Linking Teacher Characteristics to Student Mathematics Outcomes: Preliminary Evidence of Impact on Teachers and Students after Participation in the First Year of the Math in the Middle Institute Partnership

Stephen J. Meyer & John T. Sutton
RMC Research Corporation
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Background

The Math in the Middle Institute Partnership (M^2) is designed to improve K-12 student mathematics achievement by creating sustainable partnerships among individuals at each of the following entities: the University of Nebraska-Lincoln, regional Educational Service Units (ESUs), and local school districts. These partnerships are designed to educate and support teams of outstanding middle-level mathematics teachers (Grades 5-8) who will become intellectual leaders in their schools, districts, and ESUs. M^2 is particularly committed to improving the capacity of rural teachers, schools, and districts. The design of M^2 is grounded in evidence-based research on learning, teaching, and teacher professional development. M^2 involves multiple cohorts of teachers, each of which consists of approximately 30 lead teachers. Project activities began in fall 2004 and continue through summer 2009. M^2 consists of three major components:

1. *The M^2 Institute.* The multiyear M^2 Institute is designed to enhance teachers' mathematical content knowledge, teaching, and leadership skills. Each cohort of teachers completes 12 courses, which amount to 36 academic hours, through a combination of intensive summer institutes and academic school year courses over a two to three year period;

2. *Mathematics Learning Teams.* Mathematics learning teams are led by M^2 lead teachers, who participate in the M^2 Institute, with support from school administrators and university faculty. The teams are designed to help teachers develop collegiality, align their teaching with NCTM and state standards, and examine their instructional and assessment practices; and

3. *A Research Initiative.* Research activities are designed to enhance knowledge about how M^2 components affect educational improvement and innovation.

The proportion of teachers from Lincoln Public Schools was roughly half of the M^2 participants in the first Cohort and is smaller each subsequent year, as M^2 includes districts throughout the state of Nebraska. M^2 works with experienced classroom teachers who want to deepen their knowledge of mathematics and the teaching of mathematics and to build the leadership skills needed to become master teachers and intellectual leaders in their school, district, and ESU. Opportunities to participate in M^2 are shared by partner ESU staff, school administrators, and participating teachers. While teachers who have engaged in prior ESU professional development activities are encouraged to participate, all teachers in partner ESU regions may apply and an application is available on the M^2 Web site. Applications are accepted in the fall of each year and applicants are selected to ensure geographic diversity and distribution across grade levels taught. To be accepted for M^2 participation, applicants must also provide documentation that confirms support by their school administration and district/ESU core partner. Current K-12 core partners include the Lincoln Public Schools, Educational Service Units #6, 7, 8, 9, 10, 13, 16, and 17, and the local school districts served by these ESUs.

External Evaluation

RMC Research is conducting an evaluation using a quasi-experimental design that compares outcomes for M^2 lead teachers and their students to those of teachers and students in a comparison group. Teacher and student outcome data include teacher surveys, a teacher content knowledge assessment, and student mathematics achievement data. Qualitative components of the study include interviews and focus groups representing all project participants; observations of M^2 professional development activities; and analysis of documents including professional development plans, course materials and teacher course work, activity evaluations, and classroom observation data.

Evaluation Questions

1. To what extent has M^2 affected math achievement and other outcomes for participating students?

2. To what extent do M^2 activities meet standards for effective professional development?

3. To what extent has M^2 met its seven articulated goals?
   To what extent . . .
   a. Does participation in M^2 enrich teachers' mathematics knowledge?
   b. Do teachers transfer mathematics learned through M^2 activities into their classrooms?
   c. Do M^2 activities develop teachers' ability to teach diverse groups of students with different learning styles?
   d. Does M^2 support teachers' ability to engage in action research that influences teaching practice?
   e. Does M^2 foster the embedding of mathematics into the curricula of other subject areas?
   f. Does M^2 foster communities of professionals who communicate regularly with one another?
   g. Does M^2 develop lead teachers who support colleagues' efforts to strengthen math courses and curricula?

4. To what extent does participation in M^2 affect IHE and IHE faculty practice?

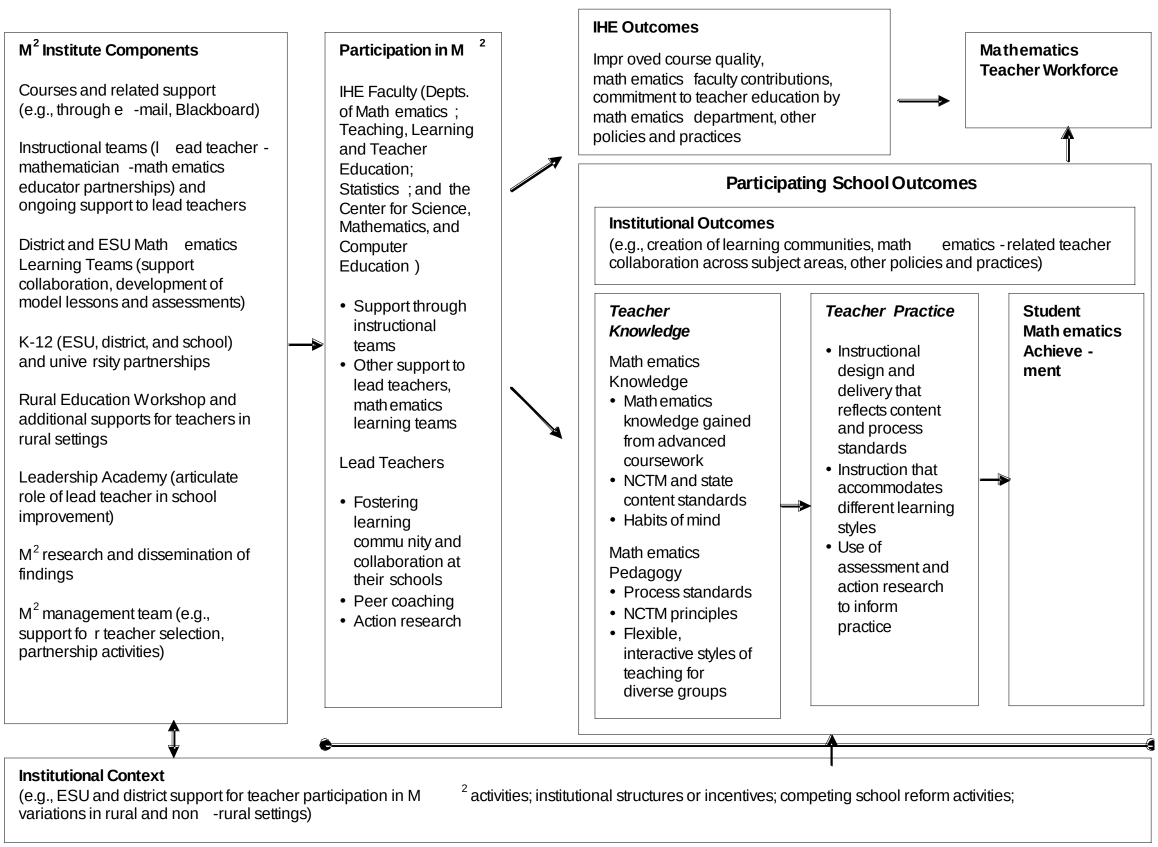
5. What factors impede or facilitate progress toward M^2 goals?

6. What progress has been made toward sustaining and "scaling up" M^2 activities and strategies?

Logic Model Guiding the Evaluation

Exhibit 1 presents a logic model that reflects hypotheses about the relationship between M^2 Institute activities and outcomes. The model illustrates that the M^2 Institute components are expected to have primary impacts on K-12 lead teachers and IHE faculty, which in turn will lead to impacts on participating schools and IHEs. The model also indicates that, within participating schools, improvements in teacher knowledge are expected to affect practice, which in turn, affects student achievement outcomes. Finally, the model indicates that institutional changes in participating schools and IHEs are expected ultimately to impact the rural mathematics teacher workforce. The logic model serves as a basis for the evaluation design and guides analyses.

Exhibit 1: Evaluation Logic Model for M2 Activities and Outcomes



Methodology

Results presented in this paper are based on data collected from Cohort 1 participants and their students in 2004 and 2005. This paper presents selected results from analyses of teacher survey and student achievement data. Complete evaluation results, including data from Cohort 2 participants and results from qualitative analyses, may be found in the 2004-2005 Evaluation Report (Sutton & Meyer, 2006).

