent to which challenging courses and curricula were being developed or promoted. The construct itself is an abstract one, to the point where direct measurement of the idea becomes intrinsically difficult.
Second, the measurement of MMP strategies was incomplete. The MMP engaged in other strategies toward this goal—formative assessment, constructed response scoring rubrics, and curriculum consolidation. However, the MMP Online Survey and other portions of the evaluation did not directly address these strategies. This was partly due to the evolution of the MMP—these strategies were first implemented in later years—coupled with the desire to continue collecting consistent data through the MMP Online survey.

The third reason for the weakness of this component of the evaluation was that it relied entirely on self-report data through the online survey. Ideally, artifacts or other evidence of adoption would have been collected to enable the evaluators to triangulate on the findings presented above and provide a more comprehensive assessment of this MSP component.

Notwithstanding the above, with any evaluation, choices must be made given limited time and resources. In the end, we chose to emphasize other MSP features in our evaluation, which resulted in more complete assessments of those areas.

**Recommendations**

Two major recommendations are offered for others contemplating this type of evaluation. First, it is important to understand the full range of program strategies keyed toward promoting challenging courses and curriculum, and develop measures for each. While strategies may evolve, and some may be implemented earlier than others, this would allow for a more comprehensive examination of how these strategies play out throughout the course of a program of this magnitude.

Second, it is important to develop multiple data sources to enable triangulation on these issues. Self-report surveys are one possible data source but should not be wholly relied on. Other data sources such as artifact collection, interviews with teachers, or observations of sessions where these ideas are being worked on would offer a more comprehensive view of the extent to which these strategies are being implemented.
Section IV: Evidence Based Design

Since the inception of the MMP, a primary focus of the evaluation efforts has been aimed at trying to determine the impact of the MMP on increasing students achievement in mathematics. We have tried many different modeling approaches with many different metrics. Different modeling approaches were used as our understanding of hierarchical linear modeling grew. Different metrics were used as our understanding of what really seemed to be making an impact in the district grew. We believed, and were able to demonstrate through our evaluation efforts, that the MMP did make a difference in the district, in terms of influencing the teaching and learning of mathematics. What follows is a summary of what we have learned from all of the different approaches that were utilized, in terms of what helped to explain variability in student achievement in mathematics.

Statistically Significant Predictors of Student Achievement

Table 4 summarizes the different modeling approaches that were used, throughout the years, to try to explain variability in student achievement in mathematics in the Milwaukee Public School District (MPS). As the table illustrates, some models used schools within the districts as the unit of analysis, while others used students within schools. Growth in student achievement was considered both at the school and at the student level. In addition, each year the evaluation considered student achievement in the fall of that year, using previous achievement as a control variable.

Over time, statistically significant increases in student achievement were consistently found, regardless of the modeling approach used. However, depending on the year, differences were observed in terms of what MMP variables helped to explain these increases. In the first two years, as well as in year 5, “math focus” at the school level, as determined by the MMP Online Survey, was found to be a statistically significant predictor of student achievement growth. In years four and five, “learning team quality” was found to be a statistically significant predictor of student achievement growth. In year six, “teacher collaboration” and “engagement” were found to be statistically significant predictors of student achievement growth, as were growth in “consistency,” growth in “MTL quality,” and growth in “engagement.” Moreover, schools with higher MMP involvement were found to have a greater percentage of proficient students in the fall of 2008, as well as greater growth in the number of students found to be proficient at their school from the fall of 2005 to the fall of 2008.2

What is striking in the table is that the variables which were most commonly found to predict higher student achievement were those that, in some way or another, quantified how much effort a school was putting into trying to improve mathematics teaching and learning.

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2 MMP Involvement represented an exploratory metric that tried to capture the extent to which schools were involved in the MMP by combining indicators such as participation in UWM courses, attendance at MTL meetings and action plan implementation. Results of this analysis were reported in the Year 7 Evaluation Report.
Schools that reported a greater focus on improving student achievement in mathematics and greater collaboration among teachers were more likely to have greater gains in mathematics achievement and higher proficiency rates. More importantly, the results of the evaluation demonstrated that, at the elementary and middle school level, growth in student achievement occurred in the district, and that this growth was related to MMP involvement, which can itself be thought of as another metric that quantifies how much effort a particular school was putting into trying to improve mathematics teaching and learning.

The lack of high school data in Table 4 also illustrates the difficulties we had in evaluating the impact of the MMP, in terms of increasing student achievement, at the high school level. This primarily is a reflection of the fact that Wisconsin, like many other states across the nation, conducts standardized testing in only one grade in high school.

