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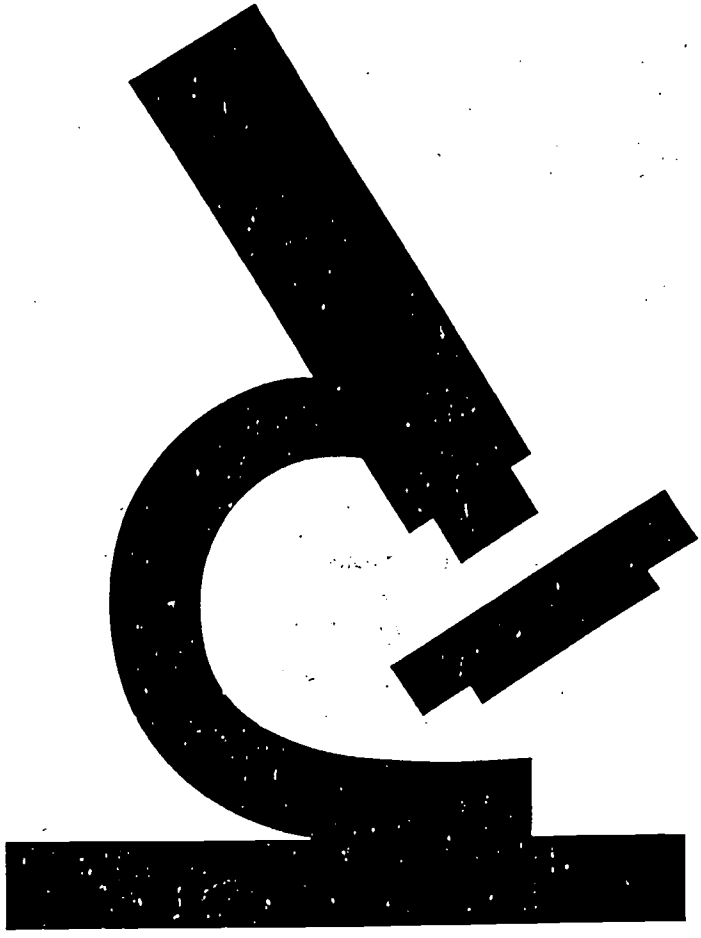
ABSTRACT

The Urban Systemic Initiatives (USI) program is an effort sponsored by the National Science Foundation (NSF) that targets large urban school systems with the goal of sustainable implementation of high-quality, standards-based teaching for the purpose of attaining system-wide increases in students' learning of challenging mathematics and science. The Milwaukee Public Schools joined USI in 1996 with the Milwaukee Urban Systemic Initiative (MUSI). MUSI consisted of four parts. The first is the driving force that unifies all MUSI activity, which comes from the perspective that a community of learners is the best way to reform mathematics and science education in the Milwaukee Public Schools. The three remaining parts are the action forces of activities that will build a strong foundation for reform. These action forces are (1) the Mathematics and Science Resource Teachers (MSRT); (2) MUSI's professional development program; and (3) the COSMIC Center. These action forces act upon six bases, or elements, which form the foundation for change. They consist of standards-based curriculum, teaching/learning and technology, assessment, leadership, equity, and school-based support. This report contains a discussion of the findings of MUSI's ongoing internal evaluation according to each of these forces, beginning with the perspective that drives MUSI, the community of learners. Appendices contain MUSI evaluation report, rubic for classroom observations, and "Tips of the Trade" for the MSRTS. (Contains 20 references.) (ASK)

Lessons Learned

Implementation of the Milwaukee Urban Systemic Initiative in Years One and Two



Report for the
Milwaukee Public Schools

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DeAnn Huinker

mps

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August 1999

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Contents

Chapter 1
Introduction

The Urban Systemic Initiative (USI) is an effort of the National Science Foundation (NSF) to enable large cities to make substantial and long-lasting improvements in mathematics and science education for all students. The goal of the USI is sustainable implementation of high-quality, standards-based teaching for the purpose of attaining system-wide increases in students' learning of challenging mathematics and science. According to NSF, the emphasis of systemic reform is comprehensiveness and synergy by elevating teaching and learning standards, enriching instructional materials and pedagogy, and refining methods to assess students' grasp of mathematics and science. Underlying this approach is the belief that improved student achievement will most effectively be achieved through a system-wide reform of mathematics and science instruction and that effort is ongoing and coordinated across educational settings in contrast to traditional piecemeal approaches. This suggests that the entire process is synergistic and aligned; that is, policies are formulated at the same time that educators and community members develop curriculum, alter instructional methods, and realign assessment procedures.

The purpose of this evaluation is to determine the lessons learned by participants of Milwaukee's Urban Systemic Initiative (MUSI). What has happened since the introduction of the USI in Milwaukee until now, nearly mid-point in a five year plan? This summary evaluation is an analysis and synthesis of the internal evaluation reports that have been collected throughout that time. This synthesis defragments the data gained thus far and helps focus efforts for future planning. These reports concentrate on the action forces of the MUSI plan, those activities designed more directly on schools and classrooms while additional district-wide aspects of reform including policy formulation and leveraging of funds are addressed in other reports including MUSI's Annual Reports and Performance Evaluation Reviews.

The findings summarized in this report contribute to the vast amount of data collected by MPS to assist MUSI participants in on-going development, refinement of appropriate indicators for goal achievement, and data-driven decision-making. The data allows MUSI planners to be better equipped to determine which components of the reform effort are successful, what catalytic practices facilitate change, and what are the pitfalls to progress. It also assists in determining which strategies can assist in planning for scaling-up in subsequent wave schools and sustaining systemic mathematics and science reform beyond the NSF funding period.

How MUSI Came To Be

The 1993-94 school year introduced NSF's Urban Systemic Initiative into Milwaukee. In 1994, the Milwaukee Public Schools (MPS) received a planning grant from the National Science Foundation that facilitated a collaboration between MPS and UWM to conduct a self-study of mathematics and science education in MPS.

Learning What is Needed: The Self-study of Mathematics and Science Education

The purpose of the self-study was to examine the status of the K-12 mathematics and science programs throughout the MPS district. The information gained from this study is detailed in the report titled, *Landscape of Mathematics and Science Education in Milwaukee* (Huinker, Doyle, & Pearson, 1995). The four major components of the study were (a) interviews, (b) classroom observations, (c) district-wide surveys of teachers, and (d) community and parent focus groups.

The findings from this study indicated that, although MPS had begun its plan for reforming teaching and learning in the district, there was a crucial need for changing the way mathematics and science were taught in MPS (Huinker, Doyle, & Pearson, 1995).

Students, teachers, and principals described their vision for ideal mathematics and science education. Their portrait looked like communities of learners where students collaborated in small groups, teachers collaborated across the entire school program, and the school district worked with the larger community of parents, agencies, and business where all were united by a vision of life-long learning. They described instruction that was thought provoking and practical using hands-on methodology. But, these ideals did not match the description of what they said was happening nor what classroom observations exposed in most MPS classrooms.

Although MPS had engaged itself in major assessment reform that moved toward performance assessments, academic success was still viewed by many educators and the public in measurable, functional ways, generally standardized test scores. Most teachers and principals attributed the gap in test scores between racial groups to socioeconomic status.

According to the parents, community members, students, teachers, and principals, too many classroom activities used paper and pencil tasks, the chalkboard, and overhead projector frequently instead of hands-on instruction. Teachers reported that two of their greatest barriers to changing were the traditional school schedule and lack of common time for collaboration while principals said that teachers needed to change their attitudes, beliefs, and motivation in order to affect a change in classrooms.

Elementary students complained that their teachers did not teach science enough. They felt that their teachers liked mathematics because they taught it everyday and did not like science because it was taught infrequently. Principals and teachers in elementary schools agreed with students; science is taught inconsistently and infrequently compared to most other major subjects for a multitude of reasons especially shortage of time. Reports of the learning community that extended beyond the classroom door varied from school to school. Some schools reported strong family involvement, while in others it was poor. Participation of the broader community was described as sporadic and more isolated to sponsorship of one or two specific events rather than active involvement on an ongoing basis.

Initiating Reform: Milwaukee's Urban Systemic Initiative (MUSI)

The findings from the self-study provided information for MPS and UWM personnel to collaboratively design a proposal to NSF's Urban Systemic Initiative and laid the framework for Milwaukee's plan to reform mathematics and science education in MPS schools. The self-study provided the baseline data for MUSI and contributed to future formative and summative evaluation. The key activities of the Milwaukee Urban Systemic Initiative from planning through the first two years of implementation are summarized in a timetable presented in Figure 1.

Planning

In May 1995, MPS submitted its proposal for systemic reform of mathematics and science education in the district to NSF. The goals of the plan are:

- Establishing ongoing collaborative vision setting,
- Instituting high standards and performance assessments,
- Narrowing ethnic, gender, and socioeconomic achievement gaps,
- Developing content, inquiry-based, and technology rich curriculum and teaching, and
- Breaking boundaries between classroom and the broader community.

Planning and Staging	
1993	USI guidelines for Urban Systemic Initiative proposals released
	MPS and UWM submit a planning grant proposal
	NSF awards MPS a planning grant in August
1994	MPS and UWM conduct a self-study of mathematics and science in MPS
	MPS and UWM hold meetings and proposal writing sessions
	MPS submits implementation proposal to NSF
	Proposal not granted, revisions suggested
1995	Ongoing MPS and UWM meetings and proposal writing
	MPS submits MUSI proposal in May
	Waiting period and conversations with NSF
1996	MUSI director, co-director, and leadership team selected
	First wave of 52 schools selected for MUSI
	First cadre of 25 Math/Science Resource Teachers (MSRTs) selected
Year 1 Implementation and Evaluation	
1996-97	MPS and NSF cooperative agreement signed
	MSRT training institute held in August and September
	Meeting and orientation for MUSI school principals in October
	First cadre of MSRTs enter the first wave MUSI schools in October
	Initial interviews held with MSRTs
	MUSI survey given to teachers in first wave schools
	MSRTs respond to three sets of focus questions throughout the year
	MUSI-UWM professional development courses offered in Spring and Summer
	Site visits conducted at sample of first wave schools in April and May
	Follow-up interviews held with MSRTs
Year 2 Implementation and Evaluation	
1997-98	A second MUSI co-director is selected
	Second wave MUSI schools selected
	Second cadre of MSRTs selected
	MSRT training institute held in August
	Meeting and orientation for MUSI school principals in August
	40 MSRTs placed in 81 MUSI schools
	Initial interviews held with new MSRTs
	MUSI-UWM professional development courses offered in Fall, Spring, and Summer
	COSMIC Center remodeling occurs
	MUSI survey given to teachers in second wave schools in November
	MUSI post-survey given to teachers in first wave schools in April
	Site visits conducted at sample of MUSI schools in May
	MSRTs complete evaluation questionnaire
	Follow-up interviews held with a sample of MSRTs

Figure 1. MUSI Timeline

The Milwaukee Urban Systemic Initiative (MUSI) is a sweeping plan for reform that includes critical components or forces over a five year period. The first is actually more than a component, but rather the driving force or philosophy of MUSI. It is the community perspective that intends to mobilize and support communities of learners at all levels - classrooms, schools, district, and city. The remaining forces are action forces. They concentrate directly on teaching reform through three critical means: (a) Mathematics and Science Resource Teachers (MSRTs), (b) a professional development plan, and (c) The COSMIC Center. The first action force is the creation of a core of teacher leaders (MSRTs) assigned to all MPS schools in waves over the five years of MUSI implementation. The second action force, MUSI's professional development plan, is extensive and

includes courses offered by UWM and programs developed by the MSRTs. The third action force is the establishment of The COSMIC Center, a mathematics, science, and technology center as a hub for teacher, parent, and student activities and a locus for increasing student opportunities and linkages with the broader community.

Rather than mandating a specific set of requirements for each school, the Milwaukee Urban Systemic Initiative (MUSI) based its plan on developing communities of learners around science and mathematics. While this provided autonomy to local schools and individual staff members, it made it very important for MUSI schools and the MSRTs to find ways to engage teachers, families, and the school community to connect with the unique strengths and needs within each setting.

The MUSI plan outlined how schools would be brought into full participation in four waves. With the principal as leader, each school was to identify a team consisting of teachers, parents, students, the MSRT, and other community members which was to serve as the nucleus of the school's community of learners. All members of the team were expected to participate in learning activities around mathematics and science, to function as in-school collaborators, and to contribute to the district's community of learners by participation in institutes, networks, courses, and other district-level activities.

Central to the design of MUSI was the establishment of a cadre of Mathematics and Science Resource Teachers (MSRT). Each year of the initiative a group of schools would be identified as MUSI schools. Each MSRT would be assigned to work with the staff at two MUSI schools for two years. The MSRTs would serve as teacher leaders who would mobilize the school community to embrace high expectations for all students in mathematics and science, develop effective teaching and learning to achieve those high goals, and serve as links to the larger district-wide initiative. Every aspect of the MSRT work was designed to build capacity for change at the classroom level, the school level, and the district level. The plan also called for the mathematics, science, and technology center, known as the COSMIC Center, to be operational with the start of the 1996-97 school year.

Start-up

MPS submitted its proposal to the National Science Foundation (NSF) in May 1995. During the period from May 1995 to Summer 1996, ongoing communications between MPS and NSF helped clarify expectations of NSF and specifics regarding implementation. Since the cooperative agreement was not signed until September 1996, MPS planners anticipated implementation to begin January 1997. However, the starting date was changed to August 1996.

During the summer of 1996, a cadre of 25 MSRTs were hired and 52 schools were selected from a pool of schools who had submitted proposals to the MUSI leadership team. Planning for a training institute for the new MSRTs was begun, and MUSI was underway.

Implementation

From 28 August to 30 September 1996, MUSI conducted an institute to prepare the first cadre of MSRTs to initiate the implementation of MUSI in First Wave schools. The MSRTs visited their assigned schools for the first time during mid-September. Meetings for principals of MUSI schools were held in mid-October.

On 24 September 1996, MPS entered into a cooperative agreement with and received funding from the National Science Foundation's Urban Systemic Initiative to help implement this reform plan over five years. Throughout that first year, various activities revolved primarily around the developing role of the MSRTs. Emphasis was placed on their professional development and the professional development of teachers. The COSMIC Center got off to a slow start.

In September 1997, 21 new MSRTs and 19 First Wave MSRTs were hired to serve in a total of 81 schools. This second group of MSRTs participated in an institute from 11-22 August 1997.

Again, throughout the year, various activities revolved around the MSRTs and professional development with an even greater emphasis on professional development of teachers in MUSI schools. The COSMIC Center was slowly emerging as a physical reality.

Methodology

The Process

- The methodological process for this summary evaluation consisted of analysis and synthesis of the existing MUSI internal evaluation reports supplemented with additional documentation including the original MUSI proposal to NSF, the cooperative agreement between NSF and MPS, MPS policies, procedures, and plans, and communications between NSF and MPS. Conversations, discussions, and meetings with members of the MUSI leadership team were also held primarily for clarification purposes. Analysis consisted of multiple readings of each of the MUSI evaluation reports followed by step by step analysis of each report. Coding consisted of extracting and reducing key sections and descriptors from each internal evaluation report. Although MUSI's forces and bases guided the analysis, they did not restrict it, and salient descriptors emerged from the data which led to new sub-categories.

Evaluation Reports

Throughout MUSI's presence in the Milwaukee Public Schools, extensive evaluation data has been collected, from a self-study to determine strengths and needs through the impact of the first two years of implementation in the five year MUSI plan. From this data, MPS and UWM personnel generated evaluation reports that were used for planning and decision making. Figure 2 lists each internal evaluation report. Collectively, these reports formed the data for this summary evaluation. A short description of each report is listed in Appendix A.

Baseline Data: The Self-study

Landscape of Mathematics and Science Education in Milwaukee: A Study of the Milwaukee Public Schools

MUSI Evaluation Data Year 1

Evaluation of the 1996 Milwaukee Urban Systemic Initiative Mathematics/Science Resource Teacher Institute
Analysis of Initial Interviews with First Cohort Mathematics/Science Resource Teachers
Initial Survey Results for First Wave MUSI Schools
The Journey Begins: First Year Activities of the MUSI Mathematics/Science Resource Teachers
Retrospections of First Year MUSI Implementation: Interviews with the Mathematics/Science Resource Teachers
First Year Site Visits to Milwaukee Urban Systemic Initiative Schools

MUSI Evaluation Data Year 2

Evaluation of the 1997 Milwaukee Urban Systemic Initiative Mathematics/Science Resource Teacher Institute
Initial Conversations with Second Cohort MSRTs
Initial Survey Results for Second and Third Wave MUSI Schools
Compilation of Focus Questions with Mathematics and Science Resource Teacher
MSRT Actions and Reflections: Second Year MUSI Implementation and the Mathematics/Science Resource Teachers
Retrospections of Second Year MUSI Implementation: Interviews with Mathematics and Science Resource Teachers
Survey Results for First Wave Schools of the Milwaukee Urban Systemic Initiative
Second Year Site Visits to Milwaukee Urban Systemic Initiative Schools
Professional Learning Communities: MUSI-UWM Professional Development Courses in the First and Second Years of MUSI Implementation

Figure 2. MUSI Evaluation Reports

Category Development

Overlooking the entire reform effort is the community of learners perspective; it drives MUSI. (See Figure 3). The action forces of MUSI include the Mathematics/Science Resource Teachers (MSRT), professional development, and the COSMIC Center.

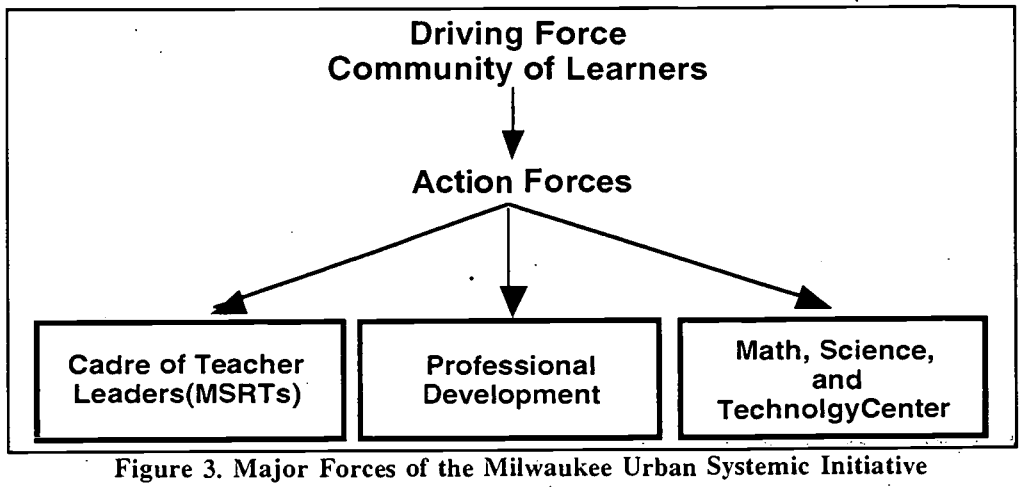

Figure 3. Major Forces of the Milwaukee Urban Systemic Initiative

The six bases shown in Figure 4 formed the skeleton or major categories used in this evaluation. The bases of MUSI were developed from six Drivers and four cross-variables (equity, quality, scaling up, and coordination) established by NSF. The six bases are (a) standards-based curriculum, (b) teaching/learning and technology, (c) assessment, (d) leadership and management, (e) equity, and (f) school-based supports.

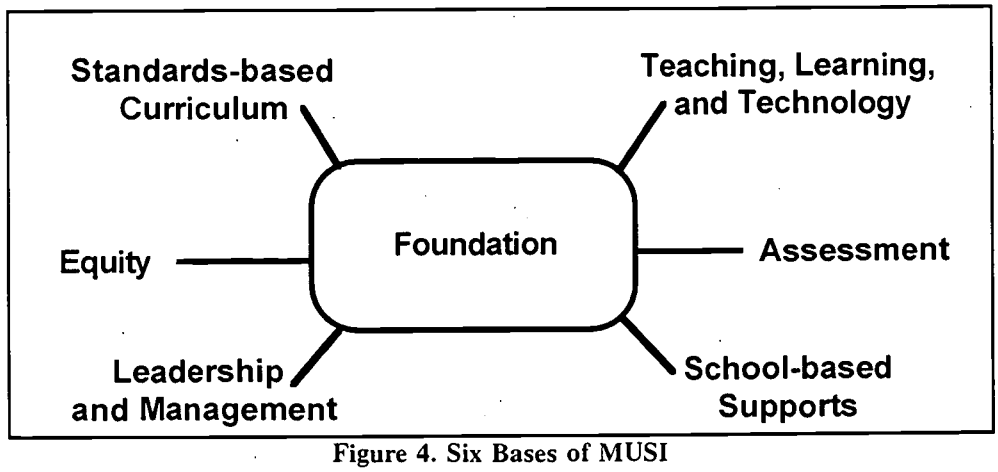

Figure 4. Six Bases of MUSI

Unlike bureaucratic models which mandate and require, reform in Milwaukee seeks to motivate and excite all potential members of the community into voluntarily reforming the way mathematics and science are taught in MPS schools. The six bases are the footings that form the foundation for excellence. They consist of the beliefs and actions of the potential members of the community of learners. The self-study revealed that parts of these bases are solid, and parts need shoring up. The action forces of MUSI were designed to do just that, to anchor each base so that the entire foundation is firm and stable and can support reform long after the actions forces are gone.

Chapter 2
Findings

As mentioned previously, the Milwaukee Urban Systemic Initiative (MUSI) consisted of four forces. The first is the driving force that unifies all MUSI activity. It is the perspective that a community of learners is the best way to reform mathematics and science education in the Milwaukee Public Schools (MPS). The three remaining forces are the action forces or activities that will build a strong foundation for reform. These action forces are (a) the Mathematics and Science Resource Teachers (MSRTs), (b) MUSI's professional development program, and (c) the COSMIC Center. These action forces act upon six bases or elements which form this foundation for change. They consist of (a) standards-based curriculum, (b) teaching/learning and technology, (c) assessment, (d) leadership, (e) equity, and (f) school-based support. This section contains a discussion of the findings of MUSI's ongoing internal evaluation according to each of these forces beginning with the perspective that drives MUSI, the community of learners.

The Driving Force: The Community of Learners Perspective

From data provided by the MSRTs, internal evaluators found that MUSI is facilitating community in many diverse ways. These evaluators made the following assertions.

- Many different strategies are being used to enhance the school community of learners.
- Many opportunities for teachers to engage in continued learning are occurring because of MUSI, including individual school-based opportunities, as well as cross-school and district-based. As a result, teachers within schools are talking with each other more about mathematics and science curricula.
- When MSRTs participate as co-learners with other teachers in UWM courses or in other professional development opportunities, they are able to build strong rapport with these teachers and are better able to support the implementation of ideas in the classroom. "We're in this together, now how can I help you."