In addition to examining change in teacher survey measures for all M^2 participants over time, teacher and student outcomes are compared using a quasi-experimental design that includes M^2

participants and non-participants in Lincoln Public Schools (LPS). All middle level (grades 5-8) mathematics teachers in LPS are asked to complete the teacher survey in the spring of each year. These data will allow for evaluation of district-wide change over time and will be the basis for a quasi-experimental study which compares outcomes for M^2 participants in LPS and their students to those of non-participating teachers and their students. RMC Research will also request individual student-level mathematics achievement data for all middle level students in Lincoln Public Schools for school years 2003-04, 2004-05, 2005-06, 2006-07, 2007-08, and 2008-09.

Teacher Survey

Exhibit 2 summarizes the teacher survey administration schedule. All M^2 participants are asked to complete a teacher survey prior to participation and each subsequent spring for a total of four survey administrations. In addition, comparison teachers are asked to complete a teacher survey on five occasions, beginning in Spring 2005.

Exhibit 2: Teacher Survey Administration Schedule

	Fall 2004	Spring 2005	Spring 2006	Spring 2007	Spring 2008	Spring 2009
M^2 Participants (Cohort 1)	X	X	X	X		
M^2 Participants (Cohort 2)		X	X	X	X	
M^2 Participants (Cohort 3)			X	X	X	X
M^2 Participants (Cohort 4)				X	X	X
Comparison Group (nonparticipating middle-level mathematics teachers in Lincoln Public Schools)		X	X	X	X	X

The teacher survey was designed by RMC Research and Math in the Middle project staff to include measures that align with project goals. Many items were adapted from existing teacher surveys including the *Mosaic II Rand Teacher Survey for Eighth Grade Mathematics* (Rand, 2003), the *Survey of Classroom Practices in Middle School Mathematics* (WCER, undated), and the *TIMSS Teacher Questionnaire for Eighth Grade Mathematics* (IEA, 2003). The survey includes measures of:

- Professional development participation;
- Readiness to teach mathematics topics;
- Ratings of capacity to serve as an instructional leader;
- Philosophy of mathematics teaching and learning;
- Mathematics curriculum and instruction;
- Ratings of learning community, teacher collaboration, collegiality, and academic climate; and
- Teacher background information.

Comparison teachers who interact with M^2 participants are asked to respond to survey items that address the roles of these lead teachers, mentorship relationships, and the quality of their leadership (e.g., training, peer coaching and observation activities).

Cohort 1 participants completed the survey as part of their participation in M^2 Institutes in October 2004 and September 2005. Logistical challenges delayed the administration of the spring 2005 survey. Comparison teacher surveys were mailed to 271 teachers in LPS in May 2005, using lists of middle-level mathematics teachers provided by the district. Comparison teachers who returned completed surveys were given a $10 gift card and a chance to win an additional $100 gift card as an incentive for their participation.
Exhibit 4 presents response rates for each group of respondents. All M^2 participants completed teacher surveys in 2004 and 2005. Among the 271 teachers from LPS who were mailed surveys, 124 teachers returned a survey and 21 indicated that they were not middle-level mathematics teachers, resulting in a response rate of 49.6 % (124/250).

Exhibit 4. Teacher Survey Respondents

	2004 Survey		2005 Survey	
	Completed Surveys	Response Rate	Completed Surveys[a]	Response Rate
Cohort 1 M^2 Participants				
LPS	16	100.0%	15	100.0%
Other Districts	17	100.0%	16	100.0%
Total	33	100.0%	31	100.0%
Comparison Group (LPS)	n/a	n/a	124	49.6%

[a]Two teachers discontinued their participation in M^2 prior to administration of the 2005 survey.

Based on results from exploratory factor analysis of items from the spring 2005 teacher survey, composite variables were created. Composite variables based on clusters of similar items are more robust and reliable than single survey items. Exhibit 5 presents each variable, along with the number of items it comprises and its reliability. Averages of teacher survey items were used to create composite variables, with the exception of the instructional technology use variable, which is the total number of uses of technology for students and teachers.

Exhibit 5. Teacher Survey Composite Variables

	Number of Items	Cronbach's Alpha
Overall Mathematics Professional Development Participation	**12**	**.83**
Overall Professional Development Emphasis on Mathematics Topics	**5**	**.86**
Overall Preparedness for Teaching Mathematics	**17**	**.91**
Preparedness to Teach Diverse Students (subscale)	4	.82
Overall Confidence in Mathematics and Teacher Support	**10**	**.90**
Confidence in Mathematical Knowledge (subscale)	3	.76
Confidence in Ability to Support Colleagues (subscale)	5	.88
Confidence in Leadership Ability (subscale)	2	.93
Emphasis on NCTM Process Standards	**5**	**.73**
Instructional Technology Use in Mathematics	**18**	**.83**
Overall Use of Assessment in Mathematics	**11**	**.78**
Use of Assessment - Analysis and Justification (subscale)	3	.82
Overall Factors that Limit Mathematics Teaching	**11**	**.70**
Factors that Limit Teaching - Student Characteristics (subscale)	5	.80
Factors that Limit Teaching - Instructional Resources (subscale)	4	.73
Overall Influence of External Factors on Mathematics Teaching	**11**	**.80**
Influence on Teaching - Standards and Testing (subscale)	4	.85
Professional Interaction	**5**	**.80**
Professional Interaction with M^2 Teacher Leaders	**8**	**.77**

Student Achievement Data

Achievement data were requested for all students of M^2 participants and for students taught by other teachers at the same schools and grade levels to provide a basis for comparison. Specifically, RMC Research requested aggregate and subtest scores for individual students, with identifying information that would allow comparison of scores across years. Mathematics achievement data were provided by LPS for all middle level (Grades 5-8) students in the district during the 2004-2005 school year. Data were also provided by 6 of the 11 districts outside LPS, in which 8 of the 16 non-LPS M^2 participants taught. Because of limitations of data provided by districts outside LPS (e.g., inconsistent outcome measures, inadequate comparison groups, and limited ability to link student data over time) and concerns about protecting teacher confidentiality, these data were excluded from the evaluation.

Achievement data provided by LPS included spring 2004 and spring 2005 mathematics scores for the district-designed CRT (Grades 4 and 8) and for the Metropolitan Achievement Test (MAT) (Grades 5, 6, and 7). Normal curve equivalent (NCE) scores on the MAT were provided for *concepts and problem solving*, *procedures*, and *total math*. Raw scores for the district-developed CRT were provided in the areas of *algebra*, *computation*, *data analysis*, *geometry*, *measurement*, and *numeration*. The *geometry* and *measurement* scores were combined into a single indicator for the spring 2005 test. A *total math* score was created for each student by computing the sum of scores across each subtest. Individual student identifiers were provided so that student data could be linked across years.

Teacher identifiers were also provided for Grades 6-8, allowing for linkage with teacher survey data and for identification of students taught by M^2 participants. For Grade 5, students taught by M^2 teachers were identified by LPS and teacher names were provided only for M^2 participants. Course names were provided only for students in Grades 6, 7, and 8 which allowed for identification of students who participated in courses with below-level, on-level, or above-level instruction. Student demographic information was also provided, including gender, race/ethnicity, and whether or not students participated in gifted/talented, special education, and English language learner (ELL) programming. Information about student-level socioeconomic status was not available.

The data for students in Grades 6, 7, and 8 included duplicate records for many students. In most cases, students had multiple records when they received instruction from a mathematics intervention specialist in addition to their regular classroom teacher. This resulted in students being linked to more than one teacher in many cases. For the purposes of this analysis, students with duplicate records were matched with the teacher who provided their on-level instruction. Students who could not be reliably matched with a teacher were excluded from analyses that included teacher survey data. Excluded students comprised less than one percent of all students at each grade level and therefore do not substantially impact the analyses.

Analysis

To examine change over time for survey responses of Cohort 1 M^2 participants, two-tailed, paired sample *t* tests were conducted for each composite variable and each item on the teacher survey. To examine differences in change over time across groups, repeated measures analysis of variance (RMANOVA) was used. Regression analysis was conducted to examine the relationship between teacher participation in M^2 and student achievement outcomes. The impact of participation in M^2 on spring 2005 student achievement data was examined, using several variables to control for differences among students and to examine the impact of variables based on teacher survey data. Repeated measures analysis of variance (RMANOVA) was also used to examine differences in 2004 and 2005 student achievement scores for teachers with different levels of interaction with M^2 participants. ***These analyses examine the impact of M^2 on participating teachers and their students and should be regarded as preliminary because they are based on data collected after only the first year of M^2 participation by the first cohort of M^2 participants.***

Change in Cohort 1 M^2 Participant Outcomes

This section presents an analysis of change in teacher measures based on pre- and post-test surveys for Cohort 1 participants to assess the preliminary impact of participation in the M^2 Institute. *Results from these analyses should be regarded as preliminary because they are based on data collected after only the first year of M^2 participation*. The Exhibits in this section present means for the 2004 and 2005 surveys, the difference in means, and indicators of statistical significance. In each table, composite variables are presented first—in cases where they could be reliably computed—followed by each survey item. Composite and subscale items are listed first, followed by survey items. Survey items are ordered according to the size of the difference between 2004 and 2005 survey ratings; items with the largest differences are presented first.