**Table 4: Summary of Models Fit to Evaluation MMP Impact on Student Achievement**

<table>
<thead>
<tr>
<th>Year</th>
<th>Unit of Analysis</th>
<th>Model Fit</th>
<th>Sample Used</th>
<th>Outcome Variable</th>
<th>Statistically Significant Predictors</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>School</td>
<td>Regression</td>
<td>All elementary and middle schools with at least 5 responses to MMP survey</td>
<td>% of Students Proficient on WKCE in fall 2005</td>
<td>Math Focus (averaged across responses within a school), after controlling for SES and previous years achievement</td>
</tr>
<tr>
<td>4</td>
<td>School</td>
<td>Regression</td>
<td>All elementary and middle schools with at least 5 responses to MMP survey</td>
<td>% of Students Proficient on WKCE in fall 2006</td>
<td>Math Focus (averaged across responses within a school), after controlling for SES and previous years achievement</td>
</tr>
<tr>
<td></td>
<td>Students within Schools</td>
<td>2-level HLM</td>
<td>Students in elementary and middle schools with valid scores for two years</td>
<td>WKCE scores</td>
<td>Learning Team Quality and Alignment, after controlling for previous achievement</td>
</tr>
<tr>
<td>5</td>
<td>School</td>
<td>Dependent T-test</td>
<td>All elementary and middle schools</td>
<td>Student Proficiency Growth on WKCE (2005 to 2007)</td>
<td>Not applicable to analysis, but statistically significant growth</td>
</tr>
<tr>
<td></td>
<td>School</td>
<td>Regression</td>
<td>All elementary and middle schools with at least 5 responses to MMP survey</td>
<td>% of Students Proficient on WKCE in fall 2007</td>
<td>Learning Team Quality, after controlling for SES and previous achievement</td>
</tr>
<tr>
<td></td>
<td>Students over time within Schools</td>
<td>3-level HLM (Growth Curve)</td>
<td>Students in elementary and middle schools that stayed in same school for three years</td>
<td>WKCE scores for 2 cohorts of students (3-5 and 6 - 8)</td>
<td>Math Focus (school level variable)</td>
</tr>
<tr>
<td>6</td>
<td>School</td>
<td>Regression</td>
<td>All elementary and middle schools with at least 5 responses to MMP survey</td>
<td>% of Students Proficient on WKCE in fall 2008</td>
<td>Teacher Collaboration (working together to improve math instruction), and Engagement 4 (talking about math instruction) Growth in Consistency, Growth in MTL Quality,</td>
</tr>
<tr>
<td></td>
<td>School</td>
<td>Regression</td>
<td>All elementary and middle schools with</td>
<td>% of Students Proficient on</td>
<td></td>
</tr>
</tbody>
</table>

24
### Lessons Learned

The internal evaluation of the MMP resulted in a cadre of UWM graduate students who understand the intricacies in conducting a large-scale evaluation of a major project. Over the course of the project we have: (1) Grappled with different approaches to analyzing the multitude of data in our possession; (2) Grappled with different statistical modeling techniques; (3) Gained a greater understanding of how to use hierarchical linear modeling in a large-scale evaluation; and (4) Developed an understanding of the difficulty of working with data from a large urban school district.

As Table 4 illustrates, the district-wide evaluation was always approached in several ways so that we had a multi-faceted look at what was occurring in the district. The truth of the matter is that no single approach to the evaluation would have told the whole story. The different approaches that we took were developed during day-long evaluation meetings with the PI, the external evaluator, the internal evaluation team, and individuals that were working in the district. One of the most important lessons learned is that this approach resulted in a much richer evaluation, because analytic anomalies often occurred for substantive reasons that only the PI and the external evaluator were aware of and could explain. Moreover, interesting questions were often posed by the team in these meetings and analytic approaches to answer these questions were developed. There is no way that the district-wide quantitative analyses could have been conducted in isolation. Quality evaluation is a team effort.

Interestingly, at times our analytic approaches were developed largely as responses to the challenge of dealing with data from a large urban school district. For example, one challenge was how to address the prevalence of student mobility (common in most large urban school districts) in our data, because we only had school level predictors in our HLM growth models. From one perspective, including students that attended different schools is important because student mobility is an issue in the district. However, from another perspective it introduces error into the model because it is unclear which school to associate with a student. Cross-classified models are one approach this problem, but we found they were not
successful, in terms of model fit. Therefore, we decided to look only at two cohorts of students that remained in the same school for three years. While this approach may have excluded some schools, and certainly excluded many students, we felt that this approach would result in the least amount of error variance.