Developing a community of learners within the Milwaukee Public Schools necessitates that everyone understands what is meant by a community of learners. The community of learners means different things to different participants. Some place considerable emphasis on the school district, parents, and the broader community. Evidence for them is increasing parent involvement and partnerships and liaisons with business and community organizations.

On the other hand, many of the MSRTs and members of the leadership team view the school as the unit of change. Although their ultimate goal includes parents and the broader community, they view development of the professional community within schools as the locus of initial change with strategies for scaling up to the broader community at a later date. They currently are attempting to create professional communities in classrooms, grade spans, and/or schools by increasing teachers' conversations with each other, decreasing teacher isolation, and deprivatizing classrooms. According to MUSI's cooperative agreement with the National Science Foundation, a community of learners perspective encompassed both of these beliefs.

Classrooms as Communities

MUSI classrooms themselves are to become communities of learners. By placing emphasis on cooperative learning and shared problem-solving, the MSRTs and MUSI's professional development programs facilitate community building from the ground up. MUSI's perspective is,

as classrooms and teachers become more cooperative, so will schools. This cooperation then moves to clusters of schools and to the broader school community. The development of community from micro to macro levels is consistent with MUSI's belief that true reform begins at the school level.

Broadened Participation: Families, Businesses, Agencies

Community also means participation of everyone in the schools including families, business, agencies, and other aspects of the local school community. The MSRTs were involved in enhancing the district community of learners although to a lesser degree than their involvement in classroom and school communities. For example, on a survey of frequency of activities, 55.4% of the MSRTs reported that they involved parents in math and science activities on a semester or annual basis, and 35.6% said they had not done this at all, whereas 58.1% reported that they provided teacher support in classrooms for science on a daily or weekly basis and 44.6% reported the same for mathematics.

The MSRT activities that did expand the community of learners typically tried to create links beyond individual school boundaries. For example, MSRTs planned and facilitated numerous staff development opportunities, inservices, and workshops for teachers district-wide and for schools other than their assigned MUSI schools. These generally took place on Saturdays and after school. Some MSRTs served as co-instructors for UWM-MUSI courses in algebra, elementary mathematics, elementary science, middle and high school science while others served on district-wide committees. Some MSRTs became interested in developing or facilitating partnerships with local businesses. Their roles are characterized in these interview comments.

- I did make a presentation to the parents PTA meeting at an open house, two open houses as a matter of fact...I've done two or three parent workshops.
- I'm just trying to start on small levels with the school community, local businesses, or perhaps the parents who are not involved in math and science or the PTA. I would be really happy to help develop a program with a local bank. There is one person who is trying to set that up.
- I have worked with the parent coordinator in one school. My other school wants me to set up a "Math Night" with parents.
- I got volunteers to do the wiring of the school for the Internet.

The primary forces that are being used to change MPS into a community of learners are the MSRTs and professional development. The next two sections discuss how each of these forces changes teaching of mathematics and science in MPS classrooms and moves schools closer to communities of learners.

The Action Force: The Role of MSRT

The successes of the Milwaukee Urban Systemic Initiative (MUSI) during its first two years can be attributed to the work of the Mathematics and Science Resource Teachers (MSRTs). These teachers, in conjunction with MUSI's strong professional development program, appeared to be the greatest influence in reforming the way mathematics and science was taught in MPS classrooms. Since the role of the MSRTs was new to the Milwaukee Public Schools, there were many challenges in defining that role. This was true not only for the MSRTs themselves, but also for others working with them in both teaching and leadership capacities.

Throughout the first two years, MUSI leaders and teachers struggled to meet these challenges and to develop activities that were common to the MSRT role, yet unique and adaptable to meet the individual needs of each school. Many of their accomplishments indicate that the MUSI team did

much of what they set out to do and suggest directions for the future of MUSI. These challenges, activities, and accomplishments comprise the remainder of this section on the role of the MSRT.

Challenges

Prior to MUSI, MPS had no supportive role positions for mathematics and science beyond two curriculum specialists, one for mathematics and one for science, who administered their content areas for the entire Milwaukee Public School District. MUSI created new positions, the MSRTs, who were to fill the void and spark teaching change in mathematics and science. The expectations for the MSRTs as stated in the MUSI cooperative agreement with NSF include the following.

- Support effective learning in school communities through a variety of collaborative techniques including peer coaching, team teaching, demonstrations, and facilitating small- and large-group meetings and workshops.
- Provide school-based leadership in forming a vision of mathematics and science learning which embraces high expectations, standards-based instruction, and commitment to principles of equity among the members of the school community.
- Foster the use of technology, authentic assessments, and community resources in mathematics and science.
- Provide access to current literature, learning activities, and other science and mathematics related resources to members of school communities.
- Learn through independent study, seminars, study groups, networks, courses, and conferences.
- Promote interconnections among teachers, students, and other community members district-wide around topics related to mathematics, science, and technology.

The MSRTs selected thus far have had formal education and certification related to mathematics and science education and have had three years of recent teaching experience in the classroom or in a supportive role. They have also had recent leadership experience in professional development activities beyond the local school, recent participation as a learner in a minimum of two mathematics or science related professional development activities, and recent mathematics or science experiences with innovative teaching and learning activities and/or the use of technology in classroom instruction.

During the internal evaluation, initial interviews with the MSRTs revealed that most of them cited their interest in mathematics and/or science as the primary reason why they applied for the MSRT position. As a group, they had strong professional histories of leadership and involvement in many professional capacities both within the district and at the state and national level. So how did these pioneers of reform feel as they embarked on their difficult journey toward changing the way their colleagues taught behind closed classroom doors?

Initial Perceptions

The feelings the MSRTs held about their new positions varied from week to week or day to day and appeared dependent upon levels of acceptance by schools. Words used frequently by the MSRTs were "challenging," "exciting," and "frustrating." For those who reported frustration, problems cited most frequently related to misconceptions between MSRTs and leadership. Others felt that, while the framework matched their expectations, the challenge of the day-to-day work of the MSRT was more daunting than they anticipated. Those who saw that their perceptions fit well with the reality of the job had a very clear sense of mission which was consistent with the clearly stated purpose within their schools. The school and its leadership knew where it wanted to go, and these MSRTs reported having less difficulty "fitting into" the structure of the school.

Emergence of the MSRT Role

As the first year of implementation progressed, the MSRTs and the schools developed relationships that were unique and suited to the needs of each individual school. MUSI's spirit of community and openness allowed each school and its MSRT to create roles that fulfilled specific needs of each school while achieving the goals and expectations of MUSI. The MSRTs began to talk about their roles differently. They described how they re-focused their approaches and rethought and revised what they felt is necessary to bring about change.

- It is becoming clearer and clearer to me that for reform to occur, a school must be constantly dialoguing about expectations, strategies, and overall curriculum for students to be successful.
- I have met both open acceptance and guarded avoidance. In those classrooms where I have been involved, I feel there is not a concern about why I am there. The students are very accepting and seem to enjoy the challenges given to them.
- I see my role in very different ways in each of my schools. I see myself as a resource and as a coach/supporter in each school. But what that looks like is very different as the needs of each school vary.

During the first two years of MUSI implementation, considerable effort was given to isolating and defining the role and activities of the MSRT. Again, since MUSI's foundation was communities of learners, tight role definitions were avoided. However, concerns among the MSRTs led to development of a set of common actions for the MSRT role and what support was expected from each school. The goal of these common actions were to guide schools in working with the MSRTs that was consistent with MUSI expectations and providing MSRTs with minimum accommodations to enable them to meet those expectations while maintaining the flexibility that a community of learners requires.

MSRT Activities

The MSRTs described more differences between their schools than similarities. Their activities were as varied as the number of MSRTs times two because each MSRT had two schools. Despite these differences, the initial plans of most MSRTs were clearly directed at MUSI goals. However, each MSRT differed as to how they embarked on their journey to reform. Many jumped right in and initiated classroom activities quickly while others spent considerable time taking inventories of needs or talking with teachers and administrators asking what others saw as the MSRTs role in the school. For those MSRTs who were actively involved in classrooms, demonstration teaching and modeling for teachers were their most frequent strategies. These MSRTs described their "tricks" and "trade secrets" for accessing classrooms where they felt they could implement change (see Appendix C). They saw themselves as "catalysts for change" and understood that to do this they needed to be visible within their schools. Due to time constraints, some prioritized needs, deciding to ignore those teachers who resisted change in favor of more ready or flexible teachers.

A summary of the primary activities of the MSRTs is delineated in Table 1. Five categories represent activities reported and discussed by many or most of the MSRTs. The categories included (a) professional development, (b) curriculum and assessment, (c) classroom teaching and support, (d) resources, and (e) partnerships for learning. Of the five, professional development was the most frequent and perceived as the most critical to change.

MSRTs served as advocates for mathematics and science in their schools by making connections, encouraging teachers to sign up for MUSI-UWM courses, gathering resources, and providing support by assisting with science fairs or simply being "an extra pair of hands." Their work with administrators consisted primarily of keeping them informed. In fact, as the first year of MUSI progressed, the majority of the MSRT activities focused on the professional development of

teachers, administrators, and other staff members. The models of professional development varied to meet the needs of specific school learning communities, as well as to meet the needs of individual teachers. The MSRTs conducted and/or planned formal staff inservice within their schools, as well as across schools. Sometimes they teamed up with each other to offer an inservice to the staffs from several schools. Many MSRTs were able to engage teachers in professional discussions around science and mathematics learning through established grade level or department meetings or by participating in other established school committees.

At a more informal level, MSRTs would conference and meet with individual teachers or small groups of teachers to discuss science and mathematics. Another strategy that was used by many MSRTs was to participate alongside teachers in courses, meetings, workshops, and other events. This provided an opportunity to engage in focused discussions around science and mathematics and often led to further interaction and work with individuals and groups of teachers.

The MSRT activities focused on helping teachers, administrators, and other staff create a common vision of standards-based science and mathematics. They engaged staff in examining national standards in science and mathematics, the emerging MPS mathematics and science curricula, and district and state assessments.

Table 1. Activities to Support School and Classroom Communities of Learners

Professional Development • Conducted formal staff inservice within and across schools. • Meet with grade level groups, departments, and school committees. • Facilitated development of a school action plan for mathematics and science. • Assisted teachers with strategies to prepare students for state assessments and for district performance assessments and proficiencies. • Conferred with individual and small groups of teachers—listening, offering suggestions, advice, and/or encouragement. • Participated alongside teachers in university courses, meetings, workshops, and events—reflecting and discussing instructional practice. • Assisted staff in writing grant proposals. • Arranged for teachers to visit other teachers within the school or at other schools.
Curriculum, Assessment, and Equity • Helped teachers understand the MPS mathematics and science curricula, national standards, science and mathematics connections, and integrated curriculum. • Developed opportunities for teachers to better understand state and district mathematics and science assessments. • Identified and discussed equity issues with school staff. • Assisted teachers in developing and modifying units and activities for classroom use. • Assisted with pilot projects.
Classroom Teaching and Support • Team taught within classrooms. • Conducted demonstration lessons and modeled techniques. • Observed and supported teachers in the classroom and provided feedback. • Worked with individual or groups of students.
Resources • Assisted with technology—curricular infusion, getting teachers online, and technical support. • Gathered and ordered materials and located resources. • Located and inventoried equipment and materials.
Partnerships for Learning • Linked staff between schools and brought other MSRTs and UWM faculty to the schools. • Contacted business partners , informal education agencies, and other community agencies. • Facilitated links with families, parent groups, and parent centers. • Helped with school-wide mathematics and science events

Although teachers took part in MUSI's professional development, attendance at professional development sessions is not sufficient for the kind of change that MUSI seeks. What really matters is the implementation of what is learned during professional development sessions, and it is here where the MSRTs had their greatest impact. They provided teacher coaching and one-on-one classroom-based support to teachers. The MSRTs team taught and conducted demonstration lessons. These provided opportunities for teachers to observe their students engaged in inquiry and standards-based instruction. The MSRTs served as another pair of eyes for conducting classroom observations or another pair of hands to help out during hands-on lessons. The frequencies of these activities are in Table 2 .

But having another professional in classrooms that were once the private domains of teachers can be threatening. To help avoid the appearance that MSRTs might be evaluating teachers' performance, the MSRTs developed an instrument, Common Eyes, to act as an initial filter for classroom observations. Used mutually by the teachers and the MSRTs, this instrument was to provide a beginning point for the dialogue that occurred between MSRTs and teachers. Not all MSRTs used the actual instrument, but it did help to provide a framework for their interactions with teachers whether or not they used the instrument.

Table 2. Common MSRT Actions in Year Two of MUSI (n=74 schools)

Item	Daily or Weekly
I provided teacher coaching/support in classrooms for **science**.	58.1
I modeled **science** lessons for teachers in classrooms.	52.8
I team taught **science** lessons with teachers.	50.0
I participated in collaborative meetings with teachers to support their implementation of the MPS **science** curriculum.	46.0
I provided teacher coaching/support in classrooms for **mathematics**.	44.6
I met with educational leaders besides the principal to discuss current status of math and science and to collaborate toward next steps.	44.5
I provided support and assistance with mathematics and/or science performance assessments.	41.9
I modeled **math** lessons for teachers in classrooms.	40.3
I participated in collaborative meetings with teachers to support their implementation of the MPS **mathematics** curriculum.	39.2
I team taught **math** lessons with teachers.	36.5
I met with the principal to discuss the current status of mathematics and science and to collaborate toward next steps.	31.1

To implement inquiry-based, hands-on learning, many MSRTs assisted in ensuring that teachers had the resources necessary to implement standards-based science and mathematics. For some it meant taking an inventory, organizing the materials and equipment within a building, and informing teachers on what was available. For others it involved identifying and ordering the needed resources. MSRTs provided support for technology infusion into student learning and teacher professional development. The needs of the teachers varied considerably. Some needed ideas and suggestions for implementing graphing calculators into their instruction, while others just needed assistance in getting online themselves or installing software.

The Number of Schools Served

Initially, the MSRTs unanimously believed that having one school over two would be a far superior service delivery model. There were problems of time, continuity, unequal pairings, but most problematic was scheduling. After the first semester, however, this problem decreased when MSRTs found that a combination of several days in each school each week (two days in, two days

out) worked better than alternating weeks between schools. They came to find that having two schools provided them with variety and an opportunity to learn more about different schools and that they could begin bridging between schools. For example, MSRTs could facilitate understanding of curricula between different schools and/or sharing of resources.

The MSRT and Community Involvement

Beyond facilitating changes that transformed classrooms into communities of learners, the Mathematics/Science Resource Teachers (MSRT) were also involved in enhancing the district community of learners. This included creating strong links with families, businesses, and community agencies, as well as with other schools within the system. Many of these activities were conducted after school hours or on weekends. These activities, whether for a limited duration of time or on-going, contributed positively to the quality of mathematics and science instruction throughout the district. The MSRTs planned and facilitated numerous professional development opportunities, inservice, and workshops for teachers district-wide and for schools other than their assigned MUSI schools. These generally took place on Saturdays and after school. Some MSRTs also served as co-instructors for UWM-MUSI courses in elementary mathematics, elementary science, middle and high school science, and middle and high school mathematics. Many MSRTs also served on district-wide committees.

Leadership

One expectation in the MUSI plan that did not materialize as expected was the leadership role that MSRTs would play in schools. The MUSI plan stated that MSRTs would "provide school-based leadership in forming a vision of mathematics and science learning which embraces high expectations, standards-based instruction, and commitment to principles of equity among the members of the school community." Although the data shows that the MSRTs espoused these goals and stimulated excitement for mathematics and science teaching, their leadership role in setting school visions and planning was generally not as strong as expected. Table 3 reflects the low frequencies of MSRT involvement in school planning. This issue is also explored further in the section on leadership.

Table 3. MSRT Involvement in School Planning in Year Two of MUSI (n=74 schools)

Item	Semesterly/Yearly	Not Done
I helped plan the **science** portion of the school's educational plan.	45.2	45.2
I helped plan the **math** portion of the school's educational plan.	53.4	35.6

In the site visit interviews, principals stated that they saw the role of the MSRT as part of the school leadership team and as a source of feedback. However, in the interviews with MSRTs, they said little about their role in school based planning and decision making. Teachers also did not credit MSRTs with a strong school leadership role and indicated that their greatest contribution to schools was in creating excitement and motivating change for mathematics and science instruction through their activities in classrooms.

Accomplishments and Satisfaction

The site visit interviews with principals, students, and teachers revealed that first and foremost, the MSRTs increased excitement and improved teaching for many teachers. By facilitating professional development opportunities, obtaining grant money, conducting demonstration teaching, team teaching, and developing and obtaining resources, the MSRTs created excitement in teachers and schools that motivated change. According to initial and follow-up teacher surveys, MUSI and the MSRTs appeared to be making a marked impact (see Table 4). At the elementary and high school levels, approximately half of the science teachers and over one third of the mathematics teachers agreed or strongly agreed that the MSRT at their school assisted them in

improving their teaching and that being a MUSI school allowed them to improve their programs. These responses were markedly higher at the middle school level where 77.5% of the science teachers reported being assisted by the MSRT and 63.5% of them felt MUSI allowed them to improve their program. Results for middle school mathematics teachers were also high at 64.3% and 53.5%, respectively.

According to the results of interviews with principals, teachers, and MSRTs and initial and follow-up teacher survey comparisons, classroom teaching did change. Teachers were using more hands-on experimentation, more varied assessment practices, and more small group problem solving, particularly in the high schools. Principals reported that they saw this reflected in student behaviors. There was a lot more excitement in classrooms and an increase in problem solving activities.

When the MSRTs were asked about their greatest accomplishments, the response that occurred most often was getting classroom teachers motivated to try new lessons. They also felt great accomplishment in getting teachers to take part in professional development. It was this combination, the role of the MSRT and MUSI's strong professional development, that gave MUSI its clout.

- I think my biggest accomplishment was with a teacher who was afraid of math. This year the teacher took a MUSI-UWM course to improve teaching elementary math. He has really taken off in math. And his kids are seeing that he enjoys it, so now they really enjoy it too. During their free time they choose to do math activities.
- (My biggest accomplishment is) getting people to try different things. Getting people to try standards based math and science and integrating math and science in the classroom.

Table 4. Follow-up Survey Perception of MUSI Impact in First Wave Schools

Item	Grade Level	n	Mean (SD)	Frequency Percentages				
				Strongly Disagree (1)	Disagree (2)	Undecided (3)	Agree (4)	Strongly Agree (5)
The MSRT at my school has assisted me in improving my mathematics instruction.	K-5	281	2.81 (1.41)	25.6	21.0	12.5	28.8	12.1
	6-8	70	3.54 (1.07)	5.7	12.9	17.1	50.0	14.3
	9-12	40	2.83 (1.28)	20.0	20.0	27.5	22.5	10.0
Being a MUSI school has allowed us to improve our mathematics program.	K-5	283	3.06 (1.29)	17.7	14.1	26.1	29.0	13.1
	6-8	71	3.63 (0.78)	0.0	4.2	42.3	39.4	14.1
	9-12	40	3.10 (1.08)	10.0	15.0	37.5	30.0	7.5
The MSRT at my school has assisted me in improving my science instruction.	K-5	278	2.91 (1.44)	23.7	21.2	11.2	28.4	15.5
	6-8	62	3.90 (1.11)	4.8	9.7	8.1	45.2	32.3
	9-12	26	3.27 (1.25)	15.4	7.7	23.1	42.3	11.5
Being a MUSI school has allowed us to improve our school's science program.	K-5	279	3.26 (1.31)	14.3	13.3	24.4	28.3	19.7
	6-8	63	3.75 (1.02)	4.8	3.2	28.6	39.7	23.8
	9-12	26	3.23 (0.99)	7.7	11.5	34.6	42.3	3.8

Another major accomplishment reported by the MSRTs was modeling lessons for teachers. Over one-third of the MSRTs reported that this had a significant impact on teachers. Obtaining grants, getting the kids more involved and having the principal "come on board" were also mentioned as accomplishments. Interestingly, interview responses that addressed accomplishments with students were sparse. During the first two years of implementation, MUSI's emphasis was on administration and teachers. Most MSRTs reported that for change to occur, it was crucial to have a good relationship with the principal.

Not all MSRTs shared the same level of accomplishment. In fact, those MSRTs least satisfied with their roles were those who felt a diminished level of accomplishment. One MSRT who decided not to return to the MSRT position the following year cited a "lack of accomplishment" as the basis for the decision. Most of the MSRTs expressed frustration at one time or another. Many MSRTs have a strength in mathematics or science, but not both. Some MSRTs felt that they could be more effective if they were paired with another MSRT who had a strength in their weaker area. Additionally, the MSRTs often lacked a broader perspective of reform—one that went beyond classroom teaching into understanding the difficulty of change in a school district that still held tightly to its bureaucratic structures. Changing mathematics and science teaching needed to be done one school at a time, one teacher at a time. The MSRTs needed to understand this ambiguity and that the absence of tight closure is acceptable and a learning experience for the collaborative community.

The Action Force: Professional Development

The Milwaukee Urban Systemic Initiative's (MUSI's) professional development program has been strong and provided extensive opportunities for many. Throughout this report, it will become increasingly clear that the strength of MUSI was more than a combination, but rather a blending, a symbiosis of the work of the MSRTs and MUSI's professional development program. In an electronic communication from Dr. Joe Reed, MUSI's program officer from the National Science Foundation (NSF), the MUSI leaders were told that "MUSI presented an outstanding approach in professional development" (communication dated 5-26-98).

Opportunities for professional development were available on both an informal and formal basis. Informal professional development was ongoing and consisted of the numerous interactions of school personnel with the Mathematics/Science Resource Teachers (MSRTs). The MSRTs stimulated professional growth by conducting demonstrations, team teaching, facilitating meetings, and acquainting staff with innovative resources and materials.

MUSI provided formal professional development in different ways to three groups of people: teachers, MSRTs, and school administrators. Formal professional development for teachers was predominantly through extensive courses offered by the University of Wisconsin-Milwaukee. MSRTs also conducted inservices and workshops for teachers in their schools or across schools. Professional development for the MSRTs consisted of preliminary institutes, and weekly meetings and seminars. Some MSRTs also attended the university courses. The third group, the principals, received their information about MUSI and reforming mathematics and science education through occasional scheduled meetings.

Professional Development and Teachers

The data was clear: the force of MUSI was the interrelationship of professional development for classroom teachers combined with the activities of the MSRTs. In surveys and during interviews, teachers reported that the impetus for changing how they taught was MUSI's professional development program, especially courses provided by UWM, which was supplemented with help from the MSRTs. Reports and course evaluations from the university also confirmed this. MSRTs observed that the greatest changes in classroom teaching occurred in classrooms in which the teachers had been involved in MUSI professional development programs.