Ratings of Preparedness and Confidence

Exhibit 6 presents ratings of preparedness with respect to various aspects of mathematics instruction before and after the first year of participation in M^2. Statistically significant increases were found for nearly every indicator of preparedness. Composite measures of overall preparedness for teaching mathematics and preparedness to teach diverse populations increased significantly. The largest significant increases were found for teacher ratings of preparedness to teach problem-solving strategies, to select and adapt instructional materials, and to use a variety of assessment strategies. Increases in the areas of preparedness to select and adapt instructional materials and to use a variety of assessment strategies are surprising because these areas were not a focus of M^2 during its first year. Average increases were smallest for preparedness to teach students with limited English proficiency (LEP), to encourage participation of females, and to use action research. Survey ratings indicated that teachers felt well prepared to encourage participation of females, indicated by the highest mean score on both the 2004 and 2005 survey. Teachers indicated being slightly less than moderately prepared to teach LEP students and to use action research. Action research was not a focus of M^2 activities in the first year.

Exhibit 6. Preparedness With Respect to Mathematics Instruction (2004-2005)

	N	2004 Mean	2005 Mean	Difference	*t*	*p*
Overall Preparedness for Teaching Mathematics	**30**	**2.49**	**2.88**	**0.39*** **	**-4.84**	**.000**
Preparedness to Teach Diverse Populations	**30**	**2.23**	**2.52**	**0.29** **	**-3.23**	**.003**
Teach problem-solving strategies	30	2.53	3.13	0.60***	-4.54	.000
Select/adapt instructional materials	30	2.80	3.37	0.57***	-4.26	.000
Use a variety of assessment strategies	30	2.23	2.80	0.57**	-3.46	.002
Sequence mathematics instruction	30	2.77	3.30	0.53***	-4.00	.000
Provide instruction that meets challenging standards	29	3.00	3.48	0.48**	-3.78	.001
Provide a challenging curriculum for all students	30	2.93	3.40	0.47**	-3.50	.002
Teach mathematics with manipulative materials	30	2.23	2.63	0.40*	-2.56	.016
Teach mathematics with technology tools	30	1.90	2.30	0.40**	-2.84	.008
Connect mathematics and other subject areas	30	2.70	3.10	0.40**	-2.84	.008
Use student assessment results	30	2.63	3.03	0.40*	-2.45	.021
Teach students with diverse abilities	29	2.62	2.97	0.34*	-2.42	.023
Teach students with a variety of cultural backgrounds	30	2.33	2.67	0.33	-1.98	.057
Encourage participation of minorities	30	2.70	3.03	0.33*	-2.57	.016
Teach students with learning disabilities	30	2.30	2.57	0.27*	-2.50	.018
Teach students with limited English proficiency	30	1.70	1.93	0.23*	-2.54	.017
Encourage participation of females	30	3.27	3.50	0.23	-1.76	.090
Use action research	30	1.67	1.83	0.17	-0.96	.344

Note: 1 = Not Well Prepared; 2 = Somewhat Prepared; 3 = Well Prepared; 4 = Very Well Prepared; *$p < .05$, **$p < .01$, ***$p < .001$. Bold text indicates scaled items.

Cohort 1 participant ratings of confidence in mathematics and ability to support other teachers are presented in Exhibit 7. Statistically significant increases were found for measures of overall confidence, confidence in mathematical knowledge, and confidence in ability to support colleagues. Teacher ratings of ability to coach or mentor new teachers and to help colleagues improve mathematics knowledge and skills increased significantly. Statistically significant differences were also found for teacher knowledge about educational issues related to mathematics, knowledge beyond their teaching, and ability to write mathematics curriculum after the first year of participation in M^2. There were no significant changes in teacher ratings of confidence related to leadership ability. Development of leadership ability was not a focus of the first year of M^2, however.

Exhibit 7. Confidence in Mathematics and Teacher Support (2004-2005)

	N	2004 Mean	2005 Mean	Difference	*t*	*p*
Overall Confidence in Mathematics and Teacher Support	**31**	**2.59**	**2.97**	**0.38*** **	**-4.16**	**.000**
Confidence in Ability to Support Colleagues	**31**	**2.41**	**2.89**	**0.48** **	**-3.88**	**.001**
Confidence in Mathematical Knowledge	**30**	**2.71**	**3.04**	**0.34*** **	**-4.36**	**.000**
Confidence in Leadership Ability	**31**	**2.87**	**3.06**	**0.19**	**-1.65**	**.110**
Ability to coach or mentor new teachers	31	2.65	3.32	0.68***	-4.33	.000
Ability to help colleagues improve mathematics knowledge and skills	30	2.53	3.20	0.67***	-5.53	.000
Knowledge about educational issues related to mathematics	31	2.19	2.68	0.48**	-3.32	.002
Ability to provide multiple types of support to colleagues	31	2.16	2.58	0.42	-2.03	.051
Ability to write mathematics curriculum	31	2.42	2.77	0.35*	-2.36	.025
Ability to coach or mentor experienced teachers	31	2.29	2.61	0.32	-1.90	.067
Knowledge beyond what you teach	30	2.53	2.83	0.30*	-2.19	.037
Ability to act as a leader among other teachers	31	2.90	3.10	0.19	-1.53	.136
That other teachers see you as a leader	31	2.84	3.03	0.19	-1.53	.136
Knowledge related to mathematics you teach	29	3.48	3.66	0.17	-1.41	.169

Note: 1 = Not Confident at All; 2 = Somewhat Confident; 3 = Moderately Confident; 4 = Very Confident; $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$. Bold text indicates scaled items.

Philosophy of Mathematics Teaching and Learning

Exhibit 8 presents ratings of agreement with several statements related to mathematics teaching and learning. Statistically significant differences were found for three statements. After the first year of participating in M^2, teachers were significantly more likely to agree that:

- Solving mathematics problems often involves making conjectures, testing, and modifying findings;
- There are different ways to solve most mathematical problems; and
- All students can learn challenging content in mathematics.

Teachers were significantly less likely to agree that students master and retain mathematical algorithms more efficiently through repeated practice than through the use of applications and simulations.

Exhibit 8. Philosophy of Mathematics Teaching and Learning (2004-2005)

	N	2004 Mean	2005 Mean	Difference	*t*	*p*
Solving mathematics problems often involves making conjectures, testing, and modifying findings.	29	3.38	3.72	0.34*	-2.77	.010
There are different ways to solve most mathematical problems.	28	3.57	3.89	0.32**	-3.58	.001
All students can learn challenging content in mathematics.	27	3.19	3.48	0.30*	-2.13	.043
It is important for student learning to make connections between mathematics and other subject areas.	30	3.57	3.70	0.13	-1.28	.211
Few new discoveries in mathematics are being made.	24	1.63	1.67	0.04	-0.33	.747
Learning mathematics mainly involves memorizing.	28	1.82	1.75	-0.07	0.57	.573
It is important for students to learn basic mathematics skills before solving problems.	27	2.70	2.56	-0.15	0.85	.404
Mathematics should be learned as sets of algorithms or rules that cover all possibilities.	20	2.30	2.15	-0.15	0.72	.481
Students master and retain mathematical algorithms more efficiently through repeated practice than through the use of applications and simulations.	24	2.17	1.75	-0.42**	3.50	.002

Note: 1 = Strongly Disagree; 2 = Disagree; 3 = Agree; 4 = Strongly Agree; *$p < .05$, **$p < .01$.

Instructional Emphasis

Exhibit 9 presents teacher ratings of the extent to which they emphasized several areas of mathematics instruction before and after participating in the first year of M^2. Statistically significant increases were found for instructional emphasis on NCTM process standards (i.e., representation, problem solving, communication, connections, and reasoning and proof). The largest increases were found for emphasis on representation and problem solving. There was also a statistically significant increase in emphasis on using manipulatives.