Finally, it was clear, when conducting the analysis, that a large proportion of students in the district simply do not take externally-mandated standardized tests very seriously. This severely hampers any evaluation efforts that are utilizing these scores as the primary dependent variable, as ours were. Of course we only have statistical evidence of this, not qualitative evidence. However, it just does not seem feasible to us that a large proportion of students had scale scores that decreased over time when the tests were vertically equated. This problem seemed to increase as students got older, which would again suggest that it was an artifact of students not caring about how they did on the test. It is unclear how to address this issue, because state assessment truly is a low-stakes test for students, but it is important to be aware of it. Only by making the test more high-stakes for students can this problem be alleviated.

**Recommendations**

One of the greatest challenges the district-wide quantitative analyses faced was the fact that we could not link students to particular teachers in our modeling approaches. We always believed that individual teachers have the greatest impact on student achievement, and the MMP was designed to influence individual teachers. Aggregating teacher responses to reflect a school level variable likely introduced measurement error into our models. The second greatest challenge was dealing with student achievement data that we believed might not be accurate and often had a lot of missing data.

One recommendation for dealing with the first challenge is to focus some of the district-wide evaluation efforts on a small number of randomly-selected schools (or purposefully selected to reflect low, average, and high performing schools). Teachers in these schools could be paid a stipend for agreeing to participate in the evaluation and providing their ID when the additional quantitative information was collected. We were only able to implement that strategy towards the end of our grant. Instead, we were forced to ask teachers to provide their teacher IDs (on a voluntary basis) when they filled out the online survey, which resulted in a very low number of IDs.

As previously stated, it is unclear how to ensure that students take large-scale, externally-mandated tests seriously. However, using benchmark assessments, as we are currently doing in our Phase II evaluation, might partially address this issue. At the very least, using benchmark assessments addresses the issue of having fall test scores associated with a teacher who has only been teaching his or her students for a few months.

Finally, dealing with missing data can best be accomplished by using growth curve models in an HLM framework. However, this only addresses the issue of what to do at the student level, not what to do at the school level.
Section V: Institutional Change and Sustainability

The MMP was successful in implementing several key institutional changes which are being sustained beyond the conclusion of the original MMP funding. First, and perhaps most significant, was the creation of the Mathematics Teacher Leader (MTL) and Mathematics Teaching Specialist (MTS) roles within the Milwaukee Public Schools. These roles were instrumental in providing ongoing support for improving mathematics teaching and learning in schools. Second, the MMP secured additional funding from the State of Wisconsin, which has helped sustain those roles. Finally, the creation of new math courses for pre-service teachers at UWM and MATC has fundamentally changed the preparation for students electing a mathematics minor as part of their teacher preparation program. This has resulted in pre-service teachers who demonstrate similar math content knowledge to that of Math Teacher Leaders. Each of these impacts is discussed below.

Institutionalization of the MTL and MTS Roles

The MTL and MTS roles have been critical for implementing MMP efforts throughout the grant. Each of these positions, while they have evolved, has been institutionalized within MPS and continues to function to date. Without these positions in place, it is very unlikely the MMP would have been successful in promoting the improvement of mathematics teaching and learning in schools on the extent that has been achieved.

The MTL is perhaps the central focus of the MMP strategy for improving teaching and learning in schools. At the outset, each school was asked to select one teacher who would serve as the MTL. While the MMP provided guidelines for selecting this individual, the exact process for selection varied from one school to another. At the onset of the MMP, a key element of the MTL role was that the teacher selected would not be released from their day-to-day classroom teaching responsibilities. MTLs were expected to attend monthly meetings to receive professional development that would help them work effectively with teachers in their schools. Since this required the MTL to be out of the classroom at least one day per month, the MMP funded sub-release time for MTLs, representing a significant financial investment for this aspect of the project. Without this investment, it is unlikely that the implementation of the MTL role would have been successful.

After three and a half years, it became clear that the expectation for MTLs to work with teachers while maintaining full-time classroom responsibilities was too great a burden. Funding was secured from the district to ‘release’ MTLs from the classroom for the second semester of the 2007-08 school year. Released MTLs retained a 20 percent teaching load, which often amounted to teaching one class or working with a select group of students. Again, the implementation of the release model varied within schools, but this was seen as critical for sustaining the role, avoiding burnout, and ensuring that the MMP strategies could be sustained. When the released MTL model was first implemented, we were concerned that removing MTLs from the classroom would undermine their credibility with other teachers in their buildings, but this did not prove to be the case. For the 2008-09 school year, funding
was secured from the State of Wisconsin to continue the MTL release model. This funding was again secured for the 2009-10 and 2010-11 school years.