MUSI-UWM Course Evaluations

The University of Wisconsin-Milwaukee (UWM) through the Center for Mathematics and Science Education (CMSER) developed and sponsored courses specifically to meet the needs of teachers and staff in MUSI. These courses focused on mathematics and science content, pedagogy,

national standards, and connections to the mathematics and science curricula in MPS. Most courses were co-developed and co-taught by UWM faculty and MPS teachers. Teachers and staff members usually enrolled in the courses as teams from their schools to ensure a support network and to foster professional learning communities within schools.

UWM offered 28 courses for MUSI during its first and second years of implementation. Nine courses were offered during the initial year of implementation and 19 courses were offered during the second year of implementation. A total of 791 participants were enrolled in these courses for 1703 university credits giving a mean of 2.2 credit hours or 32.3 contact hours per participant. The tuition for undergraduate and graduate credit was waived for each of these participants through the MUSI sub-award that was granted to UWM. The total value of the tuition waiver over these two years was approximately $350 000. Table 5 list the courses that were offered for MUSI during these two years.

Table 5. MUSI-UWM Courses Offered in Years One and Two

Name of Course	Number of Credits	Total Enrollment	Undergraduate Enrollment	Graduate Enrollment
Mathematics Teaching in the Elementary School	2	70	53	17
Science Teaching in the Elementary School	2	43	33	10
Middle and High School Science Teaching and the National Science Standards	3	49	11	38
Teaching & Learning Algebra in Middle & High Schools —Issues, Outcomes, Materials, Technology, Applications	3	38	25	13
Biology Topics for Teachers: Amazing Animals	1	7	7	0
Geology for In-service Teachers: Environmental Geology	1	8	7	1
Mathematics Teaching in the Elementary School	2	34	26	8
Teaching Standards-Based Mathematics in Grades 4–8: Curriculum Materials, Instructional Techniques, Assessment	3	14	8	6
National Science Education Standards K–12: An Introduction	1	24	3	21
Mathematics Teaching in the Elementary School	2	54	30	24
Implementing Standards-Based Mathematics in the Elementary School	1	24	15	9
Decisions in Teaching Elementary School Science: Teaching	3	22	7	15
Biology Topics for Teachers: Our Bodies	1	20	20	0
Geology for Teachers: Minerals, Rocks, & Mineral Resources	1	23	7	16
Cognitively Guided Instruction	2	20	9	11
Bringing the National Science Education Standards to Life in the Elementary Classroom	3	24	8	16
Community Linkages: Science and Mathematics Beyond the Classroom Walls	3	22	8	14
Middle and High School Science Teaching and the National Science Standards: Part I	3	14	6	8
Middle and High School Science Teaching and the National Science Standards: Part II	3	12	5	7
Using Internet for Teaching and Integrating Science, Mathematics, and Social Studies	3	67	27	36
Implementing Standards-Based Mathematics in Elementary	1	27	16	11
Decisions in Teaching Elementary School Science: Curriculum	3	22	7	15
Geology For Teachers: Geological Aspects of Ecology	1	26	0	26
Standards-based Mathematics Curriculum: Elementary	2	16	11	5
Standards-based Mathematics Curriculum: Elementary	2	34	11	23
Teaching Science in the Elementary School	2	24	12	12
Teaching Science in the Elementary School	2	33	12	21
Standards-based Mathematics Curriculum: Middle School	2	24	2	22

Participants in the UWM courses completed questionnaires during the last session of each course. Most of these questionnaires included selected-response items that addressed the impact of the courses on their knowledge-base, comfort level, beliefs, and teaching strategies. The items varied among the courses so that each set of items would better address the specific content and goals of that particular course, but contained parallel items to allow for comparisons across courses. Participants responded to each item on a 4-point scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree. A listing of all items for each course can be found in the separate course evaluations within the evaluation report by Huinker and Mueller titled, *Professional Learning Communities* (1998).

Overall, the results indicated that the UWM courses enhanced participants' knowledge-base and conceptual understanding. Participants also reported that they felt more comfortable with new teaching strategies, were better prepared to teach mathematics and science, and had actually improved themselves as teachers.

Knowledge-base. The means ranged from a rating of 3.27 to 3.86. This indicates strong agreement that the courses strengthened participants' knowledge of national science and mathematics standards or their knowledge of content.

Conceptual Understanding. The means ranged from a rating of 2.93 to 3.80. This indicates agreement that the courses helped participants be better prepared to emphasize conceptual understanding of mathematics and science.

Comfort with Hands-on. The means ranged from a rating of 2.91 to 3.73. This indicates agreement among the participants that they felt more comfortable involving their students in hands-on mathematics and activities as a result of the courses.

Better Prepared. The means ranged from a rating of 3.14 to 3.84. This indicates strong agreement that the participants believed they were better prepared to be effective in teaching mathematics or science as a result of the courses.

Improved Teacher. The means ranged from a rating of 3.19 to 3.94. This indicates strong agreement that the participants believed they became an improved teacher of mathematics or science as a result of the courses.

Results indicated that the courses impacted teachers feelings about new teaching strategies. They reported good comfort levels with inquiry/standards-based instruction, student participation, group work, and writing/drawing. Teachers planned to incorporate these strategies into their teaching.

Inquiry/Standards-based. The means ranged from a rating of 3.08 to 3.91. This indicates fairly strong agreement that participants felt they could use more inquiry-based or standards-based activities in teaching mathematics or science.

Students Develop Strategies. The means ranged from a rating of 3.08 to 3.96. This indicates fairly strong agreement among participants that they planned to give their students more opportunities to develop their own strategies to solve problems or to do investigations as a result of their involvement in the courses.

More Group Work. The means ranged from a rating of 3.06 to 3.77. This indicates fairly strong agreement that as a result of the courses, the participants planned to have their students work together more in pairs, small groups, or cooperative groups to solve problems or to do investigations and activities.

Writing/Drawing. The means ranged from a rating of 3.00 to 3.91. This indicates fairly strong agreement among participants that they planned to ask their students to write and draw more to demonstrate their understanding of mathematics or science as a result of the courses.

Participants in MUSI's professional development also indicated that, as a result of their UWM course participation, they better understood MPS curriculum, process skill outcomes and standards, and different teaching strategies.

Facilitate MPS Curriculum. The means ranged from a rating of 3.04 to 3.61. This indicates fairly strong agreement among participants that they had a better understanding of how they could facilitate the MPS curriculum in their classrooms or schools as a result of their involvement in the courses.

Understand Science Outcomes/Core Unit. The means ranged from a rating of 2.78 to 3.61. This indicates agreement among participants that as a result of the courses, they have a better understanding of the MPS science process skill outcomes and core content standards.

Utilize Different Approaches. The means ranged from a rating of 3.12 to 3.50. This indicates agreement among participants that they now have a better understanding of and are better able to utilize different approaches to teaching as a result of the courses.

Additionally, when participants in MUSI courses were asked to: "Describe something you have done differently in your teaching as a result of taking this course," they reported changing their instructional practices based on their direct involvement with the coursework. They said that they now place more emphasis on inquiry-based learning by increasing the use of hands-on activities with students and having students work more in small and/or cooperative learning groups. In open-ended responses, participants listed opportunities for discourse, discussion, and sharing among colleagues as the greatest strengths of the courses and expressed an appreciation for the course content (standards, teaching strategies, and new ideas/ information), effectiveness of the instructors, and hands-on activities and/or field trips.

Comments from MSRTs

The MSRTs reported that the UWM courses were beneficial for various reasons. A number of MSRTs said that they observed definite changes in teachers' classroom behaviors as a result of the courses. This was particularly evident when the teachers and the MSRT from their school were enrolled together in the same courses. Teachers and MSRTs discovered and learned together, and classroom teaching changed. Other MSRTs said the classes served as a tool to motivate the teachers to try new and different teaching strategies. Still, other MSRTs saw the courses as a way to "get their foot into the classroom." Some typical comments included the following.

- I had nine teachers enrolled in the elementary math course. I went to the course with the teachers so I knew what was covered. I thought the impact was very, very high. I saw them doing the actual activities in the classroom. If they didn't understand something, they would ask me for an explanation or ask me to model that part.
- I think the courses have had a significant impact. I know it has literally changed the way they do math in the building. They are so excited about doing some different things as a result of this course. I've had direct comments and I've seen the differences in the way they do things.
- At one school practically the entire math department was in the UWM class. The teachers asked me to bring in a math program and we did a mini-pilot. That was the direct result of the class. I've also had another teacher comment to me that she got so much out of the graphing calculator class.
- The courses have had a definite impact on their (teachers') attitudes. The teachers have decided that they can be more in control of their math program. They are also piloting an NSF mathematics program because they did some of that during a UWM class, that renewed their interest.

- As a result of a UWM algebra class, one teacher changed her entire class. The teacher went from repetitious arithmetic to rich problems dealing with concept development. Also, other teachers felt very comfortable talking about teaching issues as a result of the UWM classes.

Reports from Teachers

Data regarding professional development was also available from teacher surveys. Initial and follow-up survey results indicated that elementary teachers engaged in less professional development both in mathematics and science than middle and high school teachers. (See Table 6.) However, progress has been made. Elementary teachers increased their participation in professional development in the area of mathematics both in year one and year two of MUSI implementation.

The percent of elementary teachers who participated in more than five hours in mathematics professional development went from 31.5% in 1995-96 to 39.8% in 1996-97 and to 48.2% in 1997-98. The percentage of middle and high school science teachers participating in professional development more than five hours per year increased dramatically from 1995-96 to 1996-97. Percentages increased from 42.7% to 60.3% for middle school teachers, and from 43.3% to 62.9% for high school teachers.

Table 6. Number of Hours of Professional Development of Teachers in First Wave Schools

Item	Grade Level	n	Frequency Percentages				
			0 hours (1)	1-5 hours (2)	6-15 hours (3)	16-35 hours (4)	36 + hours (5)
What is the total amount of time you spent on staff development in mathematics? (Pre-MUSI includes time spent in 1995-96. MUSI data includes time spent from 1996-97 and 1997-98.)	K-5 '95-96	419	22.9	45.6	16.2	10.0	5.3
	'96-97	279	23.3	36.9	25.4	7.2	7.2
	'97-98	276	18.8	33.0	25.4	13.0	9.8
	6-8 '95-96	79	15.2	19.0	12.7	25.3	27.8
	'96-97	71	18.3	21.1	16.9	19.7	23.9
	'97-98	70	8.6	27.1	30.0	12.9	21.4
	9-12 '95-96	46	13.0	13.0	30.4	15.2	28.3
	'96-97	40	10.0	20.0	25.0	12.5	32.5
	'97-98	41	17.1	9.8	29.3	26.8	17.1
What is the total amount of time you spent on staff development in science? (Pre-MUSI includes time spent in 1995-96. MUSI data includes time spent from 1996-97 and 1997-98.)	K-5 '95-96	406	20.9	41.9	26.4	5.4	5.4
	'96-97	274	19.7	44.5	22.6	8.4	4.7
	'97-98	273	19.8	46.5	23.4	5.1	5.1
	6-8 '95-96	75	25.3	32.0	18.7	9.3	14.7
	'96-97	63	23.8	15.9	25.4	19.0	15.9
	'97-98	63	7.9	30.2	23.8	17.5	20.6
	9-12 '95-96	30	33.3	23.3	20.0	23.3	0.0
	'96-97	27	7.4	29.6	18.5	18.5	25.9
	'97-98	27	7.4	40.7	25.9	11.1	14.8

Survey data indicated that middle and high school teachers are more likely than elementary school teachers to share ideas and materials about mathematics and science teaching with other teachers on a regular basis in their school (see Table 7). This appears to be related to the structural mechanisms available for meeting in secondary schools (teams/families, curricular departments) which are absent in many elementary schools. Elementary school teachers have few opportunities to meet and share according to grade levels or subject areas.

Table 7. Teachers Sharing Ideas and Materials in First Wave Schools*

Item	Grade Level	n	Mean (SD)	Frequency Percentages				
				Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
Teachers in this school regularly share ideas and materials about mathematics.	K-5 pre	427	3.21 (1.08)	7.0	19.7	27.9	36.3	9.1
	post	282	3.39 (1.15)	5.7	22.7	12.8	45.0	13.8
	6-8 pre	85	3.58 (1.12)	3.5	17.6	17.6	40.0	21.2
	post	71	3.42 (1.19)	7.0	21.1	9.9	46.5	15.5
	9-12 pre	46	3.83 (1.04)	2.2	13.0	10.9	47.8	26.1
	post	41	3.85 (1.01)	2.4	12.2	7.3	53.7	24.4
Teachers in this school regularly share ideas & materials about science.	K-5 pre	422	3.20 (1.03)	5.2	21.8	28.9	36.3	7.8
	post	277	3.16 (1.10)	7.6	22.7	23.1	39.0	7.6
	6-8 pre	77	3.22 (1.22)	13.0	15.6	18.2	42.9	10.4
	post	63	3.52 (1.31)	7.9	19.0	14.3	30.2	28.6
	9-12 pre	31	3.58 (0.88)	0.0	16.1	19.4	54.8	9.7
	post	27	3.70 (1.30)	11.1	11.1	0.0	51.9	25.9

*Pre refers to the initial survey and post refers to the follow-up survey.

Professional Development and the MSRTs

The professional development component of MUSI was not just for teachers. Beginning MSRTs expressed considerable apprehension about their new roles and how they were to become agents of change. During their initial interviews with evaluators in August 1996, the first cadre of MSRTs shared these concerns which are represented in the following sample comments.

- (My burning issue is) how will we transform the teaching of math/science in our schools? What are strategies to bring about change? What activities will we do in schools to help us establish rapport and then what is our vision in the schools? What do we see ourselves doing?
- (I would like training in the following areas:) How to be a change agent. How to work with adults. What are the resources that are out there.

Although many of the MSRTs had some experience in working with adults and some had prior teaching experience in professional development programs, most of this experience was limited and in settings other than what was expected in the role of a MSRT. Therefore, as a group, they needed their own unique blend of professional development that was markedly different than what was provided to the teachers. Their needs centered around goals of MUSI, leadership skills, working with adults, and collaboration. Professional development for the MSRTs was provided primarily through preliminary institutes prior to the beginning of each school year and through weekly meetings/seminars.

Preliminary Institute for MSRTs Year 1

The preliminary institutes provided the initial preparation for the MSRTs. The first wave of 25 MSRTs participated in a training institute from 28 August to 30 September 1996. There were eight goals of the first institute. Participants in the institute completed questionnaires in which they were asked to rate the success of each goal attainment. Overall mean scores for each of the eight institute goals are shown in Table 8. The goals receiving the highest scores were Goals 8, 4, and 6. The development of collegiality among MSRTs, goal 8, received the highest mean score. The next highest mean scores regarded increasing the MSRTs knowledge of standards-based, content-rich mathematics and science(goal 4) and knowledge base of equity issues and strategies (goal 6). The scores and comments indicated that the participants viewed the institute as helping them develop an understanding of the overall goals of MUSI, but not providing them with enough knowledge and skills to be an effective MSRT.

Table 8. Mean Scores for the Institute Goals (5=high; 1=low)

	Goal	Mean	SD
1.	Provide MSRTs with an Understanding of MUSI	2.28	0.78
2.	Develop an Understanding of the MSRT Role	2.03	0.94
3.	Increase MSRTs' Knowledge Base of the School Change Process	2.41	0.79
4	Understand Standards-Based, Content-Rich Math and Science	2.85	0.83
5	Increase MSRTs' Knowledge Base for Action Planning	2.41	0.88
6	Develop MSRTs' Knowledge Base of Equity Issues and Strategies	2.83	1.02
7	Develop MSRTs' Peer Interaction and Mentoring Skills	1.99	0.97
8	Develop Collegiality Among MSRTs	3.08	0.89

Following the first institute, some individuals felt apprehensive about entering the schools and indicated they would like more training before entering the schools. Results of a questionnaire and written reflections indicated that additional training would be needed in most of the eight goal areas. The MSRTs entered the institute with strengths in either mathematics or science. During the institute they enriched their understanding of both the national mathematics and science standards, of connections between these two sets of standards, and of examples of standards-based, content-rich mathematics and science (Goal 4). However, the level of knowledge and understanding of their non-strength area was still limited.

The development of skills in peer interaction and mentoring were weak aspects of the institute. Although the MSRTs indicated that the institute did make them think carefully about their questioning and observation techniques and how to interact with teachers in a non-evaluative manner, many acknowledged that they needed more training in this area along with training in communication skills.

Interviews with the first wave MSRTs revealed that they had high expectations of their preparation for their new roles. For some, it was the reason they accepted the position. Many were disappointed. In their eyes, the preparation was haphazard, sporadic, fragmented, and poorly planned. The positive aspects that they did mention were regarding the quality of particular presentations (those by Enid Lee or UWM staff); however, overall, the first year preparation and training provided received poor marks by the first-wave of MSRTs.

The MSRTs felt that their needs were primarily in leadership training and developing communication skills, but that they did not receive sufficient training in these areas. They also reported that they needed substantially more training in the science standards and school change than they received. Instead of formal presentations, they wanted follow-up, practical application through activities i.e., role playing, enactment and observations of contextual situations. This would have been more consistent with the approach that they were expected to facilitate in their schools. Overall, they described their training as disorganized, and that it "jumped from one mini lesson to the next mini lesson" with no continuity or focus.

- I got frustrated with the training because I didn't see it going anywhere. The purpose was not always quite clear. It seemed like we jumped from this mini lesson to the next mini lesson and had no time to discover what these mini lessons were supposed to be telling us. I think we could have had more training on change. Part of our goal is to narrow the gap. We haven t been presented with any clear cut strategies to do that. There was never any feedback, and there was never any follow-up.

The MSRTs saw the role of the university as providing expertise, support, resources, and evaluation. Comments made about the presentations, support, and accessibility of representatives from UWM were very favorable. MSRTs reported that the training from UWM staff was

"excellent" and that they needed more time from the university. Several MSRTs also recognized the large role UWM played in the evaluation component of MUSI.

- UWM has, and I hope, will continue to do demonstrations. We hope to get more training on what a model classroom looks like. They will be running workshops for professional development not only for the MSRTs, but for math and science teachers. They are offering classes, in some cases, at a reduced rate for just the cost of materials, and they're giving college credit for it. Who wouldn't jump at that.
- UWM's role is training and support. I think UWM has responded very positively. Whenever I needed anything or dealt with several of them, it has been very positive. I am very pleased with UWM.

Preliminary Institute for MSRTs Year 2

A second institute in the beginning of the second year of MUSI was conducted from 11-22 August 1997. The purpose of this institute was to prepare a cadre of 40 MSRTs for the second year of MUSI implementation. Nineteen MSRTs returned following the first year of implementation and 21 were new to the initiative. The evaluation data was gathered from two sources: open-ended items throughout the institute and a questionnaire at its conclusion. Using results of the first institute to guide planning, goals were reduced to four for the second institute. Responses were analyzed and summarized in relation to the four goals: (a) targeting, (b) belief system, (c) building relationships, and (d) mobilizing toward targets.

Evaluation results indicated that the goals for the institute were all met. Comments were more positive when compared to the previous year; MUSI planners were learning and revising. The institute helped participants focus on MUSI targets and understand the MUSI drivers and benchmarks. Activities were well chosen and helped the MSRTs feel more competent. They reported that they gained valuable strategies which enabled them to work more effectively with both students and school staff on issues of efficacy and equity. This strengthened their own convictions that all students can achieve to high levels. The activities chosen enhanced collegiality and improved working relationships because of the emphasis placed on communication strategies and the strengths and talents of the MSRTs. Through the various activities provided, the MSRTs gained knowledge of current mathematics and science programs and initiatives, developed specific strategies and skills to help their schools and were able to begin generating initial plans for their schools. In addition, the participants indicated that they benefited from their increased awareness of the various local and national resources available to parents, teachers, and students.

The second year institute provided not only a starting point for the Second Wave MSRTs in helping them prepare for their new role as MSRTs, but also provided new and valuable information for the First Wave MSRTs. The new group of MSRTs realized they would have many challenges ahead of themselves as they entered into their school communities and began to work in this new role. Most of the individuals felt that the training they received was helpful in building their repertoire of strategies and skills for entering their schools but also acknowledged they needed to get into the schools in order to have a better sense of what further preparation and development was needed. The questionnaire and written reflections indicated that for the most part, the training provided was valuable and met all four institute goals.

Institutes Combined

Following both institutes, MSRTs reported an insecurity about content in either mathematics or science and a need for more knowledge about standards. But most of all, they wanted specific strategies to tell them how to develop working relationships in their buildings and how to reform mathematics and science teaching in their schools.

Many MSRTs were satisfied with the second year institute and reported that it exceeded their expectations. They commented, "Well-planned and organized," "Better then last year." and "I have a better understanding of data analysis; the institute was better organized and prepared me with an action plan on day one." Many more of the MSRTs felt ready to enter the schools at the conclusion of the second institute compared to the first wave of MSRTs. Since this institute included first wave MSRTs along with new MSRTs, one could speculate that working side by side with experienced MSRTs who offered suggestions and encouragement instilled confidence in this new group of MSRTs. When asked, "Do you feel ready to enter your schools?" one MSRT probably verbalized the feeling of many when he/she said, "No, but that's how I always feel at the start of something new and a new year, but I'll get over it."

Overall, the data from the MSRTs indicated that their professional development program over two years clearly articulated the goals of MUSI. Interviews with the MSRTs were consistent with MUSI goals except in one area, the blending of mathematics and science. Some of the MSRTs themselves appeared uncomfortable and reluctant to cross disciplinary lines. MUSI goals rang forth loud and clear throughout interviews with the MSRTs. The MSRTs wanted to increase the achievement of all students in mathematics and science and to reduce the gap between diverse groups of students, particularly white and non-white students. The MSRTs understood that this effort must be systemic and that it would take a community of learners to do it. The MSRTs believed that the way to implement these goals is to change the way teachers teach mathematics and science in MPS. In their interviews, they said that instruction should be standards-based and taught using hands-on inquiry based instruction that integrates thinking. The following sample comments reflect some of their feelings.