Exhibit 9. Instructional Emphasis in Mathematics (2004-2005)

	N	2004 Mean	2005 Mean	Difference	*t*	*p*
Emphasis on NCTM Process Standards	**30**	**1.85**	**2.13**	**0.28****	**-3.40**	**.002**
Representation	30	1.60	2.07	0.47**	-3.12	.004
Problem solving	30	1.93	2.33	0.40**	-3.25	.003
Communication	30	1.67	1.93	0.27	-1.76	.088
Using manipulatives	30	1.00	1.27	0.27*	-2.50	.018
Connections	30	2.03	2.20	0.17	-1.04	.305
Reasoning and proof	30	2.00	2.10	0.10	-0.62	.541
Computation	30	2.23	2.17	-0.07	0.44	.662
Using algorithms	30	2.30	2.03	-0.27	1.97	.058

Note: 0 = No Emphasis; 1 = Slight Emphasis; 2 = Moderate Emphasis; 3 = Great Emphasis; *$p < .05$, **$p < .01$. Bold text indicates scaled items.

Use of Assessment

The frequency of teacher assessment practices before and after the first year of participation in M^2 is presented in Exhibit 10. There were statistically significant increases in ratings of overall use of assessment in mathematics and use of assessment that emphasized analysis and justification. Statistically significant increases were also found for the use of demonstrations/ presentations, rubrics, short answer questions involving searching for patterns and relationships, performance tasks, short answer questions requiring explanations or justifications, and long response items requiring explanations or justifications.

Exhibit 10. Use of Assessment in Mathematics (2004-2005)

	N	2004 Mean	2005 Mean	Difference	*t*	*p*
Overall Use of Assessment in Mathematics	**28**	**2.88**	**3.45**	**0.57****	**-3.11**	**.004**
Use of Assessment - Analysis and Justification Orientation	**28**	**3.23**	**3.94**	**0.71****	**-3.01**	**.006**
Individual or group demonstration, presentation	28	2.14	3.04	0.89*	-2.77	.010
Rubrics	28	2.04	2.89	0.86*	-2.68	.012
Short answer questions involving searching for patterns and relationships	28	3.75	4.54	0.79**	-2.87	.008
Performance tasks or events (for example, hands-on activities)	28	2.79	3.54	0.75*	-2.73	.011
Short answer questions requiring explanations or justifications	28	3.57	4.32	0.75*	-2.41	.023
Long response items for which student must explain or justify solution	28	2.36	2.96	0.61*	-2.68	.012
Systematic observation of students	27	4.11	4.56	0.44	-0.90	.376
Short answer questions involving use of algorithms or other mathematical procedures	28	4.29	4.71	0.43	-1.21	.237
Mathematics projects	28	1.96	2.39	0.43	-1.76	.090
Objective items (e.g., multiple choice, true/false)	27	3.11	3.41	0.30	-0.98	.334
Portfolios	28	1.57	1.54	-0.04	0.24	.813

Note: 1 = Never; 2 = Once or Twice Per Year; 3 = Three to Eight Times Per Year; 4 = Monthly; 5 = Weekly; 6 = Almost Daily; *$p < .05$, **$p < .01$. Bold text indicates scaled items.

Professional Interaction among Mathematics Teachers

Exhibit 11 shows teacher ratings of professional interaction. There was no significant difference in an overall measure of professional interaction. Teacher ratings of the frequency with which they worked together to prepare instructional materials increased significantly after the first year of participation in M^2. Ratings were highest in both 2004 and 2005 for teachers having discussions about how to teach and sharing ideas and materials and there were no significant changes in these two areas over the course of the year.

Exhibit 11. Ratings of Professional Interaction in School, District, or ESU (2004-2005)

	N	2004 Mean	2005 Mean	Difference	*t*	*p*
Overall Professional Interaction	**29**	**2.65**	**3.00**	**0.35**	**-1.65**	**.111**
Teachers work together to prepare instructional materials.	29	2.31	3.14	0.83**	-3.04	.005
Teachers have discussions about how to teach a particular concept.	29	3.07	3.55	0.48	-1.63	.114
Teachers share ideas and materials.	29	3.72	4.03	0.31	-1.30	.204
Teachers observe each other teaching classes.	29	1.34	1.66	0.31	-1.51	.142
Teachers contribute actively to making decisions about the mathematics curriculum.	29	2.79	2.62	-0.17	0.52	.609

Note: 1 = Never; 2 = Once or Twice Per Year; 3 = Three to Eight Times Per Year; 4 = Monthly; 5 = Weekly; 6 = Almost Daily; $^{**}p < .01$. Bold text indicates scaled items.

Impact of Teacher Characteristics and Contextual Factors

To explore the impact of teacher characteristics and contextual factors on Cohort 1 participant outcomes, teachers were divided into two groups based on values for each of a range of variables that might affect outcomes. Exhibit 12 presents the variables that were used to examine differences in teacher outcomes over time and the ways in which teachers were assigned to groups. With the exception of the *from Lincoln Public Schools* and *gender* variables, teachers were grouped into one of two categories based on the median value of each variable. Repeated measures analysis of variance (RMANOVA) was used to explore differences between groups of teachers.

Exhibit 12. Teacher Characteristics and Contextual Factor Variables

	Category Definitions for Analysis of Differences Between Groups	
Participants from Lincoln Public Schools or other districts	Lincoln Public Schools	Other districts
Gender	Male	Female
Number of undergraduate mathematics courses	6 or fewer	More than 6
Middle school certification	Not Certified	Certified
Years teaching in K-12 school	10 or fewer	More than 10
Years teaching in Grades 5 to 8	9 or fewer	More than 9
Years teaching mathematics in Grades 5 to 8	10 or fewer	More than 10
Overall mathematics professional development participation	At or below median (3.33)	Above median
Overall professional development emphasis on mathematics topics	At or below median (3.30)	Above median
Overall factors that limit mathematics teaching	At or below median (1.82)	Above median
Overall influence of external factors on mathematics teaching	At or below median (3.89)	Above median
Overall professional interaction	At or below median (3.00)	Above median

Each teacher characteristic and contextual factor variable was analyzed in relation to each of the following 10 teacher outcomes:

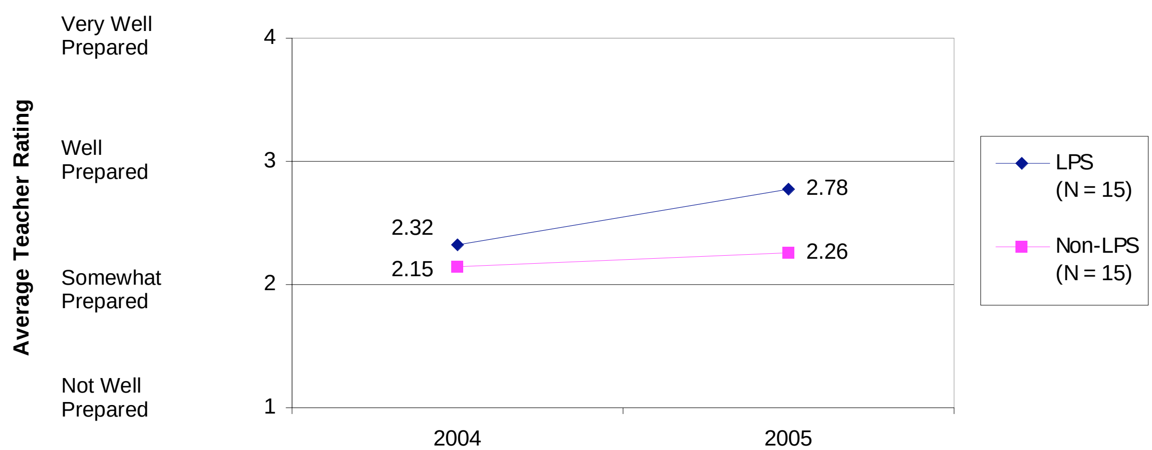
1. Overall Preparedness for Teaching Mathematics
2. Preparedness to Teach Diverse Populations
3. Overall Confidence in Mathematics and Teacher Support
4. Confidence in Mathematical Knowledge
5. Confidence in Ability to Support Colleagues
6. Confidence in Leadership Ability
7. Instructional Emphasis - NCTM Process Standards
8. Overall Instructional Technology Use
9. Overall Use of Assessment in Mathematics
10. Use of Assessment - Analysis and Justification Orientation

Teacher characteristics and contextual factors that were statistically significantly related to teacher outcomes are presented in Exhibits 13 through 18. Whether or not a teacher was from LPS was significantly related to teacher outcomes in three cases. Exhibits 13 through 15 show that LPS teachers increased significantly more than their counterparts in other districts in ratings of preparedness to teach diverse populations, overall confidence in mathematics and teacher support, and confidence in their ability to support colleagues. Three other statistically significant effects were found. Exhibit 16 shows that instructional technology use increased more for teachers who had fewer undergraduate mathematics courses. Exhibit 17 shows that confidence in leadership ability increased more for teachers with less K-12 teaching experience and Exhibit 18 shows that preparedness to teach diverse populations increased more for teachers with less middle-level teaching experience. There were no significant relationships between teacher outcomes and the following variables:

- Gender;
- Certification;
- Middle-level mathematics teaching experience;
- Mathematics professional development participation or emphasis;
- Factors that affect mathematics teaching; or
- Professional interaction.