For 2011-12, the MTL role has evolved even more, even though state funding was no longer provided by the state. Absent this funding, but recognizing the value in the MTL role, the district has implemented a new strategy. Approximately 50 MTLs have been named, each of which works with 3-4 schools. This is a departure from the model where each school has a dedicated MTL and raises new questions about the potential effectiveness of an MTL who must work across multiple schools.

Since the start of the MMP, the MTS role has been instrumental in supporting the work of the MTL in schools. The MTSs serve several vital roles. First, they are significant players in collaboration with faculty from UWM, in developing and delivering training to the MTLs during monthly MTL meetings. Second, they provide direct assistance to the MTLs in their work within schools. Third, they often work directly with other teachers in school buildings, at the request of the MTL.

Significantly, they are asked to perform these responsibilities across a cohort of approximately 20-25 different schools. Therefore, in many ways the MTS has, if not the most critical, the most difficult role in ensuring implementation of MMP strategies. There are several reasons for this assessment. First, the MTS must demonstrate multiple skills that are not always aligned with solely being a master educator. For example, they must also act as a consultant or sales person when working with schools and trying to encourage schools to take advantage of their expertise. They must also demonstrate very strong mathematics content knowledge. This is critical for being able to help MTLs and other teachers as they struggle with content issues. They must do both of these things while also being master educators in order to be able to develop and deliver training to the MTLs. Combined, these expectations place significant burdens on the MTSs and place this role at the nexus of implementing MMP strategies.

Though the MTL role has evolved significantly throughout the life of the MMP, the MTS role has remained relatively constant. There have been between 6 and 10 MTSs serving different groups of schools throughout the MMP. This role continues to be an important one within the District and will be critical for sustaining MMP efforts, and other district initiatives, in the future.

**Additional Funding for MMP Activities**

One of the key challenges to sustaining MMP efforts is funding. Without funding from the NSF and without the additional funding for the MMP from the State of Wisconsin, the district must now take over as the primary MMP funding source. Thus, sustainability of the MMP will continue to be a primary concern of those invested in the work and the results the MMP has produced to date.

Other factors, though, will be critical to sustaining MMP efforts in addition to executive leadership at the district level. The following outlines these issues.
**Funding.** The MMP was initiated with $20 million in funding from the NSF. The use of these funds has been stretched to eight years, and additional funds (approximately $10 million per year for three years) have been secured from the State of Wisconsin, primarily to support the MTL release model and the work of the MTSs. This is a clear sign that the MMP is perceived as valuable and is producing results that are worth sustaining.

There is also a recognition, however, that year-by-year funding is not sufficient to sustain the MMP, as there will always be uncertainty about future plans. As one stakeholder indicated, “there is a need for funding over time. We did not see results for five years [with the initial grant] and now a long-term grant is needed.” Some believe that the Milwaukee business community could play a role in providing sustaining funding and input as to what “a classroom should look like.” This underscores the belief that one next step for the MMP is to strengthen preparation for high school students as they work to enter college and/or the workplace.

In 2010, MPS secured a five-year grant from the GE Foundation targeted at improvements in math and science. This triggered a comprehensive initiative within the district that, while divergent from the MMP, builds on many of its core principles. For example, for the 2011-12 school year, approximately 50 MTLs have been named. Each will have responsibility for several schools rather than a single school. MTSs are also being retained as key figures for working with the MTLs and providing additional in-school assistance around mathematics improvement. An additional requirement of the GE grant is for MPS to adopt a single mathematics curriculum at the elementary and middle school levels. While this has not yet been implemented, this continues the trend begun with the MMP which facilitated the reduction in curricula for MPS schools from ‘many’ to three at the elementary and middle school levels.

**Continue the conversation around mathematics.** From the beginning, an implied MMP goal was to elevate the conversation around mathematics. This effort continues and is manifested in the shared vision and messaging that has become so much a part of the MMP work. Several stakeholders indicated that for the MMP to be sustained, this conversation needs to continue. “There needs to be a continued vision consistent with what the MMP is.” This will help others “understand and perceive the importance of the partnership.”