- MUSI is an agreement, not a grant, between the National Science Foundation and the Milwaukee Public Schools, to improve student achievement and to reduce the gap between ethnic and racial groups in Milwaukee. It is based on a model of a community of learners, so it just doesn't involve students. The whole project can draw on resources from the National Science Foundation, from the University, and from the communities. It's really a great way to focus on math and science.
- MUSI is trying to increase math and science performance of students, to create a community of learners, to get a hands-on concrete approach to math and science that makes sense. MUSI is trying to get away from what I observed on my first day when I walked into my assigned school. I saw this teacher with a tall pile of worksheets stacked in different directions. Each sheet had approximately 35 problems, three-digit multiplication by three-digit multiplication. I said give these kids a calculator.
- MUSI is a vision; it's a vision of all of the community, not just the students, not just the teachers, not just the administrators. It's a vision that everyone will be able to appreciate the beauty of math and science; to understand how they're using math and science in their daily lives.

Weekly Meetings/Seminars

Throughout both years of MUSI, the MSRTs met approximately once a week for a full day. The intended purpose was to provide professional development for the MSRTs, identify concerns, and develop strategies for use in the schools. Although this weekly format provided an appropriate mechanism for these goals, the interviews and focus questions from the MSRTs indicated that too much time was spent on administrative business rather than on professional development.

The MSRTs comments indicated that the vast majority of them found these weekly meetings "frustrating." Many MSRTs felt that too much time was spent on administrative business rather than on professional development.. The key suggestions for improvement made by the MSRTs

involved recognizing their input into planning and provision of opportunities for sharing. Several key comments were as follows.

- We needed more input into the agenda. We kept saying we needed more of this and more of that, and we never got it.
- I would like to see some long range agenda. Some of the meetings were not really useful. MSRTs tried using various methods to have some input into what would happen, and all of those attempts did not work very well.
- I would like to see a series of topical areas dealt with in meaningful ways—math standards, science standards, team building, asking questions in the classroom, cooperative learning. These topics are now either not covered or covered superficially.

Professional Development for Principals and MUSI Schools

Principals, leaders, and staff in new MUSI schools needed professional development to prepare them for what MUSI had to offer. Most were not familiar with a community of learners perspective. They did not know what an MSRT was or what they could provide. In fact, according to the MSRTs, many were unprepared and unmotivated to change. The training that new MUSI principals received was through meetings that were held on a poorly planned, disconnected schedule. In fact, during the first year of implementation, the first several meetings occurred after MSRTs were already in MUSI schools.

The MSRTs reported that this was too late. They believed that the principals in MUSI schools should have received more training and much earlier. The principals needed far more understanding of the goals of the program and the role of the MSRT, but little training was provided for them. What was done, was done too late. This lack of training of principals caused serious communication problems and placed the MSRTs in difficult and compromising situations.

- I think there needed to be training not only for us, but I think there needed to be more training for the schools that we were going to. There were a lot of misconceptions that we were coming in to be the math teachers and have groups of students.
- The principals were given only one 45 minute session about what my job was. They knew nothing. They had no idea of what was going on when we got to their schools. And, if the principals didn't know, then their staffs didn't know either.

The Action Force: The COSMIC Center

The action forces of the Milwaukee Urban Systemic Initiative (MUSI) discussed thus far were the work of the Mathematics/Science Resource Teachers (MSRTs) and MUSI's professional development program. The third action force consisted of a mathematics, science, and technology center (The COSMIC Center). The original MUSI plan called for a clearinghouse of community learning activities in mathematics, science, and technology that was to be ready by the 1996-97 school year. It was to be staffed by a full time coordinator and supplemented by the involvement of the MSRTs. However, the final agreement between NSF and MPS eliminated the COSMIC Center's full time coordinator position which left management to an already busy MUSI leadership team.

As the implementation of MUSI progressed, it became clear that the strength of the initiative was at the school level. Classroom by classroom and school by school, MUSI was making its impact through the strength of the MSRTs and professional development. Emphasis on the third force, the COSMIC Center, decreased.

During the initial interviews with the MSRTs, implementation of the COSMIC Center appeared to be a long way off. The comments of the MSRTs regarding the COSMIC Center fell into three categories. First, there were those MSRTs who shared the vision of the MUSI plan and appeared enthusiastic to have a role in COSMIC, although that role was undefined for most. Second, there were those who questioned the vision. They felt a clearinghouse was not as exciting as it may first appear. They were concerned that teachers would not use the COSMIC Center and/or that expensive equipment and resources would go under-utilized. Third, most MSRTs commented on the slowness of Center's start-up and the severe lack of supplies and resources for the MSRTs.

- I know that some of our leaders have their own impression of what the COSMIC Center is going to look like. I don t think that everybody agrees with that. So often money is invested in materials and not invested in meaningful follow through on personnel. It is not empowerment to be able to turn a computer on and use one tiny portion of what it can do. It s like a kid in a candy store. You want so much that you don t look realistically at how it will be used. I don t think that people plan well. They look at the toy, but they don t look at how to use that toy.
- I envision the COSMIC Center as a wonderful place where we can have all kinds of math resources, as well as science and technology, in one central location.
- The Center was envisioned as a place where at least once a week we would come as a group to receive training, to be our hub. I envisioned having a desk and computer access. There would be other MSRTs there and resource materials. That has not materialized.
- The COSMIC Center is a hollow building. It s not what it is intended to be. So the COSMIC center is just a place, not a reality.

The Cosmic Center is slowly developing as a physical space. It now consists of offices, meeting rooms, work areas and storage space, and demonstration labs for MUSI and is located in an MPS converted office building. The COSMIC Center comprises the second floor of the building which also houses the district's special education offices and the Technology Training and Support Center. Staff from the Divisions of School Technology Support and from Curriculum and Instruction relocated their offices from the central administration building to this building. Currently, numerous MUSI classes and demonstrations are held at the COSMIC Center. The MSRTs now have lockers and storage space available to them at this site. Use by parents and community members is almost non-existent.

Thus far, this evaluation has emphasized the forces of MUSI, its driving perspective of community and the action forces which will move MUSI forward including the MSRTs, professional development, and the COSMIC Center. It is the action of these MUSI forces on six bases that will lay a strong foundation for excellence in mathematics and science education for all. As discussed previously, these bases or elements were developed the NSF Drivers and cross-variables and consist of (a) standards-based curriculum, (b) inquiry-based teaching and learning with use of technology, (c) assessment, (d) critical leadership and management, (e) equity for all, and (f) robust school-based supports. The next section of the summary findings of the two year evaluation of MUSI is organized by these six bases.

Standards-based Curriculum

The Milwaukee Public Schools has been engaged in major curriculum development. At the center of the MPS approach to change is a focus on standards. The belief in MPS is that students can and do achieve at high levels when student expectations are articulated with absolute clarity about what students must understand and be able to do (the standards and key assessments). Thus, every learning experience must be organized around a clear understanding of the concepts and skills expected from students.

The MPS Learning Framework

Using national and state standards, MPS has developed a learning framework for the district. Ten teaching and learning goals that span all grades were identified from the input of over 1000 teachers, principals, parents, and community members. These goals drive the learning framework in MPS. At the next level of specificity are grade-span standards based on NRC and NCTM standards as well as state outcomes standards. Grade-span standards serve as key organizing points and indicators of progress. Proficiency requirements for the class of 2004 include a set of projects and on-demand assessments. Students take performance assessments at least once in each grade span: elementary, middle, and high school. Performance assessments are based on the grade-span standards and are incorporated into the school accountability system. Finally, MPS developed grade level benchmarks which specify the concepts and skills students should master at every grade or every two grades and are derived from the grade span standards.

To operationalize the learning framework, Milwaukee's standards based strategy for reform includes the following elements:

- Identify standards at grade spans which reflect commitment to high content and inquiry learning.
- Develop corresponding proficiency standards and/or district assessments.
- Identify benchmark skills for every grade or every two grades.
- Establish accountability systems for students and adults that reflect the standards.
- Align curriculum with the standards.
- Mobilize supports for students and teachers, including safety nets for students and staff development and mentoring for teachers.
- Engage students and all district staff in a constant monitoring-planning-action cycle.
- Align all other systems and resources to support student achievement of the standards.

With the assistance of the North Central Regional Laboratories (NCREL), the MPS learning framework was aligned with national and state standards and translated into appropriate grade level learning expectations and student performances. Curriculum and resource materials are being adopted by the school district to support the learning framework.

The goals of MUSI are consistent with the MPS learning framework and plans for implementation. One of the purposes of the internal evaluation over the past two years was to determine strengths and weaknesses in schools that promote or hinder progress toward MPS's curricular goals. The data revealed three patterns that provide direction for planning for future MUSI implementation. First, MPS staff members are lacking in knowledge of the standards and assessment; second, there is a weakness in teacher content knowledge particularly in science; and third, there is a feeling of hopefulness because there are signs of change.

Need for Standards and Assessment Knowledge

During the site visit interviews, principals thought that teachers were very positive about the implementation of standards-based instruction; however, the teachers told researchers that they needed to have all teaching and learning standards (national, district, and school) clarified better. Overall, teachers did not feel comfortable with the national standards in mathematics and science. However, teacher surveys did indicate that high school teachers were more familiar with standards than elementary or middle school teachers.

Even the MSRTs expressed concerns about their own unfamiliarity with either the NCTM mathematics standards or the NRC science standards. The MSRTs also reported needs in

assessment knowledge. They felt weak in their understanding of the new local and state assessments, particularly in science and reported that they did not feel they had the skills or the resources to adequately assist teachers and students in preparing for the new assessments.

Inadequacies in Content Knowledge

Most participants in MUSI felt an inadequacy in content knowledge. Elementary and middle school science teachers reported that they are less confident and prepared than high school science teachers, and elementary and middle school science teachers feel less confident than mathematics teachers. Even the MSRTs who were hired to facilitate both mathematics and science teaching reform expressed concerns about their strength in one area and their weakness in the other. For example, typical comments were, "I feel confident with my math background but only okay with science," "I am insecure in the field of science," and "I need training in the area of math." All of the MSRTs felt a need for more discussion of current elementary curriculum in science and mathematics, especially at the elementary level.

Survey results indicate teachers at all levels feel that mathematics is valued more than science in their schools. One of the greatest concerns expressed throughout the internal evaluation reports is the lack of science taught, particularly in elementary classrooms. This is explored further in the next section on Teaching/ Learning and Technology.

Change is in the Air

Although teachers continue to have further needs for knowledge about standards and content, progress has been made in the two years of MUSI implementation. Teachers of both mathematics and science are becoming more familiar with national standards. On the follow-up survey, more teachers at all three grade spans (with the exception of high school mathematics teachers who were already at the highest levels of 82% and 76%), reported that they were either "very familiar" or "somewhat familiar" with national standards than they reported on the initial MUSI survey (see Table 9).

Table 9. Familiarity with National Standards in First Wave Schools

Item	Grade Level	n	Frequency Percentages: Not at all (1)	Heard of, but don't know much about (2)	Somewhat (3)	Very (4)
How familiar are you with the national mathematics standards developed by the National Council of Teachers of Mathematics?	K-5 pre	423	12.8	38.5	35.5	11.1
	post	282	6.4	23.4	47.5	22.7
	6-8 pre	85	7.1	23.5	31.8	35.3
	post	71	9.9	15.5	40.8	33.8
	9-12 pre	46	6.5	10.9	43.5	39.1
	post	42	2.4	21.4	42.9	33.3
How familiar are you with the national science standards developed by the National Research Council?	K-5 pre	412	21.4	42.7	24.3	6.8
	post	273	12.1	33.7	45.4	8.8
	6-8 pre	77	16.9	41.6	29.9	7.8
	post	63	4.8	28.6	54.0	12.7
	9-12 pre	31	16.1	35.5	41.9	6.5
	post	27	7.4	25.9	44.4	22.2

This change was quite remarkable in the area of science where elementary teachers increased by 23.1 percentage points, middle school teachers increased by 29 percentage points, and high school teachers increased by 18.2 percentage points. Additionally, more middle school science teachers reported that they are beginning to utilize the MPS curriculum.

Although interview data indicated that the poor quality of mathematics curriculum materials often hinders reform, some teachers and students showed a sense of excitement about changes occurring in mathematics instruction. In the schools that were piloting new mathematics programs at the elementary and middle school levels, there were more positive comments about curriculum and materials. Since the curriculum being piloted was adopted by the school district, one could expect this "excitement" to spread to additional sites.

So, while teachers are learning about the changing curriculum in mathematics and science, how are their teaching strategies beginning to align with changing content? This question is addressed in the next section, Teaching/Learning and Technology.

Teaching/Learning and Technology

From the *Landscape Study of Mathematics and Science* (1995), the Milwaukee Public Schools (MPS) learned that too much classroom teaching of mathematics and science was traditional, textbook and worksheet driven, rote, and repetitive, disjointed and uncoordinated. Although there were islands of reform, they were too far and few between for most of the students in MPS. Classrooms lacked rich, contextual activities, adequate equipment, cooperative learning groups, and adequate use of supportive technology.

One question for this evaluation is, what is different about what MPS teachers do and how students learn now compared to what occurred prior to MUSI? The results of the internal evaluation reports over the past two years indicated that MUSI had indeed changed aspects of classroom instruction and that there was also much ahead to be done. Instruction in the following discussion is categorized into three areas: teaching practices/strategies, technology, and time.

Teaching Practices/Strategies

There was strong evidence to indicate that the strength of MUSI during its two years of implementation was a change in attitude toward mathematics and science instruction. Site visit interviews with principals, teachers, students, and MSRTs all indicated more teachers were interested in teaching reform than had been in the past. Principals reported that students' classroom behavior had changed and that there was a lot more excitement in classrooms. Hands-on, problem solving skills were being emphasized. They felt the strength of MUSI was in the MSRTs who were a dedicated and enthusiastic group of individuals committed to reform. A number of students reported an increase in teachers' enthusiasm and more creative work, and a few noted an increase in the use of technology. See Table 10 to compare the frequency of instructional practices from the teacher initial survey to the follow-up survey in First Wave schools.

But this is only a beginning. MUSI still has much to do to turn the excitement and motivation it has generated into more findings than these cited. During site visit interviews, principals said that despite the efforts of the MSRTs, too many teachers still cling to traditional models of instruction for both mathematics and science, and the survey results from teachers backs them up. As they self-reported, too many teachers are infrequently using inquiry-based, hands-on instructional practices such as on only a monthly or weekly basis rather than daily. They view these strategies as isolated events rather than the ongoing way to think about teaching indicating that they have not conceptualized the intent of the reform.

During the site visits to a sample of First and Second Wave schools in Spring 1998, mathematics and science teaching and learning were observed through classroom observations. A rubric was developed to evaluate the observed lessons (see Appendix B.) Each lesson was evaluated for the level of inquiry as an indicator of standards-based instruction.

Table 10. Frequency of Instructional Practices in First Wave Schools

Item	Grade Level	n	Frequency Percentages				
			Never (1)	Once/Twice a Semester (2)	Once/Twice a Month (3)	Weekly (4)	Almost Daily (5)
Students use manipulative materials to help them understand math concepts.	K-5 pre	426	1.6	5.4	18.1	38.5	36.4
	post	282	0.7	2.5	11.7	46.8	38.3
	6-8 pre	85	3.5	11.8	41.2	32.9	10.6
	post	71	4.2	14.1	26.8	47.9	7.0
	9-12 pre	46	15.2	28.3	26.1	21.7	8.7
	post	41	22.0	26.8	22.0	19.5	9.8
Students make conjectures and explore different methods to solve mathematics problems.	K-5 pre	423	4.5	8.0	19.6	40.4	27.4
	post	281	2.8	5.0	20.3	42.3	29.5
	6-8 pre	85	7.1	7.1	20.0	41.2	24.7
	post	70	2.9	2.9	28.6	55.7	10.0
	9-12 pre	46	10.9	8.7	19.6	37.0	23.9
	post	41	4.9	4.9	41.5	39.0	9.8
Students conduct student-generated experiments with outcomes unknown to them and in which students control variables.	K-5 pre	420	26.9	24.5	27.6	18.6	2.4
	post	272	11.4	23.2	40.1	23.2	2.2
	6-8 pre	77	13.0	41.6	26.0	15.6	3.9
	post	63	1.6	39.7	39.7	15.9	3.2
	9-12 pre	30	33.3	26.7	26.7	3.3	0.0
	post	27	11.1	51.9	22.2	14.8	0.0
Students perform demonstrations with materials by following a prescribed set of procedures in order to observe a scientific phenomenon.	K-5 pre	420	15.7	23.8	37.1	21.2	2.1
	post	274	8.0	20.1	44.2	26.3	1.5
	6-8 pre	77	3.9	18.2	48.1	23.4	6.5
	post	63	1.6	10.9	46.0	27.0	6.3
	9-12 pre	31	9.7	6.5	32.3	45.2	6.5
	post	27	7.4	3.7	40.7	44.4	3.7

The observations support the reports of teachers that inquiry-based practices are limited. The components of inquiry included examination of investigation and problem solving, use of materials and tools, and student explanations based on their observations. The results for inquiry are shown in Table 11. The overall mean rating for all levels and both disciplines was 2.84. The highest rating for inquiry was 3.36 in elementary school science. The lowest rating was 2.20 in middle school science.

The use of inquiry-based instruction was evident in only a small portion of the observed mathematics lessons. The observations that were rated low relied on rote activities, the discouragement of exploring anything but the "right" answer. Those classroom teachers approaching or accomplishing inquiry-based mathematics instruction employed techniques such as probing and pushing students for their justification and explanation of the path taken to their solutions, allowing students to explore alternative paths, and allowing students to share their strategies amongst themselves.

The majority of the science classroom observations that rated low involved rote or pencil and paper work and allowed for little or no inquiry and the teachers stressed only one way or the "correct" way to use the materials and equipment. The higher inquiry ratings reflected science lessons in which students were defending their conjectures and assuming responsibility for their own learning. Teachers allowed students to explore various and alternative methods of using materials and equipment and allowed students to develop strategies for solving their own problems.

Table 11. Level of Inquiry Observed in Site Visits, Spring 1998

	n	1 (low)	2	3	4	5 (high)	Mean Rating
Mathematics							
Elementary	16	31.3%	12.5%	18.8%	18.8%	18.8%	2.80
Middle	9	22.2%	11.1%	33.3%	11.11%	22.2%	2.80
High	6	16.7%	16.7%	16.7%	33.3%	16.7%	2.89
Science							
Elementary	14	0%	28.6%	28.6%	21.4%	21.4%	3.36
Middle	10	30.0%	30.0%	10.0%	0%	20.0%	2.20
High	7	42.9%	14.2%	0%	0%	42.9%	2.85
Overall Rating	**62**						**2.84**

Technology

Use of technology in classroom teaching practices was not changing as substantially as hoped by MUSI planners (see Table 12). In general, teachers appeared satisfied with availability of technological equipment. In initial surveys of teachers, the availability of technology, including calculators, computers, computer software, and lab equipment, was not cited as a major obstacle to teaching mathematics and science. In fact, 11% of elementary teachers and 28% of high school teachers listed availability of technology as a major support. Despite this, the frequency of students' use of computers and calculators clustered around the monthly to weekly levels rather than almost daily for mathematics, and far less frequently for science. Students at all levels are more likely to use computers for mathematics than they are for science.

Table 12. Frequency of Students' Use of Computers and Calculators in First Wave Schools

			Frequency Percentages				
Item	Grade Level	n	Never (1)	Once/Twice a Semester (2)	Once/Twice a Month (3)	Weekly (4)	Almost daily (5)
How often do students use computers for mathematics?	K-5 pre	426	12.9	6.8	22.3	40.1	17.8
	post	280	9.6	11.8	20.0	36.1	22.5
	6-8 pre	46	37.6	16.5	22.4	17.6	5.9
	post	70	34.3	22.9	22.9	14.3	5.7
	9-12 pre	46	37.0	26.1	21.7	13.0	2.2
	post	42	54.8	19.0	9.5	16.7	0.0
How often do students use calculators for mathematics?	K-5 pre	427	25.8	21.8	30.0	19.2	3.3
	post	283	18.0	25.1	31.1	21.2	4.6
	6-8 pre	46	4.7	8.2	17.6	43.5	25.9
	post	71	2.8	2.8	19.7	40.8	33.8
	9-12 pre	46	0.0	8.7	4.3	32.6	54.3
	post	42	0.0	4.8	7.1	16.7	71.4
How often do your students use computers for science?	K-5 pre	417	50.8	18.2	18.9	10.8	1.2
	post	273	46.5	23.4	17.2	11.0	1.8
	6-8 pre	77	35.1	32.5	19.5	9.1	3.9
	post	62	25.8	40.3	16.1	17.7	0.0
	9-12 pre	31	22.6	41.9	25.8	9.7	0.0
	post	27	14.8	40.7	22.2	18.5	3.7

Use of computers as an integral part of mathematics and science instruction is a weakness among teachers at all levels. Analysis of the initial and follow-up survey results showed that for both mathematics and science, there was only minimal change in the frequency of students' use of computers at all three levels. In interviews however, many high school teachers said that they used computers two to three times weekly; their students reported less frequent use. In the elementary schools, students indicated that they used calculators to check their work rather than to generate it.

More change was noted in the use of calculators. Follow-up survey results indicate that 71.4% of high school mathematics teachers use calculators almost daily in their classes. Results also indicate that middle and high school teachers are more likely to integrate calculators into mathematics teaching on a regular basis than elementary teachers.

Teaching Time

During site visit interviews, teachers indicated, that although the work of the MSRTs was a considerable help to their instructional practices, their need for more time to teach was acute. Elementary teachers felt that the time they can allocate to mathematics and science teaching is far too short compared to middle and high school teachers. Science teachers at all levels are more likely than mathematics teachers to report that they do not have adequate class time to teach their subject area. Teacher survey results revealed that science is taught less than mathematics. More than half (53.9%) of the elementary teachers surveyed taught mathematics 181 to 241 or more minutes weekly while more than half (58.6%) of them taught science less than 61 minutes weekly.

Interview data also revealed a startling phenomenon: The presence of a science specialist in a school might actually decrease students' contact time with science. Only two MSRTs reported that good science instruction was taking place in classrooms in schools with a science specialist. It appears that the work of science specialists undermines the intent of the role to provide support, not replacement, of classroom teaching of science. Too many students have few science experiences because their access to the science specialist is limited, and their classroom teachers feel that the science specialists are fulfilling the demands of the science curriculum. In light of their considerable teaching demands and shortage of teaching time, classroom teachers are not teaching any additional science in their classrooms.

Despite these results, some progress is being made. Interviews with the MSRTs indicated that their level of awareness regarding these problems has increased and that in second year MUSI schools, more science is being taught in regular classrooms than last year. They also noted that classroom instruction is being better coordinated with the instruction of science specialists by restructuring schedules and requiring classroom teachers to assist with lab instruction. This pattern was noted only in second year MUSI schools suggesting that the longer MUSI is in a school, the greater is its impact on increasing science teaching time. The site visit interviews with teachers indicated that MUSI and the MSRTs are helping elementary teachers teach more science, or as one stated, "The MSRT is pushing me to teach science and not just math."