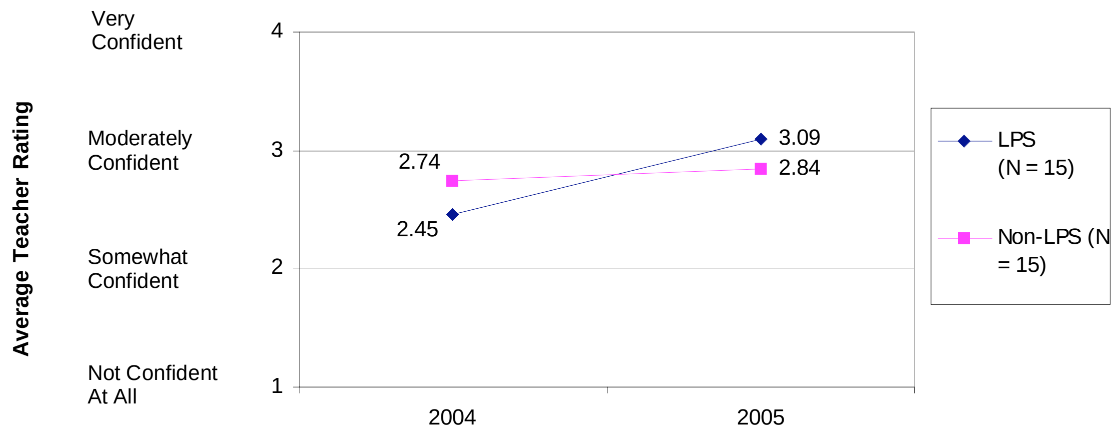
These analyses are based on a small sample of respondents (Cohort 1 participants who have pre- and post-survey responses). Subsequent analyses that use data from participants in multiple cohorts will be more robust.

Exhibit 13. Preparedness to Teach Diverse Populations by LPS and Non-LPS District (2004-2005)*



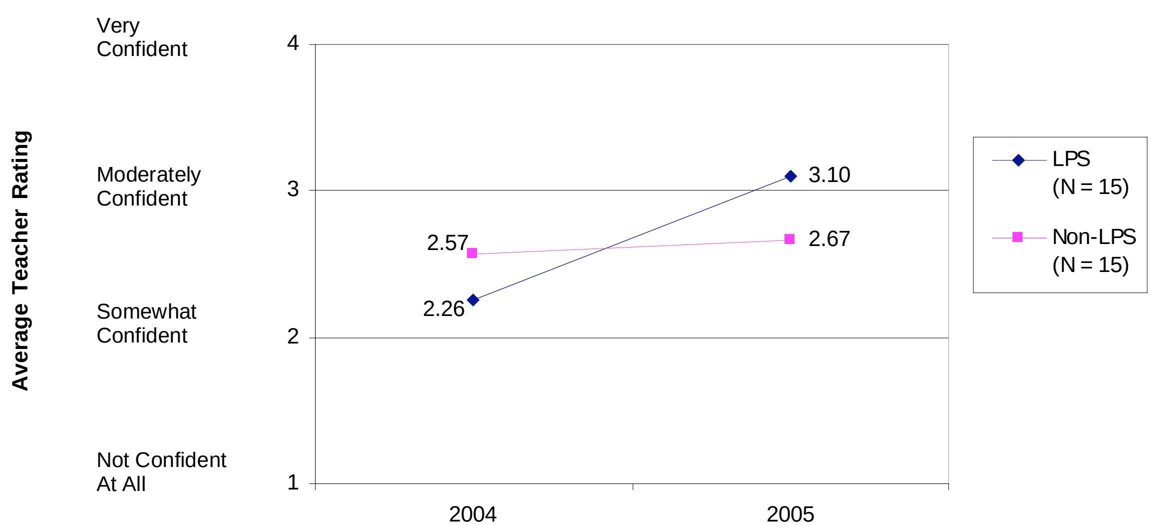
**p* < .05.

Exhibit 14. Confidence in Mathematics and Teacher Support by LPS and Non-LPS District (2004-2005)**



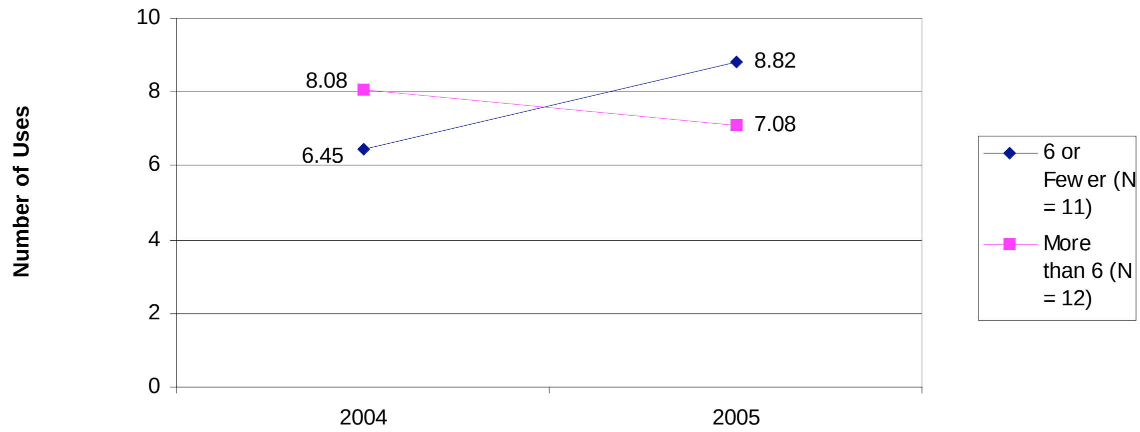
***p* < .01.

Exhibit 15. Confidence in Ability to Support Colleagues by LPS and Non-LPS District (2004-2005)**



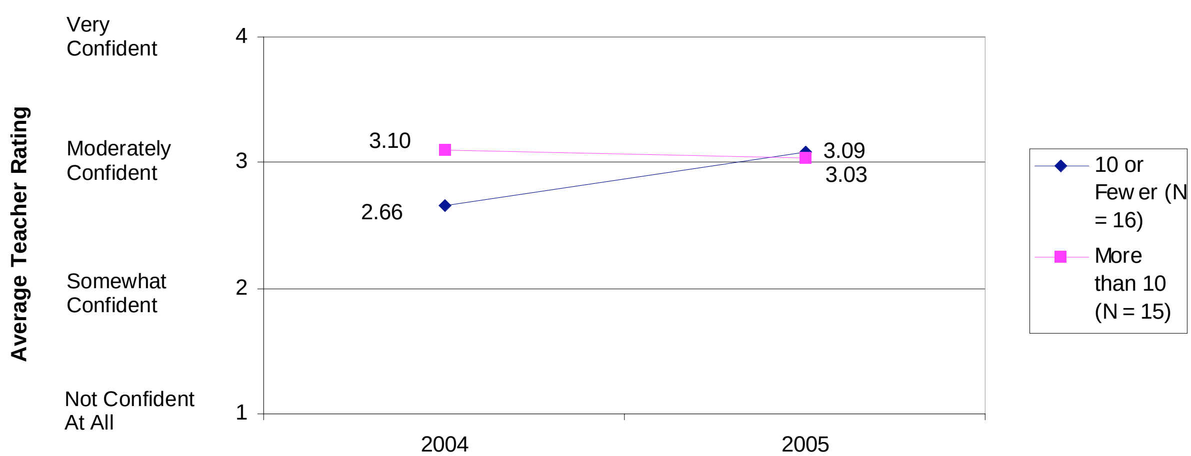
***p* < .01.