**Continued partnerships and stronger relationships.** Many stakeholders indicated that a key to sustainability will be “acknowledging the value that UWM has brought to the MMP and strengthening relationships with MPS leadership.” This element speaks to the belief by many that the MMP operates somewhat outside of the normal MPS channels and that MPS leadership has not been entirely supportive of MMP efforts. To illustrate, one stakeholder provided a contrasting example: literacy. She noted that literacy efforts within MPS were not necessarily research based with national leadership behind them, yet these efforts were embraced wholeheartedly by MPS
leadership. She noted that “MPS needs UWM to help with cutting edge stuff…they are thoughtful leaders and need to be recognized as such rather than being perceived as taking over math.” This unique relationship, then, “needs to be continued.”

- **Personal relationships.** At the same time as organizational relationships need to be continued, personal relationships also must be sustained. Several stakeholders pointed to the fact that without the ability to “call on UWM faculty,” their work would be much more difficult. Similarly, key individuals must remain in place to sustain MMP efforts. Several pointed to the need to “have Kevin and DeAnn” remain as active participants in the MMP.

- **Involve Principals more.** Lastly, there was a shared belief amongst several stakeholders that principals need to be more directly involved in the MMP. They pointed to the success of the Lenses on Learning program (LOL) that engaged principals in the work of the MMP. Despite this success, one stakeholder who was involved with the LOL program indicated that work with principals was overall “lacking” and that sustaining MMP efforts would require MMP to more fully engage these instructional leaders.

**Institutionalization of Pre-service Mathematics Content Courses**

The MMP has invested considerable effort to improve pre-service teacher education in mathematics at UWM. The premise of this strategy is that teachers with greater mathematics content knowledge will be more effective teachers of math, thus ultimately leading to improved student achievement in mathematics. In particular, because UWM graduates often become teachers in the Milwaukee Public School district, improving pre-service teacher education at UWM should, over time, lead to improved math achievement in MPS.

The centerpiece of these efforts was the revision of the introductory mathematics sequence to be taken by all elementary/middle level pre-service teachers at UWM (Math 175/176) and the initiation of these courses at MATC (MAT 275/276) . These courses have been requirements for pre-service teachers for many years but were revised as part of the MMP project. Figure 13 displays the attendance in these courses at UWM since Fall 2003. These data are likely underestimates as they are based only on the number of pre-service teachers who also took an MKT assessment as part of this course. In the initial years of the MMP, only 1-2 sections of the courses were participating in the MKT assessment plan whereas later, most, if not all were. At this time, each course is offered in both fall and spring semesters and over 100 students are enrolled. This represents a significant impact of the MMP.
In addition, the MMP created four math-focus courses. These courses are MATH 275 Problem Solving, MATH 276 Algebraic Structures, MATH 277 Geometry, and MATH 278 Discrete Probability and Statistics. Figure 14 displays the attendance in the four math focus courses from Spring 2005 through Spring 2011.

The first course to become institutionalized was MATH 275 Problem Solving. This course is now offered twice a year, once each in Fall and Spring semesters. MATH 277 Geometry and MATH 278 Discrete Probability and Statistics were the next courses to become institutionalized. These are now part of the regular curriculum with both courses offered each fall with an additional section of MATH 277 offered in the spring. The final course to be developed and institutionalized was MATH 276 Algebraic Structures. This course is now offered each spring.

To date, approximately 300 students have taken at least one of the math focus courses indicating a significant impact. Approximately 10 percent of the students have completed all four math focus courses.
An important function of pre-service teacher education is to improve content knowledge. In order to assess any changes in content knowledge during their program of study, pre-service teachers were asked to take an assessment of Mathematical Knowledge for Teaching (MKT) at several points in time. First, they took pre- and post-assessments during the MATH 175 (number and operations and algebra) and MATH 176 (geometry) courses. Second, they took a pre-assessment at the beginning of their methods courses (CURRINS 331) and a post assessment at the end of their methods courses (CURRINS 332 or 330). (Note that while MCEA pre-service teachers take two methods courses, Early Childhood pre-service teachers take only CURRINS 330; thus, there is no 331 pretest data for these students.)