Assessment

The Milwaukee Public Schools have been engaged in major reform of assessment policies and procedures since 1991. The MPS assessment system emphasizes the ability to apply high level content knowledge to solve complex, real life problems and is aligned with high quality curriculum standards. It includes MPS designed performance based assessments and high quality standardized measures at every grade span. The district also uses graduation related performance assessments to help determine if students have met the district's graduation requirements in mathematics and science. MPS performance assessments are constructed by teachers with the involvement of university faculty and community members. Assessment design teams receive training and design assessments around MPS standards through a structured process. Assessment is a district priority which helps make teaching reform part of the assessment system in MPS. Performance based assessment is incorporated into curriculum adoption decisions, curriculum supports, and staff development. Feedback from the assessments is provided to teachers to help them improve their instruction.

The Progress Made

The goals of MUSI and the assessment system of the school district are well aligned. The work of the MSRTs and MUSI's professional development program advanced the assessment efforts of MPS in the area of mathematics and science. Survey results indicate that elementary teachers have increased their use of varied assessment practices. In the follow-up survey results, elementary teachers reported using open-ended questions more frequently than they reported in the initial survey for mathematics and science (see Table 13).

Table 13. Frequency of Selected Assessment Practices in First Wave Schools

Item	Grade Level	n	Frequency Percentages				
			Never (1)	Once/Twice a Semester (2)	Once/Twice a Month (3)	Weekly (4)	Almost Daily (5)
How often do you evaluate students' learning of mathematics by having them respond in writing to open-ended questions?	K-5 pre	426	32.2	18.3	22.8	20.0	6.8
	post	282	15.6	17.0	34.0	23.0	10.3
	6-8 pre	85	10.6	14.1	34.1	34.1	7.1
	post	71	5.6	19.7	28.2	32.4	14.1
	9-12 pre	46	17.4	39.1	21.7	21.7	0.0
	post	41	24.4	19.5	36.6	17.1	2.4
How often do you evaluate students' learning by having them respond in writing to open-ended questions?	K-5 pre	419	28.4	17.9	29.1	21.2	3.3
	post	273	16.5	20.9	36.3	20.9	16.5
	6-8 pre	77	6.5	2.6	23.4	42.9	24.7
	post	63	3.2	9.5	30.2	38.1	19.0
	9-12 pre	31	6.5	16.1	38.7	32.3	6.5
	post	27	14.8	11.1	22.2	37.0	14.8

Initial and follow-up survey differences indicated that teachers in First Wave schools are evaluating their students more with authentic performance tasks that require students to solve realistic problems and explain their reasoning (see Table 14). Additionally, middle and high school teachers of both mathematics and science reported a notable increase in their use of portfolio assessment and student reflection as part of assessment.

Table 14. Assessment of Learning with Authentic Performance Tasks in First Wave Schools

Item	Grade Level	n	Frequency Percentages				
			Never (1)	Rarely (2)	Once a month (3)	Twice a month (4)	Weekly (5)
How often do you evaluate students' mathematical learning with authentic performance tasks that require them to solve realistic problems and support their solutions by explaining their reasoning?	K-5 pre	423	10.4	22.5	19.6	20.1	27.4
	post	282	3.9	13.5	24.8	21.3	36.5
	6-8 pre	83	7.2	18.1	24.1	24.1	26.5
	post	71	2.8	8.5	15.5	35.2	38.0
	9-12 pre	45	4.4	37.8	22.2	15.6	20.0
	post	42	11.9	19.0	21.4	14.3	33.3
How often do you evaluate students' science learning with authentic performance tasks that require students to use materials or equipment, to collect and organize data, and to draw conclusions?	K-5 pre	412	14.1	30.3	25.5	15.5	14.6
	post	275	6.2	29.5	28.4	21.1	14.9
	6-8 pre	77	1.3	16.9	31.2	23.4	27.3
	post	63	0.0	22.2	19.0	33.3	25.4
	9-12 pre	30	0.0	26.7	23.3	23.3	26.7
	post	27	3.7	22.2	29.6	25.9	18.5

Strategies and Instruments That Help Facilitate Change

The MPS Department of Research and Assessment has provided monthly practice assessments for teachers. According to focus question responses from the MSRTs, many schools have started

using these practice performance assessments to improve teachers' understanding of how their teaching methods have to change in order to align with the new assessment policies and procedures of the district. MSRTs have found these assessments to be an excellent way to stress assessment, teaching reform, and common meeting time for teachers. The following comments show how MSRTs are utilizing assessment, specifically performance assessments, to move teachers toward changing the way they teach. One can see in their comments, how rewarding, yet slow and arduous, this process can be.

- The monthly science performance assessment and the math pilot have taken a front seat at this school. I am trying to plan, model, and discuss one science assessment each month with the teachers. The main step here is to look at student work and to figure out what happens next in the instruction process—how to align the science unit with what we learned from the assessment. This is no easy task and we are slowing plugging along as the little engine that kept repeating....I think I can...I think I can... I think I can. If the teachers do not make the connection to align their science instruction with the assessment, then these assessments are only isolated tasks. I too fall asleep saying, I think I can.. I think I can.. I think I can...
- Practicing proficiency-type assessments still needs targeting in my schools. There are a couple of teachers determined that this, too, shall pass and they can go back to teaching the old way.
- I can enhance the community of learners in my schools using the assessment of the month focus group because it includes all of the math and science. We meet at least once a month to practice, discuss, and review the current practice assessment.
- Assessment tools have gotten me into several classrooms. Teachers really responded well to the science assessments. I've modeled several lessons using the practice performance assessments. Teachers are more confident this year that their students will succeed.
- The math assessment is not given at this time in my schools, so the teachers do not seem interested in the practice assessments. In general, inservice is offered on banking days and other staff development opportunities center around topics other than math and science. Reading and language arts still seem to be areas of real concern and effort at the schools.
- A fourth grade teacher at one of my schools requested some assistance in teaching science. She stated that she taught science, but not in a way that was going to help her students be successful on performance assessments. She admitted that she wasn't really fond of science and successfully avoided teaching it throughout her career by teaming with others, each teaching their favorite subject to all classrooms.

Leadership and Management for Mathematics and Science

The data collected over the past two years reflects just how important leadership is in providing a platform for change and the supportive scaffolding necessary for school-wide reform. The proposal for reforming mathematics and science instruction in the Milwaukee Public Schools called for systemic leadership. This was to come from three groups of people: the MUSI leadership team, the school principals, and the MSRTs.

The MUSI Leadership Team

MUSI had a difficult beginning. MPS planned for a start up in January 1997; however, conversations with NSF prompted an earlier start in August 1996. Additionally, MUSI administration was reduced. The director of the COSMIC Center was eliminated from the proposal. These changes placed considerable strain on the MUSI leadership team. As one MSRT commented, "They had a vision in mind, but things happened so quickly, there was not enough thought given to implementation."

The original MUSI leadership team consisted of a director, assistant director, a representative from the MPS Department of Research, curriculum specialists for both mathematics and science, the principal investigator, and two co-principal investigators, one from MPS and one from UWM. The MUSI Director in year one was not the same as in year two. A second assistant director was added in year two. The MPS co-principal investigator left MUSI for another assignment. Thus, the MUSI leadership remained unclear due to changing roles, as well as illness of various members.

Another confounding factor for MUSI was the instability in MPS central office leadership. From 1993 to 1997, the school district had four superintendents each with differing emphases. Correspondingly, individuals in key leadership positions in the central administration of the district also changed throughout the planning stages and the first two years of MUSI implementation.

The MSRTs overwhelmingly spoke about the respect they held for the leaders of the MUSI leadership team as individuals and described them as "committed," and "hard working." However, the MSRTs felt they received changing and conflicting messages from their leaders. They were confused about who the leaders were and did not understand the various roles of people involved in MUSI including staff members from MPS Central Services and from UWM. The MSRTs perceived that communication and organization problems plagued MUSI and that MUSI was run by crisis management rather than well planned actions. Several representative comments from the first cadre of MSRTs included the following.

- I think the leadership was overwhelmed. A lot of things came up that I'm sure they didn't anticipate.
- I haven't felt they responded completely to the concerns of the MSRTs, or the response was too little, too late. Our leaders are all serious committed people who really work hard.
- The leadership struggled to determine their own leadership style and agenda. Communication is a giant problem here. They have their minds on so many things that they're not looking at us.
- Although leadership problems improved during the second year of implementation, the vast majority of the MSRTs interviewed continued to feel that the MUSI leadership had not been effective. They cited inconsistency, lack of organization and poor communication as key problem areas.
- (Leadership) needs to be completely restructured. It is not working; it is not effective. Perhaps the leadership team is too big. It seems like when the MSRTs feel the need for something, there are too many people who have to give the okay before it can be implemented.
- My impression of leadership is that little has changed over the year.
- There seems to be no willingness to change on the part of MUSI leadership and that has become very frustrating.

Principals and Leadership in Schools

Interviews with MSRTs and surveys of teachers indicated that administrative support, collegiality, sharing, and collaborative planning were extremely important to reforming mathematics and science teaching. Much of the support appeared dependent on the level of professional development received by the principals.

The experiences of the MSRTs upon entering their assigned schools varied considerably and were dependent on the school administration. In those schools where the administrators were informed and enthusiastic about MUSI, the MSRTs were welcomed and made to feel part of the school team. Many of these administrators provided a location for the MSRT to work and time for the MSRT to introduce themselves and explain their emerging roles to their school faculties. However, these were the exception rather than the rule for the 25 first-wave MSRTs. Most frequently, the

MSRTs reported that the principals at their schools had little knowledge about MUSI and of their role as part of the systemic plan. They should have been better prepared.

The MSRTs reported that facilities and resources were a major problem for MSRTs. They did not have desks or places to store their personal belongings. For some, their access to supplies and simple photocopying services at their schools was extremely limited. The unavailability of supplies and resources at the COSMIC Center compounded these difficulties.

- In one school the principal came to the principal's meeting and was very informed about the project. When I went to that school, they were ready and waiting for me. The principal took me around and introduced me to all of the teachers, and I had a tour of the school. In my other situation, that principal had just been transferred to the school so he did not write the proposal. He was not informed about this project, and he did not attend the orientation meeting.
- In one school I brought a bag of doughnuts one day for this teacher, and he found me a desk in the basement. I'm between a refrigerator and the microwave.

But, with year two of MUSI, there were different scenarios. When principals were prepared leaders, things improved for the MSRTs. During the summer of 1997, principals received more timely information. MUSI was better prepared, and it showed. Reports from informants and observations showed an increase in the level of understanding and principal support for MUSI goals, for mathematics and science instruction, for the work of the MSRT, and for change.

- The principal attended the principal's meeting at the Cosmic Center where he explained some of the intentions he had regarding MUSI. He obviously had given the project considerable thought and was prepared to meet the MUSI goals, probably because they were consistent with his. When I first arrived at the school, I was warmly greeted, provided a small office, and taken on a tour of the building by the principal, who personally introduced me to the teachers. I believe this approach sends a clear message to the staff of support for the MSRT and MUSI.

Leadership of the MSRTs

Community and teacher leadership were new concepts difficult to conceptualize for many including the MSRTs. During interviews, the MSRTs talked about being leaders and agents of change; however, their comments and actions revealed that their understanding of leadership followed more traditional lines. For example, during interviews, the term "leadership" was not defined, and the MSRTs, in turn, discussed the leadership of MUSI as if it were only in the hands of Central Services, the MUSI Director, and the MUSI Assistant Directors. None mentioned the place of teacher leadership in MUSI and looked to the MPS bureaucracy rather than themselves for answers and directives. Their vision of leadership remained bounded by bureaucratic walls. Although they could have broadened their own perceptions toward constructivist leadership, they did not, instead viewing it from a familiar linear and hierarchical framework.

When faced with ambiguity and school administrators who did not take the lead in defining MSRT roles as the MSRTs expected, the MSRTs looked for structured job descriptions that were more characteristic of what they had known in the past, job descriptions that were uniform throughout the system rather than individualized for each school. Many first cadre MSRTs requested a detailed description of their role, and in written feedback, 13 of the 25 first cadre MSRTs listed their need for role definition and clarification of responsibilities as their top priority.

After working in the schools for several months, the MSRTs noted a variety of perceptions that the schools had regarding the MSRT role. Concern was expressed that not everyone was hearing the same thing. What emerged during the first two years was a two part set of "common actions," one delineating expectations of an MSRT and the other delineating expectations of each school to support the work of the MSRT.

Only a few MSRTs mentioned their own roles as leaders and visionaries who could define their own roles. These few viewed the leadership of MUSI more systemically. The other MSRTs reported feeling a lack of control and blamed the school leadership for limiting their access to classrooms rather than understanding their leadership role and taking more initiative independently. The professional independence that the role provided was new to them, and they looked for nurturing and guidance from others rather than creating their own because that is what was expected of them in the past.

Equity

According to the National Science Foundation's Urban Systemic Initiative, equity means closing performance gaps between ethnic, gender, and income groups of students. Of the six bases that form the foundation for excellence discussed in this evaluation report, equity is the most ambiguous. It is systemic and cannot be clearly isolated even for discussion purposes as some of the other bases can. The essence of MUSI's plan for equity is based on the belief in which teaching that is motivating, grounded in standards, authentic, and inquiry-based will gradually narrow and ultimately close performance gaps between students. This approach is based on solid research and exciting results which indicate that changing teaching and learning so that they involve cooperative and "active learning" is the right path to closing these gaps. Singham (1998) asserts that the situation is by no means hopeless. We can be encouraged by very promising experiments that have narrowed this gap. But we have to start looking at the problem in new and *deep* [italics added] ways, and we must avoid the temptation to seek simplistic one-shot solutions if we are going to make any real headway.

In responding to questions regarding equity, most participants in MUSI were more likely to talk about it as a separate issue rather than as a deep, interwoven, systemic problem. Teachers cited specific programs (Equity 2000, PUMP Algebra) as ways to address the performance gap between groups. Principals, on the other hand, said that they address equity by building awareness of the issues, setting high expectations, training teachers in efficacy, and implementing specific programs and/or methods such as, tutoring, cooperative learning, or group work. A few MSRTs focused on how their efforts at improving the overall quality of instruction would help reduce the performance gaps between groups of students.

Frustrations

The MSRTs are qualified, highly motivated, and dedicated individuals. They have practical experience in urban settings to help them understand issues of equity. Despite this and the extensive staff development and discussion of equity issues provided by MUSI, they felt frustrated by their inability to "solve the equity problem." Equity in mathematics and science education is a problem so systemic it reaches far beyond classrooms, schools, and even the district itself. It is a complex societal problem. However, in these days of functionality, intolerance for ambiguity, and quantification in education, there is pressure to have ready made "fixes" for all problems. The teachers, principals, and MSRTs in MPS all tried to identify some of these fixes.

Although the MSRTs accomplished a great deal in only two years of MUSI implementation, they wanted much more especially in the area of equity for all students. They created excitement in teachers and schools that motivated change, and classroom teaching did change according to the results of interviews with principals, teachers, and MSRTs and teacher survey comparisons. Teachers were using more hands-on experimentation, more varied assessment practices, and more small group problem solving, particularly in the high schools. Principals reported that they saw this reflected in student behaviors. There was a lot more excitement in classrooms and an increase in problem solving activities, and yet the MSRTs were frustrated.

What the MSRTs need now is to be able to recognize how their actions, no matter how small, are part of a greater system. Although they were able to verbalize theories of systemic change ("It's organic; like the body...."), their comments ("But, I need to know, how do *I* close the gap?) indicated their ongoing struggle and difficulty in understanding their role in operationalizing small steps toward the larger goal. Their good intentions combined with a strong need for closure caused frustration. For example, when discussing the professional development sessions on equity, one MSRT responded, "I didn't feel Enid Lee gave specific strategies....I feel even more frustrated after hearing her." For a few, these frustrations became too great, and they left the role of MSRT.

Continuing Low Expectations

The job is immense; the frustrations, many, and there is still much to be done. Unfortunately, the attitudes and beliefs of too many MPS teachers have not changed dramatically. They continue to hold low expectations, believe in teaching the basics before higher order thinking can begin, and cling to grouping by ability levels. Survey results indicate that MPS teachers hold low expectations for their students (see Table 15). The change in beliefs was negligible between initial and follow-up surveys with science teachers holding slightly higher expectations than mathematics teachers. After nearly two years of MUSI implementation, the majority of mathematics and science teachers surveyed in elementary, middle, and high schools continued to believe that only some or a few of their students can learn to think and work mathematically to high levels or will be able to achieve the board policy that students will be proficient in mathematics beyond algebra.

Table 15. Expectations of Students' Ability to Achieve in First Wave Schools

Item	Grade Level	n	Mean (SD)	Frequency Percentages None (1)	Few (2)	Some (3)	Most (4)	All (5)
Based upon your current class of students, how many students can learn to think and work mathematically to high levels?	K-5 pre	424	2.99 (0.99)	5.4	25.7	40.6	20.8	7.5
	post	282	3.41 (0.82)	1.1	11.3	40.1	40.8	6.7
	6-8 pre	84	3.23 (1.00)	2.4	22.6	35.7	28.6	10.7
	post	70	3.31 (0.86)	1.4	14.3	42.9	34.3	7.1
	9-12 pre	46	3.02 (1.00)	2.2	34.8	28.3	28.3	6.5
	post	42	3.05 (0.79)	0.0	28.6	38.1	33.3	0.0
How many students will be able to achieve the new School Board Policy: Students will demonstrate three years of study beyond Algebra One. Students will be expected to show proficiency in first year algebra by the end of the eighth grade.	K-5 pre	415	3.21 (0.66)	0.7	9.9	58.6	29.4	1.4
	post	280	3.31 (0.67)	0.4	6.8	57.9	31.4	3.6
	6-8 pre	80	3.20 (0.75)	1.3	12.5	55.0	27.5	3.8
	post	68	3.15 (0.72)	1.5	14.7	51.5	32.4	0.0
	9-12 pre	45	2.64 (0.68)	2.2	40.0	48.9	8.7	0.0
	post	42	2.74 (0.73)	2.4	35.7	47.6	14.3	0.0
Based upon your current class of students, how many them can learn to think and work scientifically at high levels?	K-5 pre	413	3.09 (0.98)	5.6	19.9	41.2	26.4	7.0
	post	275	3.32 (0.85)	2.5	10.2	47.3	32.4	7.6
	6-8 pre	77	3.29 (0.96)	1.3	19.5	40.3	27.3	11.7
	post	63	3.25 (0.84)	0.0	15.9	52.4	22.2	9.5
	9-12 pre	31	3.19 (0.65)	0.0	9.7	64.5	22.6	3.2
	post	27	3.26 (0.86)	0.0	18.5	44.4	29.6	7.4
How many students will be able to achieve the new School Board Policy: Students will demonstrate a high level of proficiency in science equivalent to three years of high school to include the physical, biological, and chemical sciences. Students will demonstrate and understanding of scientific inquiry & its application to real life situations.	K-5 pre	406	3.27 (0.70)	0.5	10.1	53.9	32.8	2.7
	post	268	3.41 (0.69)	0.4	6.7	48.9	39.9	4.1
	6-8 pre	77	3.39 (0.69)	0.0	7.8	49.4	30.0	3.9
	post	63	3.38 (0.73)	0.0	6.3	57.1	28.6	7.9
	9-12 pre	30	3.39 (0.72)	0.0	6.5	54.8	32.3	6.5
	post	26	3.23 (0.71)	0.0	7.7	69.2	15.4	7.7

Many of the teachers surveyed, particularly in mathematics, also believe that students need to master "the basics" before going on to higher level thinking as shown in Table 16. A majority of mathematics teachers believe (and up to 46% of high school mathematics teachers believe "strongly") that students need to master computation before going on to algebra. While many science teachers also believe that students need to learn basic science terms before tackling scientific concepts, more were likely to be neutral in their beliefs than teachers of mathematics.

Additionally, many teachers of mathematics and science do not believe that students can learn in classes unless they are grouped by ability. Beliefs in tracking by ability are strongest in mathematics teachers at the high school level and weakest in elementary teachers and middle school science teachers.

These beliefs may be MUSI's greatest challenge. It will be extremely difficult to change teaching practices if teachers do not accept the philosophy behind them. Research has demonstrated that the success rate of students increases when they are not bound by learning the basics in classes void of problem solving and manipulative learning activities. Learning is not better in classes that are grouped by ability. Perhaps it is simply easier or less complicated to teach routinely to ability-based groups, but it is not to students' advantage. It is a matter of teacher convenience, and therefore, MUSI has much to do in this area.

Table 16. Beliefs about Mathematics and Science in First Wave Schools

Item	Grade Level	n	Mean (SD)	Frequency Percentages				
				Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
Students learn best in classes of students with similar abilities.	K-5 pre	426	2.91 (1.18)	10.8	32.2	22.5	24.4	10.1
	post	283	2.54 (1.04)	11.3	48.4	20.8	14.1	5.3
	6-8 pre	84	3.27 (1.18)	3.6	28.6	23.8	25.0	19.0
	post	70	2.89 (1.12)	10.0	30.0	30.0	21.4	8.6
	9-12 pre	46	3.93 (0.98)	0.0	8.7	23.9	32.6	34.8
	post	40	3.75 (1.01)	0.0	12.5	27.5	32.5	27.5
Students need to master computation before going on to algebra.	K-5 pre	425	3.61 (1.13)	4.7	13.4	22.1	36.0	23.8
	post	281	3.64 (1.12)	2.5	16.4	22.1	32.4	26.7
	6-8 pre	85	3.44 (1.35)	7.1	25.9	14.1	22.4	30.6
	post	71	3.66 (1.19)	1.4	23.9	12.7	31.0	31.0
	9-12 pre	46	3.76 (1.39)	6.5	19.6	10.9	17.4	45.7
	post	41	4.15 (1.09)	0.0	14.6	7.3	26.8	51.2
It is important to learn basic scientific terms and formulas before learning underlying concepts and principles.	K-5 pre	420	2.93 (1.15)	11.4	28.1	24.3	28.6	7.6
	post	278	2.99 (1.20)	8.3	35.3	18.7	25.2	12.6
	6-8 pre	76	2.75 (1.26)	18.4	27.6	25.0	18.4	10.5
	post	63	3.46 (1.28)	7.9	20.6	12.7	34.9	23.8
	9-12 pre	31	3.23 (1.06)	3.2	29.0	16.1	45.2	6.5
	post	27	3.15 (1.29)	7.4	33.3	14.8	25.9	18.5
Students learn science best in classes of students with similar abilities.	K-5 pre	421	2.39 (0.97)	16.4	44.2	25.4	11.6	2.4
	post	277	2.38 (0.94)	13.0	53.8	18.1	13.0	2.2
	6-8 pre	77	2.40 (1.08)	19.5	42.9	19.5	14.3	3.9
	post	63	2.51 (1.08)	12.7	49.2	19.0	12.7	6.3
	9-12 pre	31	3.03 (1.14)	9.7	22.6	32.3	25.8	9.7
	post	26	3.27 (1.12)	3.8	26.9	19.2	38.5	11.5

During site visits to First and Second Wave schools in Spring 1998, classroom observations were conducted of mathematics and science teaching and learning. Each lesson was evaluated for the level of equity as defined by expectations of students and cultural connections. (See Appendix B for the rubric.) The results for expectations of students are shown in Table 17. The low

expectations for students noted in the survey responses were also observed in mathematics and science classrooms. The overall mean rating for all levels and both disciplines was 2.79. The highest rating for expectations of students was 3.44 in middle school mathematics. The lowest rating was 1.85 in high school science.