Exhibit 16. Instructional Technology Use by Number of Undergraduate Mathematics Courses Taken (2004-2005)*



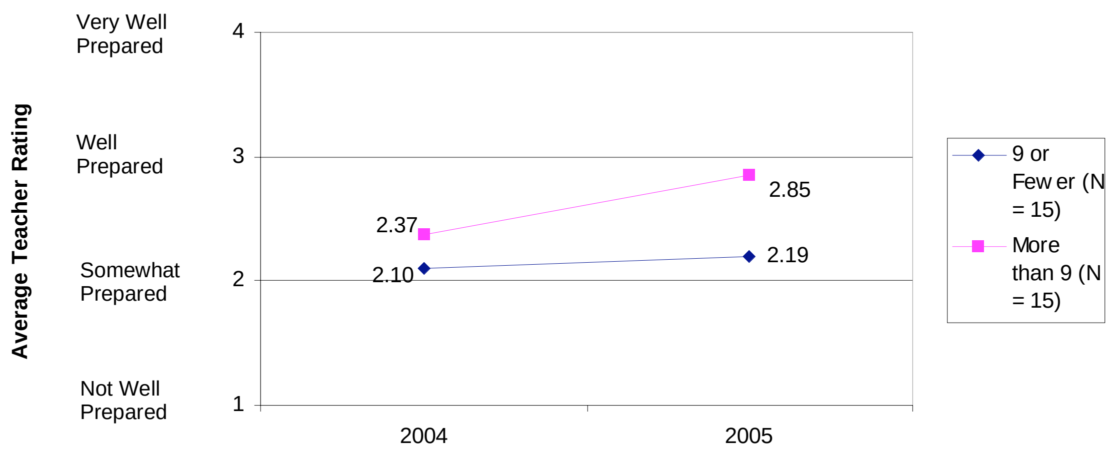
Note: The mean value for overall instructional technology use is the average count of the number of different uses by students and teachers.

Exhibit 17. Confidence in Leadership Ability by Years of K-12 Teaching Experience (2004-2005)*



**p* < .05.

Exhibit 18. Preparedness to Teach Diverse Populations by Years of Grade 5-8 Teaching Experience (2004-2005)*



*$p < .05$.

Analysis of Factors Contributing to LPS Student Mathematics Achievement

A series of regression analyses were conducted to assess the impact of various factors on student achievement outcomes. These analyses examine the impact of M^2, while controlling for a range of other factors that might otherwise explain differences in achievement outcomes. For these analyses, achievement scores are presented in their original metric (NCE scores for the MAT and point totals for the district-developed CRT). All other student variables are dichotomous or "dummy" variables that have values of either zero or one. For example, students who did not participate in gifted and talented programming have a value of zero on this variable; those who did participate have a value of one on this variable. With the exception of the teaching experience variable, which is expressed in number of years, all of the teacher variables use values that correspond to response scales on the spring 2005 teacher survey.

Impact of M^2 Participation and Student Factors on Student Mathematics Achievement

Regression analyses explored the impact of teacher participation in M^2 on student achievement outcomes, while controlling for a range of factors likely to explain differences in achievement outcomes. Charts present statistically significant findings related to the impact of M^2 teacher participation and tables present detailed statistics from the regression models. Other key findings are summarized in the text.

Grade 5

No significant differences in 5th-grade mathematics achievement outcomes were found among students of M^2 participants and comparison group teachers, after controlling for prior-year achievement and a range of student characteristics. Results from the regression models for each Grade 5 mathematics achievement measure are presented in Exhibit 19 and show that participation in gifted and talented programs had the largest positive impact on mathematics achievement and participation in ELL programming had a significant negative effect. Race/ethnicity and gender were also significantly related to scores and prior-year achievement was significantly related to 2005 achievement; however the contribution was small relative to other student factors.

Exhibit 19. Influence of M^2 Participation and Student Factors on 2005 Achievement, Grade 5

	Total Math		Math Procedures		Math Concepts and Problem Solving	
	B	*SE*	*B*	*SE*	*B*	*SE*
Intercept	518.44***	4.02	524.77***	4.89	513.67***	4.28
Prior-Year Math Achievement (2004 district-designed CRT point total)	1.77***	0.04	1.82***	0.05	1.75***	0.04
Student of M^2 Teacher (1 = participant)	3.64	4.18	7.87	5.10	-1.50	4.45
Gender (1 = male)	-0.01	1.22	-6.00***	1.49	3.90**	1.30
African American	-10.25***	2.39	-5.37~	2.91	-12.79***	2.53
Hispanic	-7.21*	3.22	-4.20	3.92	-8.66*	3.43
Asian	0.80	3.10	10.81**	3.78	-3.36	3.30
Gifted and Talented	26.90***	1.71	19.75***	2.08	27.24***	1.81
English Language Learner	-8.92*	3.75	1.65	4.52	-15.78***	3.99
R^2		.64		.53		.62
Number of Observations		1,972		1,975		1,973

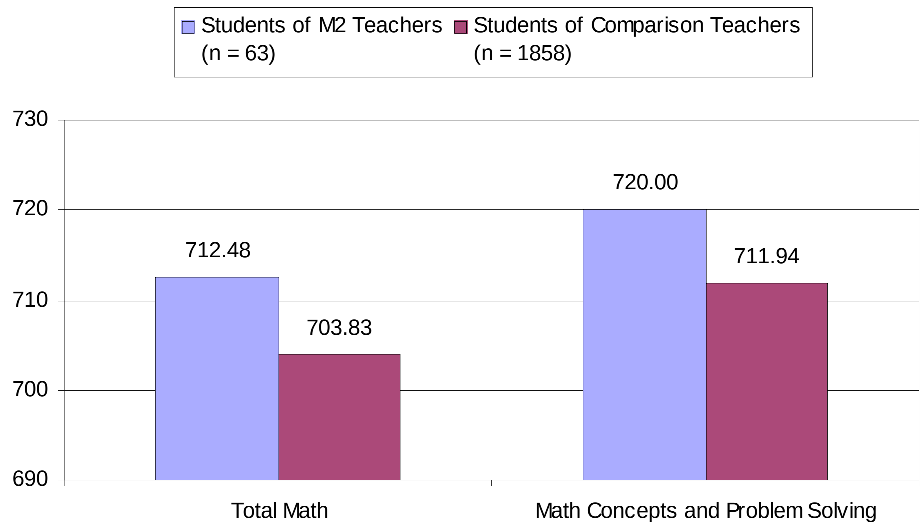
~*p* < .10, **p* < .05, ***p* < .01, ****p* < .001.

Grade 6

Students of M² participants had significantly higher *total math* and *math concepts and problem solving* achievement scores, after controlling for prior-year achievement and a range of student characteristics. Exhibit 20 shows that students in classrooms taught by an M² participant had scores that were 8 to 9 points higher than students of nonparticipants.

Exhibit 20. Influence of M² Participation on 2005 Achievement - Total Math* and Math Concepts and Problem Solving,** Grade 6

**p* < .05, ***p* < .01. Chart presents predicted values for 2005 math achievement



based on mean values for all other variables in regression model.

Results from the regression models for each Grade 6 mathematics achievement measure are presented in Exhibit 21 and show that participation in gifted and talented programs had the largest positive impact on mathematics achievement and participation in ELL and special education programming had a significant negative effect. Race/ethnicity and gender were also significantly related to scores and prior-year achievement was significantly related to 2005 achievement; however the contribution was small relative to other student factors.

Exhibit 21. Influence of M^2 Participation and Student Factors on 2005 Achievement, Grade 6

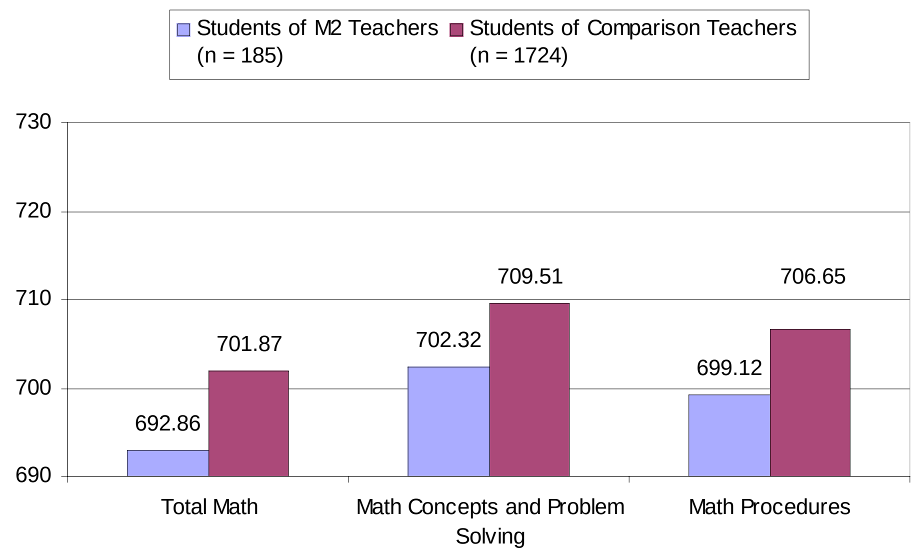
	Total Math		Math Procedures		Math Concepts and Problem Solving	
	B	*SE*	*B*	*SE*	*B*	*SE*
Intercept	285.77***	10.64	274.54***	13.73	289.72***	11.12
Prior-Year Math Achievement (2004 MAT Total Math NCE score)	0.61***	0.02	0.63***	0.02	0.60***	0.02
Student of M^2 Teacher (1 = participant)	8.06*	3.14	6.14	4.05	8.65**	3.28
Gender (1 = male)	-2.23*	1.13	-7.00***	1.46	0.05	1.18
African American	-8.22***	2.28	-3.74	2.94	-10.72***	2.39
Hispanic	-1.70	2.68	1.86	3.46	-3.70	2.80
Asian	5.95*	2.76	12.25**	3.56	1.18	2.88
Gifted and Talented	19.91***	1.59	25.53***	2.05	14.16***	1.66
Special Education	-7.09**	2.13	-3.49	2.75	-9.99***	2.22
English Language Learner	-9.42*	3.74	-3.22~	4.79	-14.88***	3.91
R^2		.66		.57		.62
Number of Observations		1,920		1,924		1,921

~*p* < .10, **p* < .05, ***p* < .01, ****p* < .001.