Figures 15-17 display these results for four groups of pre-service teachers: (1) Middle Childhood through Early Adolescent (MCEA) Math Minors; (2) other MCEA majors; (3) Early Childhood majors; and (4) other majors. Overall, the results indicate that MCEA Math Minors scored higher on the MKT at most points in time compared with other program students. This may be due to a self-selection bias where individuals who already were strong math students elected a math minor. Similarly, weak math students may have self-selected a different minor or program after taking the initial MATH175/176 sequence. Still, these results show that the MKT of MCEA Math Minors upon completion of their methods courses is strong. The results also show that both the 175/176 sequence, as well as the 331/332 sequence of courses contributed to their math content knowledge.
Figure 15: Pre-Service Teacher Number and Operations MKT

Figure 16: Pre-Service Teacher Algebra MKT

Figure 17: Pre-Service Teacher Geometry MKT
Finally, we were interested in exploring the question of how pre-service teacher MKT compared with the MKT of MPS classroom teachers and Math Teacher Leaders. We compiled three samples of data, for pre-service teachers, classroom teachers, and MTLs. For the first, we included all pre-service teachers in the MCEA Math program who completed an MKT post-test at the end of their CURRINS 332 course. For classroom teachers, data were compiled from a volunteer group of teachers who took the MKT between 2006 and 2011; if a teacher took the MKT assessment more than once, their highest score was used for the comparative analysis. For MTLs, we compiled data from all administrations of the MKT from 2006 to 2011; if an MTL took the assessment more than once, their highest score was used.

Table 5 displays the results of this comparative analysis. As shown, there were significant differences in the data. MCEA Math pre-service teachers demonstrated similar MKT to MTLs, while classroom teachers lagged in their content knowledge.

Table 5: Comparison of MKT Between Pre-service Teachers, Classroom Teachers, and MTLs

<table>
<thead>
<tr>
<th>Classification</th>
<th>Pre-Service Teachers (MCEA Math)</th>
<th>Classroom Teachers</th>
<th>MTLs</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number Mean</td>
<td>.47</td>
<td>-.30</td>
<td>.50</td>
<td>118.5</td>
<td>.000</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>.70</td>
<td>.76</td>
<td>.97</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>111</td>
<td>713</td>
<td>268</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Algebra Mean</td>
<td>.48</td>
<td>-.09</td>
<td>.64</td>
<td>87.2</td>
<td>.000</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>.50</td>
<td>.90</td>
<td>.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>100</td>
<td>713</td>
<td>282</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geometry Mean</td>
<td>.48</td>
<td>-.14</td>
<td>.30</td>
<td>43.9</td>
<td>.000</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>.66</td>
<td>.80</td>
<td>.93</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>111</td>
<td>713</td>
<td>229</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Post-hoc tests indicated that all differences were observed between classroom teachers and pre-service teachers and MTLs, with the latter two groups being similar as shown in Table 6.

Table 6: Post-Hoc Tests Comparing Pre-service Teacher, Classroom Teacher, and MTL MKT

<table>
<thead>
<tr>
<th>MKT Assessment</th>
<th>(I) Classification</th>
<th>(J) Classification</th>
<th>Mean Difference (I-J)</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>Pre-Service Teachers (MCEA Math)</td>
<td>Classroom Teachers</td>
<td>.76945*</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>MTLs</td>
<td></td>
<td>-.03448</td>
<td>.925</td>
</tr>
<tr>
<td>Classroom Teachers</td>
<td>Pre-Service Teachers (MCEA Math)</td>
<td>MTLs</td>
<td>-.76945*</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>MTLs</td>
<td></td>
<td>-.80392*</td>
<td>.000</td>
</tr>
<tr>
<td>MTLs</td>
<td>Pre-Service Teachers (MCEA Math)</td>
<td></td>
<td>.03448</td>
<td>.925</td>
</tr>
</tbody>
</table>
These results indicate that the pre-service education program established through the MMP has had high impact in terms of promoting strong pre-service teacher content knowledge. Pre-service teachers leaving UWM have similar content knowledge to Math Teacher Leaders in the Milwaukee Public schools, and their content knowledge exceeds that of the typical classroom teacher.

Lessons Learned

Evaluating institutionalization and sustainability is a difficult challenge. Through this evaluation, we were fortunate to be able to observe changes in the MMP and the District over eight years. Thus, it became clear, over time, which aspects of the MMP became institutionalized and which were being sustained.

Quantitative and qualitative data both play a part in this type of evaluation. Qualitative description is important for describing observed changes in roles and responsibilities of key actors. This can often provide anecdotal evidence of impact, but really is most useful for providing rich descriptions of what is observed as occurring. Quantitative data are more useful for describing impact. As with the UWM courses, it is relatively easy to determine the impact by simply tracking the number of participants in courses. This provides an indisputable accounting of the program impact.