In the lessons rating low on expectations for students, common behaviors exhibited by the teachers was a physical separation from the students whether it was sitting behind a desk or not circulating among the students. These teachers also tended to ignore disruptive behavior and did not push for disruptive or off-task students to work on the lesson. The behaviors of the teachers with high expectations for students encouraged them by stating they were all capable of achieving and could all master the task at hand. Overwhelming, the teachers with high ratings physically demonstrated enthusiasm in their constant motion and walking around the room, open and frequent gesturing, vocal variation, and their willingness to "get in" with the students physically.

Table 17. Level of Student Expectations Observed in Site Visits, Spring 1998

	n	1 (low)	2	3	4	5 (high)	Mean Ratings
Mathematics							
Elementary	16	12.5%	25.0%	25.0%	18.8%	12.5%	2.69
Middle	9	0%	11.0%	44.0%	34.0%	11.0%	3.44
High	6	34.0%	0%	17.0%	17.0%	33.0%	3.33
Science							
Elementary	14	14.2%	14.2%	43.0%	7.1%	21.4%	2.92
Middle	10	30.0%	20.0%	30.0%	10.0%	10.0%	2.50
High	7	71.4%	0%	0%	28.6%	0%	1.85
Overall Rating	**62**						**2.79**

School-based Supports: Policies and Resources

For the Milwaukee Urban Systemic Initiative (MUSI) to be systemic it must be comprehensive. According to the National Science Foundation and the MUSI cooperative agreement, goals can only be effectively achieved if the plan is ongoing, coordinated, aligned, and synergistic across educational settings. While other district-wide aspects of reform such as policy formation for curriculum and assessment and leveraging of funds are addressed elsewhere in the evaluation of MUSI (e.g., MUSI Annual Reports and Program Effectiveness Reviews), the internal evaluation reports used for this evaluation contain useful data regarding the supports either available or unavailable at the school level. These include school attitudes, policies, practices, and resources that facilitate the work of the MSRTs and MUSI's staff development program.

Attitudes Toward MUSI

MUSI and the MSRTs have the support of principals and teachers who are informed about the initiative. During the site visit interviews, principals expressed their support of the work of the MSRTs as mentor teachers and agents of change, as part of a feedback loop, and as a resource for the school.

- Because of the work of the MSRT, this is the first year that our teachers have not just ordered the science kits but actually used them and embellished on ideas.
- (The MSRT) has been very instrumental in a number of projects where (the MSRT) has actually gone into the classroom, done some model teaching, and provided staff development assistance.
- The MSRT meets with me often and constantly gives me feedback on the things that work and the things that don't work.

- The MUSI grant has allowed us to bring in additional resources, and the MSRT is involved in grant writing, assisting us to get additional monies to support our in-service staff training and material acquisitions.

According to teacher surveys, teachers have strong positive feelings regarding MUSI and the MSRTs. They believe that MUSI and the MSRTs have had a marked impact in their schools and that being a MUSI school allowed them to improve their programs. Almost one half of all science teachers and over one third of all mathematics teachers reported that MUSI has allowed their schools to improve their content area programs.

Additionally, the MSRTs impacted a large number of teachers. Considering that most MSRTs have been working in a school only four half days per week for two years, they have reached a considerable number of teachers in a short amount of time. At the elementary and high school levels, approximately half of the science teachers and over one third of the mathematics teachers agreed or strongly agreed that the MSRT at their school assisted them in improving their teaching. These responses were markedly higher at the middle school level where 77.5% of the science teachers agreed or strongly agreed that they were assisted by the MSRT, and 63.5% of them felt MUSI allowed them to improve their program. Results for middle school mathematics teachers were also high at 64.3% and 53.5%, respectively.

Reports from the MSRTs indicated that individual teachers were extremely appreciative of the one-on-one support and care that the MSRTs were able to provide. MSRTs are confidence builders. According to the MSRTs, individual teachers have been more willing to try new things and more willing to talk with peers about their efforts. The MSRT is there when a teacher is on the verge of taking a risk and just needs that small push from a supportive individual to jump that hurdle and try it. These small supportive first steps are having big dividends. Teachers who have been helped by an MSRT are spreading the word to other teachers that an MSRT can be a valuable person to have around. Through the MSRT, MUSI is reaching those teachers that have been isolated from the reform movement and just didn't realize there was something out there that could work to reach all students.

Policies and Practices

School support for MUSI and mathematics and science education varied in two key ways. First, schools either welcomed and provided support for the MSRTs or they did not. Second, schools provided varying levels of policies, opportunities, and resources to support MUSI's efforts to teachers.

School Support Provided For MSRTs

When principals and schools had adequate preparation, many opened their doors widely to MUSI and the MSRTs. They welcomed the MSRTs and provided opportunities for them to address the school faculty. Even though space in most schools was tight, some found a location for the MSRT to work. This demonstrated that they considered mathematics and science education to be of great importance to their school vision.

On the other hand, while all principals interviewed said that they supported MUSI and hoped for institutionalization of the role of the MSRT, the actions of some did not support their words. Too many of the MSRTs complained that they did not have an adequate introduction or welcome to their schools. They complained that they were not provided with space nor opportunities to speak with teachers, and they related many of these problems to the overall level of support for mathematics and science education in the school. Several of their comments reflect the varying welcomes and support the MSRTs received.

- I spoke to both principals at first. They both came to the orientation meeting, and they both welcomed and empowered me, and entrusted me to do my own thing rather than trying to micro-manage my services. One school is working better than the other. They have given me a place to work and everything; in the other school I'm having a little harder time, but we'll work it out.
- I have placed notes in the principal's mailbox, and I feel there isn't any communication at all. The librarian told me there was a table in the back I could sit at. I now sit at this table, but I have no place to put my coat, or lock up my purse. At the other school they were not told anything about me or MUSI. I was never introduced at a staff meeting.
- I was warmly received at both schools. Some of the staff in the buildings didn't really have a good perception of what MUSI was all about, and I wish that I would have been in the schools much earlier.

Support Provided For Teachers

All internal evaluation reports indicated that teachers across the grades feel that the lack of adequate planning, especially collaborative time with colleagues, is an obstacle to successful teaching, and this was most pronounced in science. During site visit interviews, the teachers reported that although they repeatedly express this problem, they never have enough time. In MUSI evaluations, it appeared that some schools were actively tackling this problem; others were not. Schools varied considerably in the manner and amount of meeting time they provided to teachers. Some teachers reported weekly or bi-weekly content area meetings with pay. For example, one middle school held bi-monthly meetings for two groups of teachers. Science teachers met separately with the MSRT as did mathematics teachers, and all of them were paid with Title I monies. Other schools held monthly meetings with or without pay while others provided no additional meeting times beyond banking days or personal unpaid time.

The responses of principals regarding meeting time also varied. Although most of them verbally recognized the need for more collaborative meeting time, their responses during the site visits indicated that some of them held other priorities. Some implied that banking days adequately provide the opportunities for teachers, and others indicated that they would like to see teachers meeting consistently and effectively according to their grade levels (i.e., in middle school family groups) before they extended meeting times to content areas.

The organization of MPS middle schools does pose some problems for MUSI. Most middle schools are organized around grade level groupings, i.e., families, houses, or teams. Because the teachers in middle schools meet daily according to grade level, there often is no time established for disciplinary meetings. Therefore, the MSRTs found it difficult to meet with teachers according to content areas to specifically address issues in mathematics and science.

Resources

Overall, the feedback from teachers regarding the adequacy of resources is inconsistent district-wide. In surveys, teachers reported the adequacy of resources, materials, equipment, and supplies as both an obstacle and a support for teaching mathematics and science (see Table 18). This district-wide inconsistency might be attributable to the differences between schools. According to reports from the MSRTs, some schools provide adequate resources while others do not, and still others have adequate resources, but make access so difficult that teachers do not use them..

Table 18. Obstacles & Supports in Teaching Mathematics and Science in First Wave Schools

		Percent Responding	
	Grade Level	Mathematics	Science
Major Obstacle: Lack of adequate resources, materials, and supplies including textbooks, manipulatives, measuring tools, science equipment, consumable, and non-consumable supplies.	K-5	23	42
	6-8	15	64
	9-12	8	23
Major Support: Materials and equipment readily available in the building or through the elementary science kits. Budget available for mathematics or science materials.	K-5	52	45
	6-8	30	15
	9-12	2	33

Furthermore, science teachers see the lack of adequate resources and materials more as a problem compared to teachers of mathematics (see Table 19). More teachers of mathematics reported that they had most or all of the needed non-consumable supplies in sufficient quantity compared to science teachers. The science shortages were most pronounced at the elementary level, but this showed a marked improvement in follow-up survey comparisons. Additionally, survey data indicated a notable drop in the availability of consumable supplies for science at the middle school level with a notable increase in the availability of consumable science supplies for science at the high school level. The explanation for this is unknown.

Table 19. Consumable and Non-Consumable Supplies in First Wave Schools

				Frequency Percentages				
Item	Grade Level	n	Mean (SD)	None (1)	Few (2)	Some (3)	Most (4)	All (5)
How many needed consumable supplies are regularly purchased by your school for use in mathematics?	K-5 pre	422	2.94 (1.15)	12.8	22.0	32.9	23.0	9.2
	post	281	2.93 (1.11)	12.1	22.4	32.7	26.0	6.8
	6-8 pre	84	2.87 (1.14)	10.7	31.0	27.4	22.6	8.3
	post	70	3.11 (1.22)	12.9	17.1	28.6	28.6	12.9
	9-12 pre	45	3.40 (1.10)	8.9	6.7	33.3	37.8	13.3
	post	42	3.64 (1.16)	4.8	11.9	26.2	28.6	28.6
How many needed non-consumable math supplies are available in sufficient quantity for student use?	K-5 pre	425	3.57 (1.03)	3.3	12.2	26.6	39.8	18.1
	post	283	3.54 (0.93)	0.4	15.2	28.6	41.7	14.1
	6-8 pre	85	3.75 (1.14)	1.2	9.4	22.4	47.1	20.0
	post	71	3.51 (0.95)	1.4	12.7	35.2	35.2	15.5
	9-12 pre	46	3.63 (0.93)	0.0	15.2	21.7	47.8	15.2
	post	42	3.76 (1.01)	4.8	4.8	21.4	47.6	21.4
How many needed consumable science supplies are regularly purchased by your school?	K-5 pre	406	2.80 (1.16	15.0	26.8	28.6	22.7	6.9
	post	76	3.08 (1.18)	9.2	25.0	26.3	27.6	11.8
	6-8 pre	63	3.06 (1.03)	4.8	27.0	33.3	27.0	7.9
	post	30	4.10 (0.86)	1.3	15.8	34.2	36.8	11.8
	9-12 pre	27	4.19 (0.88)	0.0	3.7	18.5	33.3	44.4
	post	27	4.19 (0.88)	0.0	3.7	18.5	33.3	44.4
How many of the non-consumable science supplies are available in sufficient quantity for student use?	K-5 pre	409	3.09 (1.07)	5.6	19.9	41.2	26.4	7.0
	post	273	3.40 (0.93)	1.6	15.9	33.3	39.7	9.5
	6-8 pre	76	3.42 (0.94)	0.0	6.7	13.3	43.3	36.7
	post	63	3.40 (0.93)	1.6	15.9	33.3	39.7	9.5
	9-12 pre	30	4.33 (0.61)	0.0	0.0	6.7	53.3	40.0
	post	27	4.15 (0.77)	0.0	3.7	18.5	33.3	44.4

Chapter 3
Discussion

The purpose of this evaluation was to determine the lessons learned during the first and second years of implementation of the Milwaukee Urban Systemic Initiative (MUSI) in the Milwaukee Public Schools (MPS). These lessons, in turn, can be used to determine which aspects of the reform effort are successful, what are catalytic practices to facilitate change, what are the impediments to progress, and which strategies can assist in scaling-up in subsequent years and sustaining systemic reform beyond the NSF funding period.

The MUSI plan incorporates four major forces. (See Figure 5.) The first is the driving force. It is the perspective that MPS is a community of learners at all levels—classrooms, schools, district, and city. The remaining three are the action forces. They are the key components of MUSI intended to make fundamental changes to the foundational practices in MPS. These three action forces include (a) the Mathematics and Science Resource Teachers (MSRTs), a core of teacher leaders who were charged with transforming the teaching of mathematics and science in MPS, (b) a professional development program, and (c) the establishment of a mathematics, science, and technology center called the COSMIC Center. Based on needs determined in the self-study of the status of mathematics and science education in MPS, these action forces were specifically designed to stabilize the Milwaukee Public Schools' foundation so it could sustain teaching and learning excellence in mathematics and science beyond funding from NSF.

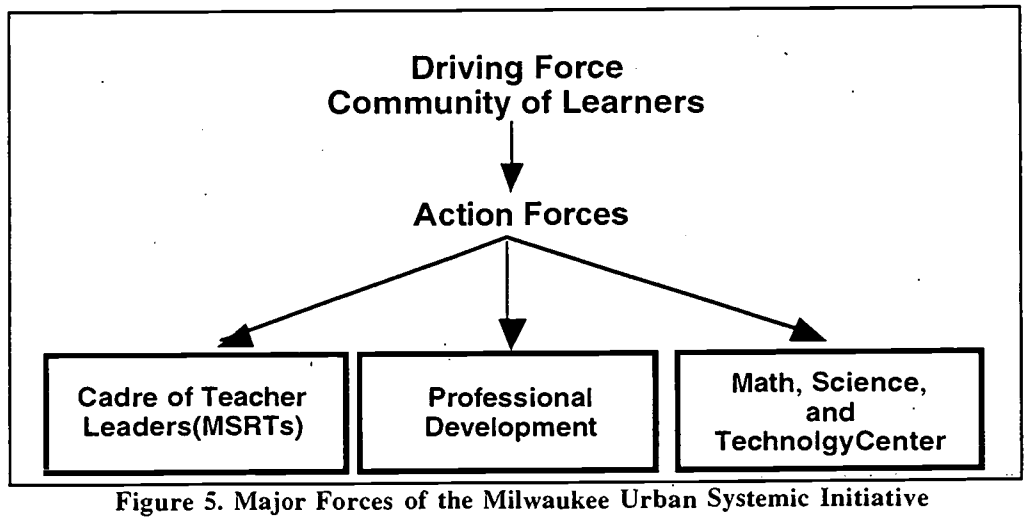

Figure 5. Major Forces of the Milwaukee Urban Systemic Initiative

Six bases form this foundation for excellence. (See Figure 6.) They include (a) standards-based curriculum, (b) teaching, learning, and technology, (c) assessment, (d) leadership and management, (e) equity, and (f) school-based supports. These six bases focus the work of the action forces within the community of learners perspective.

From the analysis, we have learned that MUSI has accomplished much within its first two years of implementation. Although there is much to be done in the subsequent years of MUSI implementation, the data from the ongoing evaluation over the past several years has shown that MUSI has had a strong impact on mathematics and science education in MPS schools and is beginning to realize many of its aspirations.

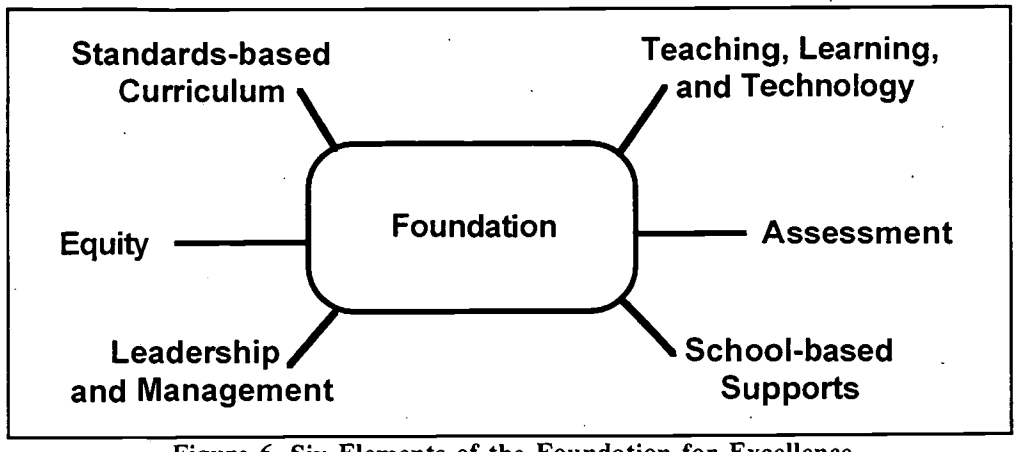

Figure 6. Six Elements of the Foundation for Excellence

Realizations

- First and foremost, the MSRTs helped to increase many teachers' excitement and enthusiasm for mathematics and science, as well as helped many teachers improve their instructional practices. There is simply more interest in and activity around mathematics and science teaching and learning than there was before MUSI and this is reflected in student behaviors. There is a lot more excitement in classrooms and an increase in problem solving activities.
- Classroom teaching has changed. Teachers are using more hands-on inquiry-based approaches, more varied assessment practices, and more small group problem solving. Almost one half of all science teachers and over one third of all mathematics teachers believe that MUSI and the MSRTs have had a marked impact in their schools and have helped to improve the mathematics and science programs in their schools.
- The interrelationship of professional development for classroom teachers combined with the activities of the MSRTs were the dominant action forces of MUSI. Professional development plants the seeds for reform; the MSRTs cultivate those seeds in classrooms.
- MUSI's professional development program is extensive and impacts many. Approximately 800 participants were enrolled in MUSI courses offered by the University of Wisconsin-Milwaukee.
- MSRTs are advocates for mathematics and science in their schools. They make connections, provide school-based professional development, encourage teachers to sign up for MUSI-UWM courses, gather resources, and provide much needed support for teachers within the contexts of their individual classrooms.
- MSRTs facilitate implementation of what is learned during professional development sessions. This is where the MSRTs had their greatest impact. They accomplished this through teacher coaching, team teaching, conducting demonstration lessons, ensuring that teachers had the resources necessary to implement standards-based mathematics and science instruction, and provided support for technology infusion into student learning.
- MSRTs expanded the community of learners perspective within the classroom and beyond. Approximately half of the MSRTs provided teacher support in classrooms on a daily/weekly basis and fifty-five percent were actively involved with parents in mathematics and science activities. The MSRTs created strong links with families, businesses, and community agencies,

as well as with other schools within the system.

- Teachers of both mathematics and science are becoming more familiar with national standards, especially in science.
- The amount of time that science is taught in MPS schools, particularly elementary schools, is gradually increasing.
- Teachers are beginning to change the way they assess students. There is an increased use of varied assessment practices in MPS schools.
- Numerous tools and instruments have been developed as part of MUSI activities which can be used in future MUSI activities and adapted for use in other settings.

Critical Lessons Learned

This evaluation has identified several realizations and accomplishments of MUSI over the first two years of implementation. The evaluation has also provided some critical lessons about the action forces of MUSI and their effect on strengthening MPS's foundation for excellence. In the future, when MUSI funding is no longer available, MPS will have to answer several difficult, but critical questions. What impact did the activities of MUSI have on school-based goals; in other words, did the MUSI forces shore up the six elements adequately so that they can stand as a strong foundation for ongoing change? Do schools now have the foundation they need to sustain excellence in the teaching of mathematics and science for all? What are the district's plans to maintain this foundation so that excellence is ongoing?

Participants of MUSI often do not think systemically. They view the community perspective as another component, but it is more than that; it is the driving force behind Milwaukee's action plan. Community of learners and systemic thinking are new concepts which are difficult to conceptualize for many. What MUSI participants often lacked was a broader perspective of reform: one that went beyond classroom teaching into understanding how to change schools in a school district that still held tightly to its bureaucratic structures.

Participants needed to understand that power needed to be shared and that ambiguity and the absence of tight closure is acceptable and a learning experience for a collaborative community. However, in our product oriented, efficient society, we educators often have difficulty tolerating ambiguity, and communities of learners are more ambiguous than bureaucracies. The MUSI plan was built on the concept of community, and each participant came to MUSI with their own perspective as to what that meant. MUSI's professional development program emphasized MUSI goals and the community of learners, but, for many, there was a dichotomy between the MUSI plan and their own beliefs and/or needs. Although they espoused collaboration and community, when ambiguity prevailed, many succumbed to what they knew previously, looking for the rule, and the norm that bureaucratic uniformity provides.

Forces That Facilitate Reform

A comparison of Pre-MUSI to Two-Years of MUSI Implementation is shown in Table 20. The overarching finding from this summary evaluation is that the successes of MUSI during its first two years can be attributed to two critical action forces: the Mathematics and Science Resource Teachers (MSRTs) in conjunction with MUSI's strong professional development component. This combination is more than a pairing of services, but rather a fusion or symbiosis: each is dependent on the other for success and it is the essence of what makes MUSI work. The professional development program plants the seeds which the MSRTs cultivate. One principal capsulated this well when she said, "The purpose of the MSRT is to show teachers what they can

do and then help them do it...unless you show teachers how to do the proposed changes, change isn't effective. If they (teachers) just go to workshops, that's O.K., but I don't think that it is as effective as someone also coming into their classrooms."

Additionally, the MSRTs are reaching those teachers who are not involved in reform, those teachers who did not realize that there was something out there that could work to reach all students. The MSRT is there when a teacher is on the verge of taking a risk and needs support. These small supportive first steps are having big dividends. Teachers who have been helped by an MSRT are spreading the word to other teachers that an MSRT can be a valuable person to have around.

The third action force, the COSMIC Center, made far less impact than the other two action forces. The MUSI cooperative agreement called for a mathematics and science hub. It was to be a visible place, a community meeting spot, and a technological site designed to help institutionalize the goals of MUSI in MPS. The COSMIC Center had a difficult beginning, and it is only now that it has become a viable physical reality. It remains to be seen what future planning will bring to convert COSMIC from this physical space to the exciting hub as it was once envisioned.