Grade 7

Students of M^2 participants had significantly lower *total math*, *math concepts and problem solving*, and *math procedures* achievement scores, after controlling for prior-year achievement and a range of student characteristics. Exhibit 22 shows that students in classrooms taught by an M^2 participant had scores that were 7 to 9 points lower than students of nonparticipants.

Exhibit 22. Influence of M^2 Participation on 2005 Achievement - Total Math,*** Math Concepts and Problem Solving,** and Math Procedures,*** Grade 7



**p < .01, ***p < .001. Chart presents predicted values for 2005 math achievement based on mean values for all other variables in regression model.

Results from the regression models for each Grade 7 mathematics achievement measure are presented in Exhibit 23 and show that participation in gifted and talented programs had the largest positive impact on mathematics achievement and participation in ELL and special education programming had a significant negative effect. Race/ethnicity was also significantly related to scores and prior-year achievement was significantly related to 2005 achievement; however the contribution was small relative to other student factors.

Exhibit 23. Influence of M^2 Participation and Student Factors on 2005 Achievement, Grade 7

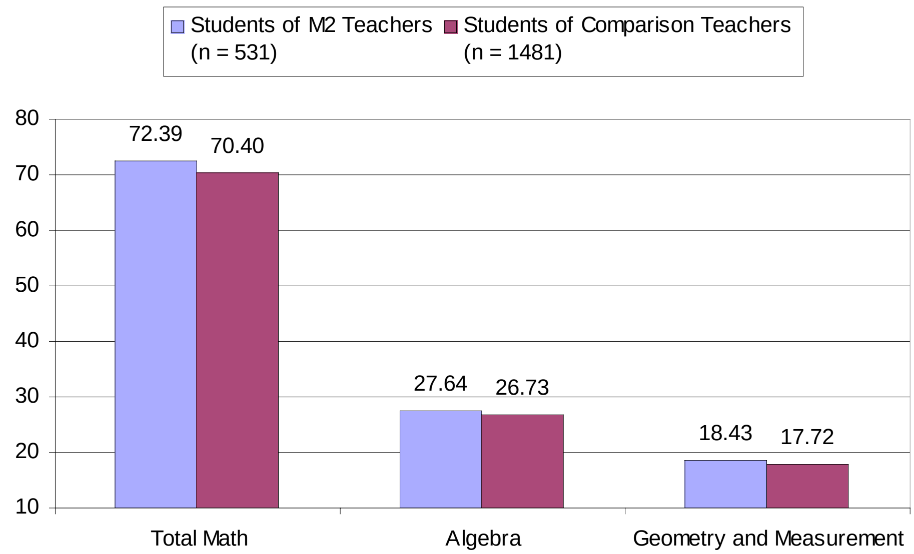
	Total Math		Math Procedures		Math Concepts and Problem Solving	
	B	*SE*	*B*	*SE*	*B*	*SE*
Intercept	163.91***	11.32	251.24***	13.34	207.96***	11.85
Prior-Year Math Achievement (2004 MAT Total Math NCE score)	0.77***	0.02	0.65***	0.02	0.70***	0.02
Student of M^2 Teacher (1 = participant)	-7.53***	1.80	-7.19**	2.51	-9.01***	1.92
Gender (1 = male)	0.35	1.06	0.15	1.47	0.52	1.14
African American	-6.57**	2.03	-10.79***	2.82	-6.93**	2.16
Hispanic	-3.32	2.64	-6.80~	3.68	-3.01	2.83
Asian	8.92	2.87	12.54**	4.00	7.20*	3.07
Gifted and Talented	18.49***	1.49	22.82***	1.98	23.24***	1.58
Special Education	-3.03~	1.75	-5.84*	2.42	-5.73**	1.87
English Language Learner	-6.70~	3.66	-7.34	5.08	-10.28**	3.93
R^2		.73		.58		.70
Number of Observations		1,909		1,915		1,916

~p < .10, *p < .05, **p < .01, ***p < .001.

Grade 8

Students of M^2 participants had significantly higher *total math*, *algebra*, and *geometry and measurement* scores, after controlling for prior-year achievement and a range of student characteristics. Exhibit 24 shows that students in classrooms taught by an M^2 participant had scores that were 0.7 to 2 points higher than students of nonparticipants.

Exhibit 24. Influence of M^2 Participation on 2005 Achievement - Total Math,*** Algebra,*** and Geometry and Measurement,*** Grade 8



***p < .001. Chart presents predicted values for 2005 math achievement based on mean values for all other variables in regression model.

Results from the regression models for each Grade 8 mathematics achievement measure are presented in Exhibits 25 and 26 and show that participation in gifted and talented programs had a significant positive impact on achievement and participation in ELL and special education programming had a significant negative effect. Race/ethnicity and gender were also significantly related to scores and prior-year achievement was significantly related to 2005 achievement; however the contribution was small relative to other student factors.

Exhibit 25. Influence of M^2 Participation and Student Factors on 2005 Achievement, Grade 8

	Total Math		Algebra		Computation	
	B	*SE*	*B*	*SE*	*B*	*SE*
Intercept	-141.53***	4.29	-50.78***	1.75	-27.43***	1.08
Prior-Year Math Achievement (2004 MAT Total Math NCE score)	0.30***	0.01	0.11***	0.00	0.06***	0.00
Student of M^2 Teacher (1 = participant)	1.99***	0.46	0.91***	0.19	0.12	0.12
Gender (1 = male)	0.39	0.41	-0.17	0.17	0.22*	0.10
African American	-4.86***	0.85	-1.52***	0.35	-0.86***	0.21
Hispanic	-4.24***	0.97	-1.61***	0.39	-0.48*	0.24
Asian	-0.16	1.14	0.38	0.46	-0.09	0.28
Gifted and Talented	2.75***	0.58	0.57*	0.24	0.35*	0.15
Special Education	-2.88***	0.72	-1.17***	0.29	-0.70***	0.18
English Language Learner	-4.96**	1.61	-0.49~	0.66	-0.93*	0.41
R^2		.73		.66		.61
Number of Observations		2,012		2,018		2,016

~p < .10, *p < .05, **p < .01, ***p < .001.

Exhibit 26. Influence of M^2 Participation and Student Factors on 2005 Achievement, Grade 8

	Data Analysis		Geometry and Measurement		Numeration	
	B	*SE*	*B*	*SE*	*B*	*SE*
Intercept	-12.78***	0.77	-32.08***	1.57	-18.05***	0.75
Prior-Year Math Achievement (2004 MAT Total Math NCE score)	0.03***	0.00	0.07***	0.00	0.04***	0.00
Student of M^2 Teacher (1 = participant)	0.10	0.08	0.71***	0.17	0.13	0.08
Gender (1 = male)	-0.03	0.07	0.33*	0.15	0.01	0.07
African American	-0.68***	0.15	-1.16***	0.31	-0.64***	0.15
Hispanic	-0.58**	0.17	-1.08**	0.36	-0.50**	0.17
Asian	0.23	0.20	-0.59	0.42	-0.06	0.20
Gifted and Talented	0.13	0.10	1.66***	0.21	0.05	0.10
Special Education	-0.37*	0.13	-0.48	0.26	-0.32*	0.13
English Language Learner	-1.87***	0.29	-0.79	0.59	-0.88**	0.28
R^2		.48		.54		.55
Number of Observations		2,012		2,014		2,015

~*p* < .10, **p* < .05, ***p* < .01, ****p* < .001.