An ongoing challenge for this evaluation was working with extant data from UWM databases. Rarely were data on course completion provided in an easily interpretable format, and this limited the types of questions that could be asked and answered using these data. An alternative would be to collect original data but the scope of this effort is both cost and time prohibitive. Thus, we worked with what we were provided.
Without both types of data, however, it is difficult to provide a complete assessment of what is occurring in a project of this magnitude. The evaluators worked hard to ensure that both types of information were available for analysis. We succeeded in this to varying degrees.

**Recommendations**

The following recommendations are offered for future projects seeking to evaluate institutionalization and sustainability.

- It is important that qualitative data be gathered according to a defined schedule so that changes over time can be wholly documented. We would recommend that stakeholder interviews take place at least annually rather than irregularly, as was done with this project. The value of this would be to contribute regular input to the questions of institutionalization and sustainability rather than attempting to recall events that may have occurred one or two years prior.

- An alternative approach to evaluating impact of math focus courses could be to follow a specific cohort of students from the time they enrolled in MATH 175/176 through completion of their degree. This would amount to a tracer study that articulates the different paths students may take as they progress through their coursework toward becoming certified teachers. This study could also track these students beyond degree completion into the workforce.
Section VI: Conclusions

This final report section seeks to summarize the key MMP impacts discussed in this report as a way of providing a final evaluative assessment of the MMP. First, student achievement impacts are discussed. Then, impacts are presented in alignment with the five key MSP features presented above.

Student Achievement Impact

The overriding question regarding the MMP is did the program make a difference in student achievement across the Milwaukee Public Schools. There is ample evidence to indicate that, YES, the program did make a positive difference. The most telling data to support this claim can be found in comparing the basic student achievement results from November 2005 and November 2010.

We examined these data and conducted statistical tests to determine if the difference between the proportions of students scoring proficient or advanced improved from 2005 to 2010. Table 7 displays these results for students scoring proficient or advanced on the annual state standardized mathematics exam. Results showed that Milwaukee Public Schools students improved at a higher rate than the state of Wisconsin, overall—increasing the proportion of students proficient or advanced by 10.4 percentage points compared with 4.4 percentage points for the state. This increase for MPS was statistically significant \( z=28.38, p=0.00 \). The results also show that statistically significant increases within MPS were seen at each grade level, except for Grade 10, which showed a slight non-significant decrease.

<table>
<thead>
<tr>
<th>Table 7: WKCE Results: Students Scoring Proficient or Advanced</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 2005</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Enrolled</td>
</tr>
<tr>
<td>All Wisconsin</td>
</tr>
<tr>
<td>All Milwaukee</td>
</tr>
<tr>
<td>Grade 3</td>
</tr>
<tr>
<td>Grade 4</td>
</tr>
<tr>
<td>Grade 5</td>
</tr>
<tr>
<td>Grade 6</td>
</tr>
<tr>
<td>Grade 7</td>
</tr>
<tr>
<td>Grade 8</td>
</tr>
<tr>
<td>Grade 10</td>
</tr>
</tbody>
</table>

These findings overall indicate that Milwaukee Public School students made important student achievement gains during the time the MMP was functioning. As we have shown, it
is often difficult to directly attribute MMP related variables and results to student achievement but our perception is that the MMP did make a difference in these results.

Another perspective on these results can be seen by looking at the proportion of students scoring minimal on the state standardized mathematics assessment. A similar analysis was conducted where the proportion of minimal students in November 2005 was compared with the proportion of minimal students in November 2010. Table 8 displays these results and conveys a similar story. Milwaukee Public Schools students showed a greater decrease in the proportion of minimal students when compared with all students in Wisconsin, -7.4 percentage points to -2.7 percentage points. This decrease within MPS was statistically significant ($z=-20.95$, $p=.00$) as were all grade level decreases within MPS with the exception of the grade 10, which showed a small, non-significant increase in the proportion of students scoring minimal.

<table>
<thead>
<tr>
<th></th>
<th>November 2005</th>
<th>November 2010</th>
<th>Change in Percent Minimal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Enrolled</td>
<td>Percent Minimal</td>
<td>Enrolled</td>
</tr>
<tr>
<td>All Wisconsin</td>
<td>447,708</td>
<td>14.4%</td>
<td>432,664</td>
</tr>
<tr>
<td>All Milwaukee</td>
<td>40,781</td>
<td>38.9%</td>
<td>33,436</td>
</tr>
<tr>
<td>Grade 3</td>
<td>5,567</td>
<td>40.2%</td>
<td>5,077</td>
</tr>
<tr>
<td>Grade 4</td>
<td>5,808</td>
<td>39.6%</td>
<td>5,073</td>
</tr>
<tr>
<td>Grade 5</td>
<td>5,715</td>
<td>39.4%</td>
<td>4,970</td>
</tr>
<tr>
<td>Grade 6</td>
<td>5,966</td>
<td>39.2%</td>
<td>4,760</td>
</tr>
<tr>
<td>Grade 7</td>
<td>5,923</td>
<td>37.8%</td>
<td>4,560</td>
</tr>
<tr>
<td>Grade 8</td>
<td>6,084</td>
<td>34.1%</td>
<td>4,399</td>
</tr>
<tr>
<td>Grade 10</td>
<td>5,718</td>
<td>42.3%</td>
<td>4,597</td>
</tr>
</tbody>
</table>