Foundational Elements that Support Reform

The following discussion is a summary of the six foundational elements which were analyzed throughout this evaluation report. Table 21 shows a comparison of Pre-MUSI to Two-Years of MUSI implementation.

Standards-based Curriculum

MPS had been engaged in major curriculum goal setting before MUSI came to Milwaukee. The MPS approach focused around broad standards encompassing all disciplines and the belief that all students can and do achieve at high levels when students and teachers clearly understand what is expected. The district established the K-12 Teaching and Learning Goals which have been incorporated into the MPS Learning Framework. However, the district lacked clear content specific curriculum frameworks aligned with national and state standards. Currently, MPS, with the assistance of the North Central Regional Educational Laboratory (NCREL) is working to align national and state standards, district grade level learning expectations, and district performance assessments in mathematics and science.

Curriculum and resource materials are being adopted and revised by the district to support the emerging content specific curriculum frameworks. In Spring 1998, MPS adopted two NSF supported mathematics curriculum programs. The district adopted *Connected Mathematics* for grades 6–8 for implementation in the 1998-99 school year and adopted *Investigations in Number, Data, and Space* for grades K-5 for implementation in the 1999-2000 school year. The district also is piloting a high school integrated mathematics program. The science curriculum in elementary and middle school was adopted prior to MUSI. The elementary science adoption, *Explorations* from Addison Wesley, contains no student texts and promotes an inquiry-approach. A science kit distribution program was established for the district elementary schools prior to MUSI. Modules are being developed for middle school science to further promote an inquiry-approach. During the two years of MUSI implementation, the elementary and middle school science curriculum has been under revision to align it with national standards and to strengthen the science content.

In order to clearly articulate high expectations to students, teachers must know what they are and how to get there by having standards-based curriculum materials. The MPS Learning Framework and emerging content curriculum frameworks place considerable emphasis on using an inquiry approach to content-rich instruction. Problem posing and problem solving needs to be integral to

teaching and learning. This means great change for teachers who continue to use traditional teaching strategies. It dramatically changes the way content is interpreted and delivered.

Although the needs continue, the data indicates that MPS teachers have increased their understanding of national standards. The self study of mathematics and science in MPS revealed that, prior to MUSI, MPS staff members were lacking in knowledge about standards and performance assessments. MUSI provided opportunities for teachers and administrators to gain a better understanding of standards-based curriculum and assessment proficiencies through support from the MSRTs, coursework, conferences, inservices, and meetings. There are signs of change and feelings of hopefulness about the shift to standards-based curriculum.

Teaching, Learning, and Technology

Pre-MUSI studies revealed that traditional teaching strategies dominated classrooms. Instruction was often rote, repetitive, uncoordinated, textbook and worksheet driven, and as most students reported "very boring." The only things the students found interesting were hands-on activities, but these were few and far between. But results of ongoing evaluation indicate that MUSI has indeed changed some of this. There is much more excitement about teaching mathematics and science. Hands-on, problem solving strategies are being utilized more frequently with some teachers moving from direct-instruction and cook-book type lessons to open-ended and inquiry-based learning. Although there are many more teachers and schools to reach, the forces of MUSI clearly demonstrated that they were on the right path. The interrelationship of professional development and the activities of the MSRT was a strong force in changing instruction, classroom by classroom and school by school.

Unfortunately, these new ways of teaching and learning in MPS and in MUSI are still thought of as new strategies. Teachers have not re-conceptualized their thinking about teaching and learning. A new conceptualization of teaching that is constructivist does not view inquiry-based teaching strategies as isolated events. Teaching reform is not a blend of traditional instruction with new strategies, but rather a new way of thinking about the way students learn and correspondingly, the way teachers teach at all times. This needs to be conceptualized by all MUSI participants.

Before MUSI, there was a critical need for more teaching time, especially for science. Small gains have been made. Second year MUSI schools saw an increase in science teaching suggesting that the longer MUSI is in a school, the greater the impact on the amount of time being spent on science instruction. Additionally, in schools with science specialists, little or no additional science was taught in classrooms beyond what was taught in the science labs by the science specialists. What was intended as a supplement, has often become the mainstay. Efforts to resolve this problem include efforts to coordinate classroom instruction with instruction in the science labs. But, overall, science is still taught less than mathematics, and teachers still feel a need for more time to teach science.

The evaluation data indicated that the use of technology in classroom teaching practices did not increase as substantially as hoped by MUSI planners. MUSI goals would have teachers at all levels using computers as an integral part of mathematics and science instruction. The MUSI plan for the COSMIC Center was to help facilitate this. However, the late construction and remodeling plans and slow start-up of the COSMIC Center may have hampered this. If this is to remain an action force of MUSI, thinking needs to move from what COSMIC is currently, an emerging physical space, to the vision it once was, a hub for parents, students, teachers, and the community. The vision was that when one thought of mathematics, science, and technology in MPS, one thought of the COSMIC Center.

Assessment

Performance assessment is a powerful tool to change instruction. MPS has been engaged in major reform of assessment policies and procedures since 1991. The MPS assessment plan is comprehensive and includes locally designed performance assessments and stringent graduation requirements. MUSI's goals and action forces advanced the assessment efforts of the district, and all efforts are directed at aligning curriculum, teaching, and the assessment system. MUSI is providing extensive professional development that incorporates and coordinates this alignment. Feedback of student assessments is provided to teachers and schools so that they can modify their teaching to better align with curriculum standards.

Prior to MUSI implementation, student assessment was driven by paper and pencil skill tasks in many classrooms. However, evidence indicates that, after two years of MUSI implementation, teachers have increased their use of varied assessment practices. They are looking at more authentic performance activities. Assessment is often an avenue that provides the MSRTs access to classrooms that might have otherwise been closed to them. The monthly science performance assessment and preparation for the district performance assessments in science and mathematics were a powerful tool that provide this access and help teachers learn alternative assessment and teaching strategies.

Leadership and Management

With most new ideas, programs, or initiatives, planning and start-up are times of excitement and enthusiasm. Some refer to this time as the "honeymoon." It typically is a time of rapid growth, changes, flexibility, excitement, and enthusiasm before the trappings of uniformity and bureaucracy set in. Unfortunately, this period was rocky and difficult for MUSI's leadership team, school principals, and the MSRTs.

MUSI's leadership was plagued with instability. Members on the MUSI leadership team changed markedly during the first year of implementation as did the leadership in the district's central office. Stability and support in leadership was missing. Although the MSRTs overwhelmingly expressed respect for each member of MUSI's leadership team, they reported significant problems in communication and organization. These improved in the second year of MUSI, but not sufficiently according to the MSRTs who continued to report inconsistency, lack of organization, and poor communication as key problem areas.

The data reflects just how important leadership is in providing a platform for change and the supportive scaffolding necessary for school-wide reform. This support extended further than central administration and the MUSI leadership team. The data showed how critical the support of school principals was to the activities of the MSRTs, and this in turn appeared dependent on the level of professional development and information received by principals. Although the first year of MUSI was marked by management problems, during the second year, the organization and management of MUSI improved. School principals received information and professional development about MUSI in a more timely manner, and this facilitated MUSI activities in the schools much better than during the first year.

Additionally, the concept of teacher leadership was new and difficult to conceptualize for many including the MSRTs. A dichotomy existed for the MSRTs. Because they understood that each community, each school, each faculty, each teacher, and each student had different needs, many were trying to adapt accordingly. This is just what MUSI's community of learners wanted them to do; however, that was not being communicated adequately to them. The MSRTs did not understand their own level of autonomy in decision-making and goal setting. This much individual direction was foreign to the MSRTs who, for the most part, have had their goals and job

descriptions centrally decided. Autonomy was a major change for them; uniformity was familiar and expected.

Frequently MUSI participants shifted into old beliefs looking for the comforts of familiar organizational structures that the community model replaced. The MSRTs did not always understand and/or accept their leadership role as part of a community of learners. Rather than mandating a specific set of requirements for schools, teachers, and MSRTs, MUSI's communities of learners perspective left roles open and flexible for school communities to develop specifically for their needs, but many MUSI participants wanted more defined parameters to guide their work. It is difficult to understand the empowerment that the community perspective provides if one has worked under a bureaucratic organization for an extended period of time as the MSRTs had. Decision-making in a community shifts from "Tell me what to do" to "What would and should I do?" Bryk (1988) and Sergiovanni (1994) cautioned that members in a budding community constantly need to be on guard against old tendencies; they need to instill norms, not rules. When difficulties and ambiguities prevailed, the MUSI community too often looked to old rules for clarification.

Equity

The essence of MUSI's plan for equity is based on the belief that reforming the way teachers teach will meet the needs of all students rather than a select few. Teaching that it is grounded in standards, inquiry approaches, and authentic and motivating experiences will gradually narrow and ultimately close performance gaps between groups of students.

Equity cannot be clearly isolated even for discussion purposes as some of the other bases can. However, in responding to questions regarding equity, most participants in MUSI were more likely to talk about equity as a separate issue rather than an interwoven, systemic problem. The MSRTs are a dedicated and committed group of educators who believe deeply in the abilities of students. Despite professional development and discussion of equity issues provided by MUSI, they felt frustrated by their inability to "solve the equity problem" as if it were a separate issue. MUSI needs to help them deal with this frustration in constructive ways by helping them conceptualize what is meant by systemic reform. Too often our need to measure progress breaks systems into unique parts, drivers, and core data elements at the expense of the whole. Although accountability necessitates this, members of the community of learners need to be reminded of the critical role they are playing in changing the whole despite how we dissect and measure it.

One of the most disturbing findings in this evaluation is that MPS teachers have not substantively changed their attitudes about student learning. Teachers continue to hold low expectations. They believe that they must teach the basics before higher order thinking can begin, and they cling to grouping students by ability levels. Changing these beliefs may be MUSI's greatest challenge. It will be extremely difficult to change teaching practices if teachers do not even believe or trust in the learning abilities of their students.

School-based Support: Policies and Resources

MUSI provides the action forces that provide support to teachers who need to change the way they teach mathematics and science, but much more is needed for these forces to have an effect on practices. Each school needs to establish its own policies and provide the resources to not only allow this to happen, but also to facilitate it and to create the organizational structures needed for change to grow. Each school facilitated the activities of the MSRTs in different ways and to various levels. Some MSRTs were welcomed and given time to address the faculty and adequate space in which to work. For other MSRTs, simply finding a desk or a place to hang their belongings was a major problem. Much of a school's support was related to the principal's and

staff's understanding of MUSI goals and activities. Many of these supports involved increasing planning time, often through flexible scheduling and adequate resources.

Some schools provided time for teachers to meet by content areas. This time was either accommodated within the school day through flexible scheduling techniques, or teachers were reimbursed for after school meetings. Unfortunately these opportunities were more the exception than the rule. Many teachers across all grade levels reported the need for more planning time, and this was most pronounced for collaborative meetings. MPS teachers do not have enough time to meet together to learn, to reflect, and to dialogue. However, as Goodman (1992) pointed out, the issue is not only that teachers simply need more time to talk but also that there is real substance to what they talk about. Reflection and dialogue do not mean another general discussion of a new learning theory; that is still transmission of knowledge. Instead, reflection and dialogue asks how each educator is applying that theory in classrooms.

Adequate resources also support teachers. Some schools provide adequate resources while others do not. Having sufficient resources in a building with inconvenient access, renders those resources inadequate. When teachers are struggling to accommodate the needs of many diverse students, and at the same time, change the way they have done this for many years, the additional hurdle of insufficient or inaccessible materials may simply be the last straw to inhibit potential change. Interestingly, teachers of mathematics are more satisfied with teaching resources than their counterparts in science. The discrepancy between them raises serious questions for future inquiry. Do teachers of mathematics continue to view their content area traditionally with paper and pencil tasks still the primary resource needed? If so, it is easy to be satisfied with teaching resources. On the other hand, are science teachers less satisfied with their resources because they feel they need so many more in order to accomplish hands-on, inquiry based instruction?

Table 20 . The Status of the Forces of MUSI

Force	Pre-MUSI	Two Years of MUSI Implementation (1996-98)
Driving Force: Community of Learners Perspective	• Bureaucratic perspective; shift to site-based management. • Mandated • Primary mechanisms for reform: Sporadic, focus on individuals	• Community of Learners emerging. Perspective encompasses classrooms, schools, and the broader community of families, business, agencies, etc. • Voluntary • Primary mechanisms for reform: (1) MSRTs, (2) Professional development, (3) COSMIC Center
Action Force: Cadre of Teacher Leaders (MSRTs)	• District-wide curriculum specialists—one for mathematics and one for science.	• A cadre of MSRTs providing school-based support: Each MSRT is half-time in an MPS school for two years (or more) providing frequent inservice programs, teacher coaching, classroom-support, team teaching, demonstration lessons, resource development and acquisition, support for technology infusion, parent programs, etc. • Many teachers report that assistance by MSRTs has helped them improve their instructional practices.
Action Force: Professional Development	• Professional development often consisted of short-term (often one-shot), pull-out inservice sessions for teachers, staff, and administrators. • Often no follow-up support for teachers and staff back in their schools.	• For Teachers: Approximately 800 teachers participated in sustained professional development through 27 MUSI-UWM courses in mathematics and science. The MSRTs supported implementation of teacher learning from courses and other district professional development at the school level. • For MSRTs: MSRTs participated in intense institutes designed for them and participated in weekly seminars. These improved from Year 1 to Year 2 but are still in need of restructuring. • For Principals and School Leaders: Staff in new MUSI schools receive limited information on the goals and efforts of MUSI and on the role and actions of the MSRT within their schools which impeded start-up efforts in many MUSI schools.
Action Force: Mathematics, Science, Technology Center (COSMIC Center)	• Poor coordination of mathematics and science initiatives, technology for instruction, and teacher networks. • Location of facilities to conduct professional development is difficult. Space is at a premium and shared among all disciplines.	• District building identified as location for Mathematics, Science, and Technology Center (COSMIC Center). • District funds allocated and renovation of building occurred during Years 1 and 2 of MUSI. • Physical space available towards end of Year 2. • COSMIC Center is not yet the hub of mathematics, science, and technology in MPS.

Table 21 . The Status of the Six Foundational Elements

Base	Pre-MUSI	Two Years of MUSI Implementation (1996-98)
Standards-based Curriculum	• District developed and established the MPS K-12 Teaching and Learning Goals. • District established two-year benchmarks in the various disciplines, but these lacked alignment with national or state standards. • MPS staff members lacking in knowledge of national standards. • District mathematics curriculum is not standards-based. • District science curriculum is being developed and revised based upon national science benchmarks and emerging national standards. • The elementary science program adoption, *Explorations*, contains no student texts, only teacher guides. • A Science Kit distribution program is established for the district elementary schools.	• Development of Curriculum Frameworks specific to mathematics and science and coordinated throughout grades K-12 and aligned with national and state standards began during Year 2 of implementation with assistance from NCREL. • Pilots in Year 1 and 2 of NSF funded curricula in elementary, middle, and high school mathematics. • NSF curricula adopted for district implementation. Grades 6-8 adopted *Connected Mathematics* for 1998-99 school year implementation. Grades K-5 adopted *Investigations in Number, Data, and Space* for implementation in the 1999-2000 school year. • New ninth grade Integrated Science course is developed. • Science curriculum in elementary and middle school continues revision and enhancement to support standards-based, content-rich instruction. • Teachers improve understanding of national standards. • Feelings of hopefulness and signs of changes emerge throughout the district regarding the focus on standards-based mathematics and science curriculum.
Teaching, Learning, and Technology	• Traditional teaching strategies dominate that are textbook and worksheet driven with much rote, repetitive, and disjointed work. • Teaching strategies lack use of cooperative learning groups and rich contextual activities. • District goals and plans are created for increased classroom use of technology. • Time for teaching science is not adequate, particularly in elementary classrooms. • Mathematics is valued more than science.	• Tools for changing teaching implemented, such as the use of replacement units at the elementary level through MUSI-UWM courses and the pilot of mathematics programs at all levels. • More emphasis on hands-on, inquiry-based learning and problem solving; more students working in groups; and more student-generated science experiments. • More teachers interested in mathematics and science; more excitement in classrooms; some positive changes in student behaviors. • Use of technology not changing substantially; use of computers not an integral part of mathematics and science instruction. • More time needs to be devoted for teaching science, especially at elementary school level.
Assessment	• MPS engaged in major reform of assessment since 1991; assessment system includes MPS designed performance assessments and graduation requirements. • Performance based assessment incorporated into professional development. • Student assessment in most classrooms still driven by paper and pencil skill tasks.	• Work of the MSRTs and the MUSI professional development program advance assessment efforts of MPS within schools, especially for science performance assessment. • Goals of MUSI and MPS assessment system well aligned. • Tools for changing assessment developed, such as the science performance assessment. • More teachers have varied their assessment practices and moved towards performance-based assessment.

Table 21 . The Status of the Six Foundational Elements (continued)

Equity	• Equity is a separate issue. • Privatized teaching in isolated classrooms. • Low expectations and teacher beliefs that learning in ability-based groupings and teaching the basics first and foremost are best practices.	• Equity is becoming a systemic issue yet the systemic nature and complexity of the problem is still often misunderstood. Individuals are unsure how to "solve the equity problem." • De-privatization of practice and major reform of teaching emphasizes standards and inquiry approaches. • Low expectations and teacher beliefs continue as in Pre-MUSI.
School-based Supports	• Strong need for preparation and professional development about MUSI in the schools. • Lack of adequate planning time is an obstacle to successful teaching, especially in science. • Severe need for collaborative planning. • Adequacy of resources, materials, and equipment viewed as both an obstacle and a support for teaching mathematics and science.	• Varying levels of welcome and supports within schools for MUSI and MSRT role still unclear in some schools. • Overall attitudes about MUSI excellent in that many teachers believe that MUSI had a marked impact in their schools and that being a MUSI school improves mathematics and science programs. • Lack of adequate planning time continues. • Severe need for collaborative planning time continues. • Inconsistent data regarding adequacy of resources, materials, and equipment in schools.
Leadership and Management	• Bureaucratic perspective with strong linear organizational patterns. • Central administration support from one Mathematics Curriculum Specialist and one Science Curriculum Specialist district-wide. • Little emphasis on teacher leadership. • Instability in central administration during MUSI planning.	• Teacher leadership and community are new concepts that are difficult for many to conceptualize; more emphasis on teacher leadership. • Community perspective emphasized; however, leadership often still traditionally perceived • Instability in central administration and MUSI leadership team occurred during implementation. • Difficult start-up for MUSI leadership which is perceived as a critical base for MUSI reform. • Management problems for MUSI continue such as inconsistency, lack of organization, and poor communication. • The support of school principals is critical to the activities of the MSRTs and efforts of MUSI within the schools.

Chapter 4
Ideas and Impressions

Over the past two years, participants in the Milwaukee Urban Systemic Initiative (MUSI) have collected extensive data. This evaluation summary of that data has revealed many aspirations that were realized. It has also uncovered many lessons that can help MUSI planners learn and plan for the future of MUSI and beyond. The following ideas suggest continuation and/or strengthening of current practices while others encourage major modifications. The list is not exhaustive and is offered only as a starting point for discussions. These ideas are organized around the forces of MUSI because they are the activities that can directly impact the foundation of excellence for all in the Milwaukee Public Schools (MPS).

The Driving Force: The Community of Learners

- Have schools identify MUSI teams in which members receive training to provide leadership in mathematics and science within the schools. Encourage all interested stakeholders to participate including administrators, teachers, coordinators, and implementors, and parents.
- Clarify, communicate, and foster a new vision of teacher leadership and increased autonomy for all educators. Provide the MSRTs with more direct input into decision-making. Increase delegating responsibility to the MSRTs. Although several MSRTs may have difficulty making this change, the majority are seeking new levels of autonomy and opportunities for influence.
- Instill norms, not rules. Encourage all educators to ask, "What would and should I do?" rather than, "Tell me what to do."
- Provide unique and distinct opportunities for collaboration and project/product direction to the weekly MSRT seminars. Responsibility and decision-making for defining and producing expected outcomes should come directly from the MSRTs. To help facilitate this, eliminate MUSI administrative issues from the weekly MSRT seminars and establish alternative formats for completing these management activities, e.g., through information flyers, written exchanges, email communication, and short, periodic (monthly) meetings not associated with weekly seminars.
- Pair and combine the varied expertise of MSRTs by forming small collaborative professional development groups in which the MSRTs can share their strengths, e.g., MSRTs with strengths in mathematics with those in science, MSRTs with strong assertive leadership styles with quiet collaborators who strive for consensus.
- Continue to facilitate and build the collaborative relationship established between MPS and the University of Wisconsin-Milwaukee (UWM).

The Action Force: The MSRTs

- Continue and expand current practices (team teaching, demonstration teaching, modeling, etc.) within classrooms that operationalize the ideas presented in professional development activities.
- Stimulate discussions in schools on how to provide time for teachers to meet according to content areas either through flexible creative scheduling within the school day or reimbursement for after school hours meetings.

- Facilitate staffs to envision creative scheduling arrangements that provide longer blocks of time for teachers who want to meet (e.g., banking time and rearranged schedules to accommodate lengthened lunch hours).
- Encourage customizing educational programs that are alternatives to traditional groupings of students in isolated classrooms that promote greater interaction and collaboration among teachers.
- Examine how educators comply with mandated time allocations for content areas. For example, encourage consider reordering teaching into thought provoking projects that incorporate multiple subject areas over a period of time or establish team teaching arrangements that incorporate staff not typically assigned to classrooms such as psychologists, administrators, and counselors to increase contact time with each child.

The Action Force: Professional Development

For Teachers

- Continue and expand the professional development activities for teachers that are currently in place.
- Guide teachers to trust in the learning abilities of their students. For example, stage activities that contrast results of students under low and high expectations, dramatize learning in ability-based groupings versus diverse groupings, or portray the excitement of inquiry-based teaching versus the dullness of teaching and learning skills only.
- Elevate teachers thinking about inquiry-based teaching strategies from isolated events to conceptualizing a new way of thinking about teaching and learning.
- Since the interrelationship of the MSRTs and MUSI's professional development program is the most forceful component, additional strategies that enhance this relationship should be explored and implemented whenever possible. For example, planners can incorporate at least one cooperative session for the school MSRT and each school team in each professional development activity, encourage teachers to develop plans for teaching reform that include how the MSRT will be utilized in the process, or encourage teachers to develop plans for teaching reform that include how they will incorporate technology into their teaching.