Impact of Additional Teacher Factors on Student Mathematics Achievement

A second set of analyses explored variables derived from the spring 2005 teacher survey, using responses from both M^2 participants and comparison teachers. These analyses use the subsamples for teacher survey data analyses described above and include outcomes for students in Grades 6, 7, and 8. Fifth-grade students were excluded because teacher information was only provided for a handful of teachers at this grade level. Selected variables were chosen to represent a range of key constructs measured on the teacher survey. Variables were selected to minimize intercorrelation among predictor variables and to support identification of areas that M^2 can affect.

While the exhibits report results only for the additional teacher variables examined, each regression analysis includes the full range of variables reported in the prior models (i.e., M^2 teacher participation and the range of student characteristics). This allows for examination of the additional impact of these teacher factors, while controlling for the variables considered previously. Because professional interaction with M^2 teacher leaders was reported only by teachers in the comparison group, separate regression analyses were conducted with this smaller sample to examine the impact of this variable.

Several of the results in this section are mixed and, sometimes, counterintuitive. For example, both negative and positive relationships were found between student achievement and teachers' (1) use of NCTM process standards, (2) use of analysis and justification in assessment, and (3) interaction with M^2 *teacher leaders. Again, these findings should be regarded as preliminary, based on only one year of data. These relationships will be tested again in subsequent analyses.*

Grade 6

Results from the regression models for each Grade 6 mathematics achievement measure are presented in Exhibit 27 and show that middle level mathematics teaching experience and professional interaction with M^2 participants were significantly and positively related to achievement.

Exhibit 27. Influence of Additional Teacher Factors on 2005 Achievement Grade 6

	Total Math		Math Procedures		Math Concepts and Problem Solving	
	B	*SE*	*B*	*SE*	*B*	*SE*
Years of Middle Level Mathematics Teaching Experience	0.28	0.09	0.22	0.12	0.37***	0.09
Confidence in Mathematical Knowledge	0.10	1.63	-0.01	2.21	1.58	1.73
Preparedness to Teach Diverse Students	-0.75	1.66	-2.98	2.25	-1.76	1.76
Instructional Emphasis - NCTM Process Standards	-0.07	2.14	2.92	2.90	-0.50	2.27
Use of Assessment - Analysis and Justification	-0.01	0.92	0.13	1.25	0.00	0.97
R^2		.66		.54		.61
Number of Observations		891		893		891
Professional Interaction with M^2 Teacher Leaders	3.33~	1.87	8.87***	2.43	1.62	1.99
R^2		.65		.56		.60
Number of Observations		791		794		791

~$p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$.

Grade 7

Results from the regression models for each Grade 7 mathematics achievement measure are presented in Exhibit 28 and show that middle level mathematics teaching experience and emphasis on NCTM process standards were significantly and positively related to achievement. Ratings of confidence in mathematical knowledge, use of analysis and justification in assessment, and professional interaction with M^2 teacher leaders were significantly and negatively related to achievement.

Exhibit 28. Influence of Additional Teacher Factors on 2005 Achievement, Grade 7

	Total Math		Math Procedures		Math Concepts and Problem Solving	
	B	*SE*	*B*	*SE*	*B*	*SE*
Years of Middle Level Mathematics Teaching Experience	0.44**	0.14	0.41*	0.20	0.42**	0.15
Confidence in Mathematical Knowledge	-8.27~	4.61	-2.69	6.37	-9.25~	4.85
Preparedness to Teach Diverse Students	-0.76	2.43	1.48	3.36	-2.81	2.56
Instructional Emphasis - NCTM Process Standards	11.91*	5.08	5.69	7.03	14.71**	5.34
Use of Assessment – Analysis and Justification	-2.61**	0.87	-3.37**	1.20	-1.91*	0.91
R^2		.73		.58		.70
Number of Observations		975		979		976
Professional Interaction with M^2 Teacher Leaders	-10.15***	1.60	-12.95***	2.20	-8.86***	1.67
R^2		.72		.57		.69
Number of Observations		811		814		812

~$p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$.

Grade 8

Results from the regression models for each Grade 8 mathematics achievement measure are presented in Exhibits 29 and 30 and show that ratings of confidence in mathematical knowledge and use of analysis and justification were significantly and positively related to achievement. Ratings of preparedness to teach diverse populations, emphasis on NCTM process standards, and professional interaction with M^2 teacher leaders were significantly and negatively related to achievement.

Exhibit 29. Influence of Additional Teacher Factors on 2005 Achievement, Grade 8

	Total Math		Algebra		Computation	
	B	*SE*	*B*	*SE*	*B*	*SE*
Years of Middle Level Mathematics Teaching Experience	-0.02	0.02	-0.01	0.01	-0.01	0.01
Confidence in Mathematical Knowledge	2.66*	1.06	0.49	0.43	0.71**	0.27
Preparedness to Teach Diverse Students	-1.56**	0.60	-0.32	0.24	-0.36*	0.15
Instructional Emphasis - NCTM Process Standards	-3.53***	0.60	-0.79**	0.24	-0.48**	0.15
Use of Assessment – Analysis and Justification	0.61~	0.33	0.04	0.13	0.09	0.08
R^2		.71		.63		.58
Number of Observations		1,325		1,329		1,327
Professional Interaction with M^2 Teacher Leaders	-2.23*	0.90	-0.84*	0.35	-0.22	0.22
R^2		.74		.67		.60
Number of Observations		546		547		546

~p < .10, *p < .05, **p < .01, ***p < .001.

Exhibit 30. Influence of Additional Teacher Factors on 2005 Achievement, Grade 8

	Data Analysis		Geometry and Measurement		Numeration	
	B	*SE*	*B*	*SE*	*B*	*SE*
Years of Middle Level Math Teaching Experience	0.00	0.00	0.00	0.01	0.00	0.00
Confidence in Mathematical Knowledge	0.40*	0.19	0.75~	0.40	0.22	0.19
Preparedness to Teach Diverse Students	-0.08	0.10	-0.57**	0.23	-0.20~	0.11
Instructional Emphasis - NCTM Process Standards	-0.40***	0.11	-1.45***	0.23	-0.39***	0.11
Use of Assessment – Analysis and Justification	0.04	0.06	0.40**	0.13	0.02	0.06
R^2		.47		.52		.53
Number of Observations		1,325		1,327		1,327
Professional Interaction with M^2 Teacher Leaders	-0.13	0.15	-0.31	0.35	-0.72***	0.16
R^2		.50		.57		.58
Number of Observations		546		546		546

~*p* < .10, **p* < .05, ***p* < .01, ****p* < .001.

Discussion and Next Steps

These preliminary analyses suggest positive effects of participation in M^2 on a range of teacher outcomes, including ratings of preparedness and confidence, philosophy of mathematics teaching and learning, instructional emphasis, use of assessment, and professional interaction among mathematics teachers. A handful of differences in outcomes were found for teachers from Lincoln Public Schools and those with different levels of undergraduate mathematics coursework and teaching experience. Analysis of student mathematics achievement data indicated both positive and negative effects of teacher participation in M^2, which were small after controlling for a range of student characteristics. Examination of teacher-level factors that contributed to student achievement outcomes showed mixed effects. For example, while middle level mathematics teaching experience was associated with higher student mathematics achievement, several other factors (e.g., emphasis on NCTM process standards, ratings of confidence in mathematical knowledge) had a mixed or negative association with student achievement.

The conclusions that can be drawn from these early findings are limited primarily due to the small initial sample of teachers and their relatively short period of participation in M^2 at the time data were collected. Other concerns include the need to ensure adequate statistical power and group equivalence for some grade levels where there were relatively small numbers of M^2 participants and a lack of information to control for school and student level socioeconomic status. As the evaluation progresses and additional longitudinal data are collected from M^2 participants, comparison teachers, and their students, analyses will better allow for conclusions about impact. Subsequent analyses of impact on student achievement will, for example, control for differences among teacher characteristics that may explain observed differences. A more complete dataset will also allow for examination of impact using multilevel statistical models.

References

Council for Chief State School Officers, Wisconsin Center for Educational Research, American Institutes for Research (undated). *Survey of Classroom Practices in Middle School Mathematics*. Authors.

International Association for the Evaluation of Educational Achievement (2003). *TIMSS Mathematics Teacher Questionnaire: Grade 8.* Author.

Sutton, J.T. and Meyer, S.J. (2006). University of Nebraska-Lincoln Math in the Middle Institute Partnership evaluation. Denver, CO: RMC Research Corporation.

Rand (2003). *2003 Rand Teacher Survey, Eighth Grade Mathematics, Mosiac II.* Santa Monica, CA: RAND.