Taken as a whole, these results suggest that the MMP has been effective both in improving the proportion of students scoring proficient or advanced as well as decreasing the proportion of students scoring minimal on the state standardized mathematics assessment.

**Partnership Driven**

The most significant “partnership driven” aspect of the MMP has been that partnerships have been developed and sustained at multiple levels and amongst multiple stakeholders across the MMP. Two significant partnerships were developed and are being sustained. First, mathematicians and math educators partnered to develop new mathematics courses for pre-service teachers at both MATC and UWM. Second, partnerships were developed between UWM faculty and MPS employees at multiple levels. Both of these partnerships represent significant MMP impacts. While the roots of these partnerships may have existed prior to the MMP, it is clear that the funding provided by the MMP was crucial for strengthening the partnerships and contributing to their institutionalization.
In addition, to the partnerships outlined above, within-school distributed-leadership partnerships were formed. These were primarily characterized by math teachers elevating their level of conversation around mathematics. We observed that multiple teachers reported communicating with many other teachers about mathematics. Also, with the introduction of an MTL into a school, there was a new focal point for improving mathematics teaching and learning.

**Teacher Quality, Quantity, and Diversity**

The MMP engaged in multiple activities to improve teacher quality and quantity. The MMP did not focus specifically on improving teacher diversity due to the already diverse nature of classroom teachers within the Milwaukee Public Schools. Instead, the MMP adopted three major initiatives. First, UWM offered mathematics courses for MPS teachers. These were mostly college-level courses and, in many cases, teachers earned undergraduate or graduate credit for completion of a course. Second, monthly MTL meetings were designed to enhance the content knowledge, pedagogical knowledge, and leadership skills of MTLs, to enable them to work more effectively with teachers in their schools. Third, the MMP established a more direct pathway for individuals who began their education in the Teacher Education Program (TEP) at the Milwaukee Area Technical College (MATC) and then sought to matriculate in a teacher education program at UWM.

Each of these activities had high impact. Nearly 1,500 unique teachers participated in at least one UWM-MMP course. MTLs received, on average, approximately eight days of focused professional development each year. The TEP pathway produced several teachers and has been institutionalized within MATC and UWM.

**Challenging Courses and Curricula**

The MMP has made substantial impact in addressing the rigor of courses and curricula used within the Milwaukee Public Schools. This has been accomplished primarily through promotion and use of various strategies that mirror best education practices. These include development of learning targets and of Classroom Assessments Based on Standards (CABS). As a result, teachers have become more engaged in instruction and in efforts to improve mathematics teaching and learning in schools.

**Evidence Based Design**

Since the inception of the MMP, a primary focus of the evaluation efforts has been aimed at trying to determine the impact of the MMP on increasing student achievement in mathematics. We have tried many different modeling approaches with many different metrics. Different modeling approaches were used as our understanding of hierarchical linear modeling grew. Different metrics were used as our understanding of what really seemed to be making an impact in the district grew. We believed, and were able to demonstrate through our evaluation efforts, that the MMP did make a difference in the district, in terms of influencing the teaching and learning of mathematics.
Institutional Change and Sustainability

The MMP was successful in implementing several key institutional changes which are being sustained beyond the conclusion of the original MMP funding. First, and perhaps most significant, was the creation of the Mathematics Teacher Leader (MTL) and Mathematics Teaching Specialist (MTS) roles within the Milwaukee Public Schools. These roles were instrumental in providing ongoing support for improving mathematics teaching and learning in schools. Second, the MMP secured additional funding from the State of Wisconsin, which helped sustain those roles and which are now funded by the district. Finally, the creation of new math courses for pre-service teachers at UWM and MATC has fundamentally changed the preparation for students electing a mathematics minor as part of their teacher preparation program. This has resulted in pre-service teachers who demonstrate similar math content knowledge to that of Math Teacher Leaders.