For Mathematics and Science Resource Teachers (MSRT)

- Provide professional development to help MSRTs reduce their frustrations with ambiguity, problems of equity, and the slowness of systemic change. They need to understand that they cannot "solve the equity problem" as if it were a separate issue, but can and are contributing to narrowing the gap through their efforts of reforming instruction. Their goal is to help others, especially classroom teachers, also see how they are keys to successful reform.
- Provide extensive training and modeling in leadership, communication, and group dynamics for the MSRTs.
- Through intensive training and support, develop and nurture an image of leadership for each MSRT. Understand that these are new roles, and rather than designing structures for conformity, foster abilities of each MSRT to adapt and make independent decisions.

For the MUSI Leadership Team

- Provide separate training and modeling in management for the MUSI leadership team that is unique to their specific needs.

- Develop skills in group dynamics and methods of improved communication for use with varied groups of participators, e.g., schools, parents, central administration, agencies, and MSRTs.

For Schools and Principals

- Generate more and clearer communication between MUSI and principals so that schools take full advantage of what MUSI and the MSRTs can provide, e.g., more direct MSRT involvement in how mathematics and science can become an integral part of school visions and future plans.
- Foster stronger interaction between MUSI and school principals because informed and supportive principals were very influential in how effectively the MSRTs function in their schools. Effective support took the form of introducing and welcoming MSRTs, creating structures and mechanisms for communication between MSRTs and faculty members, and providing facilities and resources. Without this support, MSRTs felt "frustrated" and "ineffective."

The Action Force: The COSMIC Center

- Clarify and define MUSI's plan for the COSMIC Center. Will MUSI resources be concentrated on the two action forces that have already demonstrated the greatest impact thus far (MSRTs and professional development) with the COSMIC Center remaining as another supplement to them, or should MUSI redirect resources to develop the COSMIC Center into a stronger action force of its own? What are the specific actions, resources, and timelines needed to implement whichever course is chosen?
- Expand use of the COSMIC Center's demonstration labs beyond mathematics and science experiments. For example, facilitate changing teachers' expectations and beliefs by dramatizing how students in varied ability groups and/or "low ability students" learn in new ways using inquiry-based teaching.

Other

- Obtain input from additional sources in future evaluation plans. Include data from MUSI's leadership team members, central administration personnel, and additional community members.

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Appendix A
MUSI Evaluation Reports

Baseline Data: The Self-study

Landscape of Mathematics and Science Education in Milwaukee: A Study of the Milwaukee Public Schools
(Huinker, D., Doyle, L. H., & Pearson, G. E., 1995)

During the 1993-94 school year, MPS, in consultation with UWM, received a planning grant from the National Science Foundation's Urban Systemic Initiative to study the current status of the K-12 mathematics and science programs throughout the school district. The information gained from the study provided input into the development of a systemic implementation plan to improve mathematics and science learning for all students. The four major components of the research design were (a) interviews, (b) classroom observations, (c) district-wide surveys of teachers, and (d) community and parent focus groups. Site visits were conducted at 40 of the 157 MPS schools. Three different versions of a survey were distributed to teachers district-wide: one to elementary school mathematics and science teachers, one to middle and high school mathematics teachers, and another version to middle and high school science teachers. Focus group discussions were held with 27 individuals who represented business and industry, cultural agencies, parents, community organizations, government, state agencies, and universities and colleges.

MUSI Evaluation Data Year 1

Evaluation of the 1996 Milwaukee Urban Systemic Initiative Mathematics/Science Resource Teacher Institute
(Huinker, D. & Pearson, G., 1997)

MUSI conducted an institute from August 28 through September 30, 1996 to prepare the first cadre of 25 Mathematics/Science Resource Teachers. This report presents an evaluation of that institute. The evaluation data was gathered from two sources. Participants responded daily to two or three questions. The responses to these questions provided formative feedback to the facilitators on a day-to-day basis. The responses were then analyzed and summarized in relation to the goals of the institute. On the final day of the institute, each participant completed a questionnaire that was designed to assess the participants' perceptions of the degree to which the institute met its goals.

Analysis of Initial Interviews with First Cohort Mathematics/Science Resource Teacher
(Doyle, L. H., Huinker, D., & Posnanski, T., 1997)

In November 1996, interviews were conducted with the first cadre of 25 MSRTs to determine their early impressions of MUSI. The MSRTs had completed a month-long training institute and had been working in their assigned schools for approximately one month at the time the interviews were conducted. Eleven questions were developed to elicit perceptions of the strengths and weaknesses of the initiative in its earliest stage.

Initial Survey Results for First Wave MUSI Schools
(Huinker, D., Pearson, G., Enochs, L., Porter, C. & Mueller, L., 1998)

In November 1996, elementary, middle, and high school teachers of mathematics and science in 52 First Wave MUSI Schools were surveyed regarding mathematics and science teaching and learning. This report contains the results of this initial teacher survey. Three different survey

instruments were used: (a) elementary school mathematics and science, (b) middle and high school mathematics , and (c) middle and high school science. Across all three levels, 670 teachers responded; 429 teachers responded to the elementary survey, 131 teachers responded to the middle and high school mathematics survey, and 110 teachers responded to the middle and high school science survey. The surveys contained scaled-response items and open-ended response items. Results are discussed separately for mathematics and for science according to nine categories: (a) instructional practices, supplies, and time, (b) assessment practices, (c) technology, (d) knowledge, perceptions, and beliefs, (e) student expectations and policy, (f) professional development and collaboration, (g) obstacles to teaching, and (h) supports for teaching.

The Journey Begins: First Year Activities of the MUSI Mathematics/Science Resource Teachers
(Huinker, D. & Pearson, G., 1997)

This report consists of summaries, compilations, and reflections of the activities engaged in by the Mathematics/Science Resource Teachers (MSRT) during the 1996-97 school year. Since the establishment of MSRTs in the Milwaukee Public Schools was a new venture, the question arose, How do the MSRTs support the classroom, school, and district communities of learners through systemic reform in mathematics and science? To examine patterns of MSRT activities, MSRTs submitted reports every three months describing their activities. For each report, they answered several open-ended questions and provided examples of what was happening in their schools as well as their involvement in MUSI throughout the district.

Retrospections of First Year MUSI Implementation: Interviews with the Mathematics/Science Resource Teachers
(Coan, C., Huinker, D., Mueller, L., Posnanski, T., & Porter, C., 1998)

Follow-up interviews were conducted with the first cadre of 25 MSRTs. Eleven questions which were more specific than the open ended questions used in the initial interviews conducted in November 1996 probed specific activities. These responses, combined with the responses in the initial interviews, contributed to the formative evaluation of MUSI during its first year of implementation.

First Year Site Visits to Milwaukee Urban Systemic Initiative Schools
(Huinker, D., Pearson, G., Posnanski, T., Coan, C., & Porter, C., 1998)

In April 1997, site visit teams visited eighteen of the First Wave MUSI schools: eight elementary, six middle , one K-8, and three high schools. In each school, procedures included interviews with two groups of approximately three teachers each, an interview with one group of six students, an interview with the principal, and observations of four classes, two mathematics and two science. Data collection instruments were based upon those used in the self-study of mathematics and science education in MPS and modified as needed. Site visit teams were trained using these instruments and guides. This report is a summary of the responses from the interviews and from the classroom observations.

MUSI Evaluation Data Year 2

Evaluation of the 1997 Milwaukee Urban Systemic Initiative Mathematics/Science Resource Teacher Institute
(Huinker, D., Mueller, L., Porter, C., 1998)

MUSI conducted an institute from 11–22 August 1997. The purpose of this institute was to prepare a cadre of 40 MSRTs for the second year of MUSI implementation. Nineteen MSRTs returned following the first year of implementation and 21 were new to the initiative. The

evaluation data was gathered from two sources: open-ended items throughout the institute and a questionnaire at its conclusion. The responses were analyzed and summarized in relation to the four goals of the institute: (a) targeting, (b) belief system, (c) building relationships, and (d) mobilizing toward targets.

Initial Conversations with Second Cohort MSRTs
(Huinker, D., Porter, C., Mueller, L., & Posnanski, T., 1998)

In fall 1997, interviews were conducted with the second cohort of MSRTs, those new to MUSI in its second year of implementation. The MSRTs had completed a two-week training institute in August and had just begun working in their assigned schools at the time the interviews were conducted. Nineteen of the 21 MSRTs participate d in individual semi-structured interviews. Eleven questions were used to elicit perceptions of the initiative and their role as an MSRT.

Initial Survey Results for Second and Third Wave Schools of the Milwaukee Urban Systemic Initiative
(Huinker, D., Evanow, M., & Posnanski, T, 1999)
This report contains the initial survey results for both Second and Third Wave schools. However, for the purposes of this evaluation summary, only the results for the Second Wave schools will be considered. In fall 1997, teachers of mathematics and science in the Second Wave MUSI Schools were surveyed regarding mathematics and science teaching and learning. Three different survey instruments were used: (a) elementary school mathematics and science, (b) middle and high school mathematics, and (c) middle and high school science. Across all three levels of Second Wave schools, 252 teachers responded; 182 teachers responded to the elementary survey, 36 teachers responded to the middle and high school mathematics survey, and 34 teachers responded to the middle and high school science survey. The surveys contained scaled-response items and open-ended response items.

Compilation of Focus Questions with Mathematics and Science Resource Teachers
(Pearson, G., & Mueller, L., 1998)

During the 1997-1998 school year, the Mathematics and Science Resource Teachers (MSRTs) were asked a series of open-ended questions three times throughout the year: in November 1997, in January 1998, and in March 1998. These questions focused on several key areas: (a) the type of support provided by MSRTs and specific examples, (b) the current status of mathematics and science instruction in each school, and (c) the emergence of the school community of learners. Responses to these questions were compiled, and from these, assertions were derived regarding the activities of MSRTs in their schools, opportunities for support, and examples of change.

MSRT Actions and Reflections: Second Year MUSI Implementation and the Mathematics/Science Resource Teachers
(Huinker, K., Mueller, L., Porter, C., & Coan, C., 1998)

This document describes the activities of the MSRTs during the 1997-98 school year and summarizes their recommendations. Near the conclusion of the second year of implementation, 37 of the 38 MSRTs completed a questionnaire and responded to a series of selected-response and free-response items. The responses to the items provided the MSRTs with an opportunity to reflect on their accomplishments and work during the second year of MUSI implementation and provided the MUSI leadership team with input to inform their discussions and planning for the third year of implementation. Frequencies were determined for the responses to 38 selected-response items and, where appropriate, means and standard deviations were calculated. The responses to nine free-response items were categorized and tallied according to themes which focused on accomplishments/impacts, activities/strategies, challenges, and suggestions.

Retrospections of Second Year MUSI Implementation: Interviews with Mathematics and Science Resource Teachers
(Coan, C., Huinker, D., & Evanow, M., 1999)

Follow-up interviews were conducted with a sample of the first and second cadres of MSRTs to represent a range of elementary, middle, and high school levels and to reflect strengths in mathematics or science, as well as to represent members of both cadres. Eight MSRTs were individually interviewed. The interviews were semi-structured based on eight questions. Responses were synthesized for each question along with illustrative comments.

Survey Results for First Wave Schools of the Milwaukee Urban Systemic Initiative
(Huinker, D., Porter, C., & Mueller, L., 1999)

Elementary, middle, and high school teachers of mathematics and science in the First Wave MUSI Schools were surveyed in fall 1996. Follow-up surveys were given to the teachers at the end of two years in spring 1998. A total of 485 responded to the follow-up surveys: 282 to the elementary survey, 113 to the middle and high school mathematics survey, and 90 to the middle and high school science survey. This report consists of contrastive tables containing the initial and follow-up survey findings. The data tables contained in this report address questions regarding teachers' perceptions of mathematics and science teaching and learning including instructional practices, assessment, technology, beliefs, expectations, and professional development. The open-ended items asked teachers to identify the biggest impact of MUSI on mathematics and science instruction and to comment on the support provided by the MSRTs. The responses to the open-ended items were analyzed for recurring themes and patterns.

Second Year Site Visits to Milwaukee Urban Systemic Initiative Schools
(Huinker, D., & Coan, C., 1999)

In April 1998, site visit teams visited nine of the First and SecondWave MUSI schools: four elementary, three middle, and two high schools. In each school, procedures included interviews with groups of teachers, a group of students, the principal, and observations of eight classes, four mathematics and four science. Data collection instruments were based upon those used in site visits during the first year of MUSI. In addition, a rubric was developed to rate each observed lesson in three areas: (1) standards-based instruction, (2) equity, and (3) community of learners. This report is a summary of the responses from the interviews and from the classroom observations.

Professional Learning Communities: MUSI-UWM Professional Development Courses in the First and Second Years of MUSI Implementation
(Huinker, D. & Mueller, L., 1998)

The University of Wisconsin-Milwaukee) developed and sponsored courses specifically to meet the needs of teachers and staff in the Milwaukee Urban Systemic Initiative. The university offered 28 professional development courses for approximately 800 MPS teachers, administrators, and staff during the first and second years of MUSI implementation. These courses focused on mathematics and science content, pedagogy, national standards, and connections to MPS mathematics and science curricula. Most courses were co-developed and also co-taught by UWM faculty and MPS teachers. Teachers and staff members usually enrolled in the courses as teams from their schools to ensure a support network and to foster professional learning communities within schools. This report includes descriptions and evaluations of the courses that were offered during the first year (1996-97) and second year (1997-98) of MUSI implementation. Tables listing the courses offered, enrollment numbers, and evaluation findings expressed in mean ratings are included. Illustrative responses to open-ended items are also included.

Appendix B
Rubric for Classroom Observations

Standards-based Instruction

Inquiry

1	2	3	4	5
No investigation or problem solving evident in the lesson. Mostly pencil and paper or lecture with no or very brief explanations.	Lesson is mainly "follow the recipe." Demonstration with materials and tools by teacher or by a few students. No or very little probing for observations or explanations.	Beginnings of investigations or problem solving in the lesson. Materials and tools used by many students but in a prescribed manner only. Some probing for observations and explanations.	Some opportunities for students to explore information in different ways. Available materials and tools used by students with some flexibility. Students make observations, design strategies, construct explanations, but usually for teacher posed questions.	Investigation or problem solving evident throughout the lesson. Wide variety of tools available for students to select from and use flexibly. Students pose questions or conjectures, develop investigations or strategies, use observations to construct explanations, and evaluate approaches and conclusions.

Content Rich

1	2	3	4	5
Lesson focuses on recalling facts, terms, or procedures. Emphasis on having fun or enjoyment more than deep learning. No evidence that this lesson went beyond recall to making connections in some way for the students.	Lesson focused on acquiring new facts, terms, concepts, or procedures through rote strategies. Some emphasis on comprehension. Students make some comparisons, but mostly restate answers, resulting in superficial or no connections.	Attempts at applying acquired knowledge, concepts, and procedures in new situations. Lesson aids in making weak connections in some way to same or other disciplines or the real world.	Lesson challenges students to examine current conceptions and deepen to understanding of concepts and procedures. Students make observations that prompt them to look for connections within a discipline, to other disciplines, or to the real world.	Lesson deepens students' conceptual understanding by examining, reasoning about, and synthesizing content. Students can explain the content of the task. Students make critical connections within the discipline, as well as with other disciplines or with real world experiences.

Teacher Questioning

1	2	3	4	5
Teacher is interested only in correct answers; usually goes no further than to ask "what" was the answer seeking no further reflection. Ignores or disregards errors.	Teacher asks how students solved problems, asking them only to recall steps taken as procedural summaries, not an explanation of why. Disregards or simply corrects errors.	Teacher asks why a particular strategy or approach was chosen, seeking an expected response or just accepts response and does not press for a deeper rationale. Acknowledges errors but does not use them to build further learning.	Teacher attempts to dialogue with students by asking probing questions to elicit reasons and solution strategies, and presses students to reflect on their conceptual thinking to strengthen their understanding. Attempts to use errors to build further learning.	Teacher consistently asks students to justify, evaluate, compare, or defend strategies and answers with links to mathematical or scientific reasoning, and presses students to reflect on building on their own thinking. Errors are used as opportunities to reconceptualize problems, explore contradictions, and seek alternative strategies and explanations.

Equity

High Expectations				
1	2	3	4	5
Teacher only calls on or engages a few students fully in the lesson. No reassurance that students are capable or ideas are valued. Participation is very uneven across cultural and gender groups.	Teacher calls on or engages some students in the lesson with little encouragement that they are capable or that ideas are valued. Participation is solicited unevenly across cultural and gender groups.	Teacher attempts to engage all students, but relies on a subset (e.g. students with correct answers). Teachers states, but does not reinforce, that all ideas are valued. Participation is uneven across cultural and gender groups.	Teacher engages most students in the lesson with repeated encouragement and valuing of students' ideas. Even participation across cultural and gender groups.	Teacher engages all or most students fully in the lesson with the constant reassurance that they are capable and that their ideas are valued. Participation solicited evenly across cultural and gender groups.
Cultural Connections				
1	2	3	4	5
No references in lesson nor evidence in the classroom decor of cultural or gender group contributions to math and science. No references of impact on students' home culture. Stereotypes and biases were not discussed.	Some evidence in room displays of cultural and gender group contributions to math and science, or of impact on home cultures, but no references observed in the lesson. Stereotypes and biases were not discussed.	Brief comment made regarding contributions of cultural and gender groups or impact on students' own home cultural environments, but peripheral to lesson. Stereotypes and biases that arose were acknowledged but not discussed.	Lesson attempts to bring in cultural and gender group contributions to math and science or attempts to relate lesson to students' home cultures. Stereotypes and biases that became evident during the lesson were challenged and discussed.	Lesson meaningfully integrates the contributions of cultural and gender groups or integrates the impact of math and science can or does have on students' own home environments. Discussion of stereotypes and biases was integrated into the lesson.

Community of Learners

Interactions				
1	2	3	4	5
Class is a collection of individuals. No or very few exchanges between peers in small or whole group settings. Exchanges among peers focus mainly on off-task topics.	Students sit in small groups or as pairs for all or part of the lesson, but exchanges focus only on sharing of materials and answers.	Some students are engaged in collaborative working relationships, exchanging ideas, reasoning, and solutions strategies.	Many students are engaged in collaborative working relationships, responding to one another's ideas and solutions, and trying to understand the validity of alternative approaches and answers.	Class is a learning community. All or most students participate in substantial exchanges among peers in small or whole group settings in order to compare and merge their observations to make sense of mathematical and scientific ideas.
Intellectual Engagement				
1	2	3	4	5
Students are not intellectually challenged (e.g. busy or rote work) but are compliant in performing requested actions, not on task, occasionally on task, or involved in disruptive disengagement.	Students are briefly challenged to reason but they do not respond, put forth little effort to become involved, or the teacher provides the responses.	Sporadic or episodic intellectual challenges move students to become involved, but it is inconsistent, mildly enthusiastic, or dependent upon frequent prodding from the teacher.	For much of the lesson, students are challenged to reason about math and science concepts and may students discuss issues and important ideas with some enthusiasm and interest.	Students are challenged intellectually with important mathematical and scientific ideas throughout the lesson. All or most students are actively and consistently involved, excited, and interested.
Source of Knowledge				
1	2	3	4	5
Only teacher and text materials are recognized, used, and valued as sources of knowledge and authority.	Acknowledgment that sometimes students can be a knowledge source, but they are not used or provided with an opportunity to be a source. Authority remains with teacher and text materials.	Acknowledgment of students as a source of knowledge, and they are given opportunities to generate ideas and strategies. Much reliance still on teacher, text or other outside entities as authorities.	Students are recognized as a source of knowledge, and some students join in the process of generating ideas, conjectures, and strategies. Evidence of teacher not being the ultimate authority.	All students are recognized and valued as knowledge sources and play an integral part as knowledge sources throughout the lesson as they generate ideas, conjectures, strategies and approaches. Evidence of students as authorities.

Appendix C
Tips of the Trade for MSRTs

(Suggestions for new MSRTs from incumbents)

Participate in activities with teachers

Participate in staff meetings, join school committees, and work on special school projects.

I tried to set up classroom events that involved the use of math and science skills. Then I asked teachers to participate in those events through team teaching. I worked with those who were willing to work with me and hoped they spread the word to others.

I gave mini-informational sessions at staff meetings or on banking day. This lead to entries into some classes.

Seek out leaders and key people.

I sought out the leaders in the building and worked with them first. They then helped me gain access to others.

Attend UWM/MUSI courses or inservices with teachers.

I went to courses and inservices with teachers. This was very powerful since you could share and react to what was learned and then together plan a follow-up together. It also allowed you to get to know the teachers in an out of school atmosphere.

Be Accessible and Be a Good Listener

An approach that has had some mild payback was arriving at school early and walking the playground and chatting with the duty teachers and the students before school started. Just before the bell a good number of teachers come out and I could get a lot of scheduling done. I discovered teachers and students interests and could provide resources that meet with their needs.

I tended to find something to do near the key case at the end of the day and during lunch hours when teachers checked their mailboxes. This had been a great avenue for teachers and myself to engage in conversations and set up appointments.

Listen, talk one-on-one, be a sounding board, be friendly and empathetic, and offer encouragement.

My main strategy was to talk with teachers, talk with them, talk with them. They gradually felt more comfortable and shared insights and needs. I did most of the visiting one-on-one, since there were not enough meetings at either school that get the math and/or science teachers together.

First understand before being understood. Don't go in and tell people what to do. Ask their opinions.

Do a lot of listening. Develop good relationships with your teachers first.

Use district and state assessments.

The ITBS, WSAS, and MPS science performance assessment have provided many initial entries, mainly because we as MSRTs have information which teachers might not have access to. Being able to explain the data and having information from the MPS Curriculum Specialist on the mathematics topics has been helpful.

Helping out with the science assessment and preparing for it was a great way for me to get into rooms and work with teachers. They knew we were in it together.

Have something to share.

I found it much easier to get into the classrooms when I had something specific to share such as The Math Game materials, the UWM classes, other professional opportunities, holiday activities, and assessment preparation materials.

Ask to come into the class and do one thing.

I did mini-lessons in classrooms as a test to get teachers and kids feelings about a possible future project. Guess what! Many of the classes started the projects themselves. The teachers liked these projects and the simplicity and the kids like them too. Many people are looking for simple, understandable ideas.

I asked the teachers if I could come into the classroom in order to assess the student's math portfolio work.

Some Additional Thoughts

Listen all of the time. Reflect and think about what people tell you and think things through, don't just react. Keep your target in mind and always ask yourself if using your time for "X" will benefit MPS students.

Don't try to do too much too fast. Be patient. Remember that you aren't going to get all of the training in the world, because training is an ongoing process. You don't need to be trained to be effective. Rely on what you know. Pace yourself and remember to take care of yourself.

Keep an open mind. Don't rush in and try to accomplish too many things. Go with the flow. Have an idea of what accomplishments can be made.

Go in with a plan and stick to it. Make demands of the leadership. Don't go in like a bull in a china shop. Just continue and struggle.

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