

Executive Summary

TL=MS has definitely changed my thinking. First, I used to do what I thought was hands-on. But, actually, I was very much regimented and worksheet-based. I try to let the students lead the instruction now. I used to have to stick to my lesson plan, but now I am able to see what the students need and what they are interested in and remain flexible. (TL=MS teacher participant)

I used to hear kids say, "I hate math!" but I don't anymore. The kids ask me where I was when I miss a day. In one class, they cheer when I walk in the door! (TL=MS teacher participant)

Introduction

Teacher Leaders for Mathematics Success (TL=MS) is a five-year project designed to build the capacity of Bronx teachers and schools in supporting continued improvement in mathematics education for all students in a standards-based environment. The project, implemented by the Institute for Literacy Studies at Lehman College and funded by the National Science Foundation, seeks fundamental educational change by enhancing the understanding of mathematics content, standards-based curriculum, and performance standards, as well as student-learning strategies among teachers, principals, and other administrators.

The project facilitates discourse about and reflection on the relationships between content knowledge, pedagogy, student learning, and school change. Its goal is to create conditions for institutionalizing teacher leaders as agents for instructional reform in mathematics within schools and districts. It is founded on the notion that the "effectiveness of mathematics teaching and learning is a function of teachers' knowledge and use of mathematical content, of teachers' attention to and work with students, and of students' engagement in and use of mathematical tasks" (National Research Council, 2001).

Project Description

Working with three cohorts of approximately 20 schools and 80 teacher and administrator participants each, the project is organized around three levels of activities across three years for each participating cohort.

Level one immerses participants in an intensive study of mathematics topics, aligned with standards-based curricula implemented in the schools, and their relationship to performance standards and student learning. During this first year, all participants are asked to attend a 60-hour summer institute. Once the school year begins, participants attend monthly Saturday seminars (eight Saturdays for six hours each) and work with a teacher consultant on a biweekly basis. The teacher consultant provides a range of services, including meeting with, and conducting observations of, teachers, facilitating team meetings, coteaching classes, and assisting in lesson and project planning. The teacher consultants also provide support to school administrators and the district by participating in meetings, facilitating discussions, and conducting workshops. Through this immersion, participants enhance their understanding of mathematical concepts as well as develop effective strategies to teach these concepts in the classroom.

In level two, during the second year, TL=MS focuses on curriculum and leadership development as well as the development of a mathematics "leadership action plan" for the school. Participants continue to attend professional development sessions on Saturdays and after school, and teacher consultants continue to visit the school, although less frequently. During this second year, TL=MS participants also involve other teachers and administrators in their school in mathematics reform. In level three, the third and final year of each cohort's involvement, participants focus on implementing their school leadership plan and sustaining school-based leadership.

TL=MS Evaluation

The Academy for Educational Development (AED) conducted a five-year formative and summative evaluation of TL=MS. The evaluation addressed research questions related to program participation; outcomes for teachers, students, and schools; and district and administrative support for the project. These questions were investigated through multiple data collection methods including surveys of participants, in-depth interviews with administrators and project teachers at selected schools, classroom observations at selected schools, and analysis of pre-post student assessment data from 15 classrooms.

This report presents findings from all five years of the evaluation but focuses on results from the final teacher survey and pre-post student assessment data. (See AED's previous reports on TL=MS for a discussion of findings from earlier years.) Findings were triangulated with results from earlier data collection efforts.

Key Findings on Impact on Teachers and Other Participants

Major findings are summarized below.

- 80% or more of survey respondents reported that TL=MS had a great deal or good amount of impact on their 1) understanding of math content; 2) comfort level teaching math; 3) effectiveness as a teacher; and 4) teaching practices.
- High levels of impact in these areas were reported by teachers regardless of different grade levels taught, years of experience, and project cohort.
- At the end of the project, TL=MS teachers reported very high levels of use of reform-based practices (such as solving math problems in small groups or with a partner). They also reported that their use of these practices increased as a result of their participation. For example, 90 percent or more said they asked students to explain how they arrived at their answers, had students discuss solutions to mathematics problems with other students, and used manipulatives at least once or twice a week. At the same time they reported decreasing their use of traditional classroom practices (such as lecturing and using worksheets) as a result of the project.

It is impossible to help children come to any understanding if we as teachers do not have deep understanding of the content. (TL=MS participant)

In summary, many TL=MS participants entered the project as self-described math “phobics” and with limited knowledge of mathematics content and limited understanding of constructivist approaches. They emerged from the project more confident and competent in their understanding of mathematics and their skills as mathematics teachers. Further, longitudinal survey data show that teachers—up to five years after first participating in TL=MS—continued frequent use of the reform-based approaches espoused by the project, indicating that TL=MS was sustained—at least at the classroom level.

Comparisons with a National Sample

In comparison to a nationally representative sample,¹ TL=MS teachers were much more likely to use reform based practices than their peers and less likely to use traditional practices ($p \leq .01$). For example:

- Almost double the percentage of TL=MS teachers reported asking students to discuss solutions to math problems almost everyday compared with a national sample of teachers at the same grade level (86% vs. 44%).
- Over three times as many TL=MS teachers reported asking students to solve math problems in small groups or with a partner (80% vs. 26%) almost everyday.
- Over four times as many TL=MS teachers reported asking students to write a few sentences about how to solve a math problem almost everyday compared with teachers nationwide (59% vs. 14%).
- TL=MS teachers were less likely to report using multiple choice exams to assess student learning compared with teachers nationwide (12% vs. 20% reported using the practice 1-2 times a week).
- The majority of TL=MS teachers (88% or more) reported placing a heavy emphasis on developing an appreciation for the importance of math, learning how to communicate ideas in mathematics effectively, and developing reasoning and analytic ability to solve unique problems, areas that are consistent with a reform-based approach. Compared with teachers nationwide, TL=MS teachers were much more likely to report placing heavy emphasis on these areas ($p \leq .01$).
- The majority of TL=MS teachers (73% to 86%) also placed heavy emphasis on students' learning mathematics facts and concepts, as well as skills and procedures for solving routine problems, but to a much less extent than teachers nationally ($p \leq .01$). These findings indicate that TL=MS teachers practice reform-based practices to a much greater

extent that most teachers nationally, while maintaining an emphasis on facts and concepts and the skills and procedures necessary to solve routine problems.

In summary these findings show that the impact of TL=MS on teachers was deep—affecting their comfort level with teaching mathematics as well as their content and pedagogical knowledge around teaching mathematics. Further, more than just increasing or decreasing their knowledge and their use of specific practices, teachers described changes in their whole approach to mathematics instruction.

Teachers attributed much of this shift to the powerful impact of the summer institute and the value of the work conducted by teacher consultants (TCs). TCs supported teachers and schools in a variety of ways, including conducting observations and providing individual feedback to teachers, modeling and demonstrating lessons, and participating in team meetings and planning sessions. In addition, many teachers spoke of the benefit of working and learning with a collegial group of TL=MS participants. TL=MS gave teachers a community and network through which they could share ideas, learn from each other, problem-solve, and support each other. These positive findings held for teachers at different levels of their career (novice, experienced and veteran), different grade levels, and for each of the projects' three cohorts.

Key Findings on Student Impact

The impact of TL=MS on students was equally impressive. The majority of teachers and administrators reported that they saw a great deal or good amount of impact on students' engagement in mathematics instruction and achievement. These findings were substantiated by an open-response, pre-post performance assessment completed by students in a sample of TL=MS and non-TL=MS classrooms.

TL=MS students saw large gains between pre- and post-assessments of their mathematical knowledge, strategic knowledge and mathematical communication.

- Nearly nine out of 10 TL=MS students showed increases in their total scores on the assessment, and between 72% and 79% showed an increase in a specific sub-area (mathematical knowledge, strategic knowledge and mathematical communication).
- Multilevel analyses showed that, controlling for teacher characteristics and pretest scores, TL=MS classes gained an average of 3.29 points more (out of 12) than non-TL=MS students on the post-test. This is a very strong, statistically significant finding, especially given the small sample size (12 TL=MS and 3 non-TL=MS classrooms).
- The positive effect of TL=MS held for a diverse group of low-income students, showing no differences by gender, race/ethnicity or English language learner status.

Kids get extremely excited about math—it is the highlight of their day! Even those who are struggling with some of the math concepts still get to participate and “play.” There are a lot of student-helping-student scenarios. (TL=MS participant)

In conclusion, findings from multiple sources, including multilevel statistical analyses of pre-post student assessment data, converge to provide strong evidence that TL=MS provided teachers with a deep and lasting professional development experience that had an impact on teachers' practices and attitudes about teaching mathematics as well as on student achievement. This study is one of a small number of studies that have looked beyond impact of professional development on teachers to investigate the impact on student outcomes (Killion, 1998). Results from this study also support findings from other studies that have shown a connection between high-quality, sustained professional development opportunities, reform-based practices, and student achievement (Garet et al., 2001; Hamilton et al., 2004; Wenglinsky, 2000).

¹The sample was provided by the National Assessment of Educational Progress (NAEP) survey of teachers. The NAEP is a nationally representative sample of students whose teachers took the survey.

²($p \leq .10$). A level of significance of .10 was used for identification of variable effects. The sample size of 15 teachers is small enough to warrant such a consideration; a strict .05 level of significance might mask some important tendencies or trends.