A Sustained Professional Development Partnership in an Urban Middle School

Cathy Liebars, The College of New Jersey liebars@tcnj.edu

Abstract

This paper describes a sustained professional development project, Teachers as Leaders and Learners (TALL), that focused on the implementation of a reform-based middle school mathematics curriculum in urban middle schools. Early results from data collected as part of the evaluation of TALL are very promising. Student test scores have increased and teacher feedback has been excellent.

Introduction

The National Commission on Teaching and America's Future states emphatically that "students will not be able to meet high learning standards unless their teachers are prepared to meet high standards." (p.7, 2003) The report further declares that "teachers must know their subject areas deeply, understand how children learn, be able to use that knowledge to teach well, use modern learning technologies effectively, and work closely with their colleagues to create rich learning environments". The need to set and achieve high learning standards becomes even more critical in schools of high poverty and documented low student outcomes.

The "teacher gap" between high-poverty and wealthier schools is identified by Olson in the national survey entitled "Quality Counts 2003," published by Education Week (2003). The analysis concludes that "students in high poverty, high-minority, and low-achieving schools have the least access to skilled instructors." The report notes that many educators are committed and willing to work in high poverty, high minority, low achieving schools, but that they need adequate resources and professional development, especially in the curriculum content areas.

The National Commission on Teaching and America's Future identifies the "missing ingredient" to recruiting and preparing highly qualified teachers as being "finding a way for school systems to organize the work of qualified teachers so they can collaborate with their colleagues in developing strong learning communities."

Purpose

The purpose of this formative evaluation study was to analyze the professional development provided for implementation of a reform-based middle school mathematics curriculum in urban middle schools. Multiple data sources are presented to assess the effectiveness of the professional development program. The study sought to address these questions:

1. What are the effects of sustained professional development (graduate courses and in-classroom coaches and teacher leaders) offered to urban middle school teachers?
2. Were there statistically significant gains in student achievement in the middle schools in this urban district?

Teachers as Leaders and Learners (TALL) Project

At the start of the reform mathematics project, all middle school mathematics teachers were invited to meet with the College partners to discuss changes in the mathematics curriculum. As a result of that meeting, a design team was formed, composed of at least one mathematics teacher from each of the district's four middle schools, the district curriculum director, a mathematics teacher from the high school, and mathematics professors from our college. The charge of the design team was to select a research-based middle school mathematics curriculum and devise a plan for adoption and implementation. The team chose *Connected Mathematics* (CMP), the only middle school curriculum rated exemplary by the U.S. Department of Education's Mathematics and Science Expert Panel (1999).

In order to phase in CMP over a three-year period, design team members developed a plan based on recommendations from the publisher. They decided to pilot one or two units at each grade level at the end of the 2003–2004 school year and planned for professional development provided by the publisher during spring and summer of 2004. The district hired a mathematics specialist to coordinate the professional development and ensure that the teachers received all the materials and support they needed to adopt the new program.

The grant-funded College partners provided graduate-level, on-site, after-school mathematics content courses for the middle school teachers in the district. Teachers could elect to earn a Professional Specialization certificate by completing four courses. The district supported this effort by paying the tuition up front for the enrolled teachers. The College supplied textbooks and any other necessary resources. Problems and projects from *Connected Mathematics* were used as a basis for studying the mathematics content to help teachers make connections between what they were learning in the courses and their own classroom teaching. Where appropriate, technology, such as *Geometer's Sketchpad* and the TI-73 graphing calculator, was integrated into the courses. The College purchased *Geometer's Sketchpad* for each of the middle schools in the district and the district purchased TI-73 graphing calculators for the middle school classrooms so these technologies were accessible to all teachers in the courses.

The first course focused on Geometry since that was the area where the students showed the weakest performance on standardized tests. The Geometry course was offered in spring 2004, followed by Number Theory and Systems; Data Analysis and Probability; Patterns, Functions, and Algebra; Geometry again in spring 2006; Discrete Mathematics; and Number Theory and Systems again in spring 2007. There are plans to offer a course in Concepts of Calculus in fall 2007. At the writing of this paper, a total of 40 teachers from the district have taken at least one of the courses with an average of 20 enrolled in each course. This number includes 24 general education teachers, 6 special education teachers, 5 high school teachers, 4 teachers from the local diocese, and 1 science teacher. There are 36 non-special education middle school mathematics teachers in the district. Eleven teachers have completed the Professional Specialization.

In addition to the graduate level courses, the College provided an in-classroom coach to support the teachers in the implementation of the new middle school curriculum and the district also provided a coach. In the third year of the project, the superintendent hired four mathematics teacher leaders. Implementation support from the coaches and leaders included modeling, co-teaching, assisting with planning, observing lessons and providing confidential feedback, and making sure that the teacher had all the materials needed to implement a lesson. In one middle school, the coach had weekly grade level meetings with the teachers to discuss implementation efforts and concerns.

Summer offerings in 2004, 2005 and 2006 included three-day institutes to supplement the coursework that teachers were taking during the school year. Each institute focused on a specific topic, such as Discrete Mathematics, Lesson Study, and the Trends in International Mathematics and Science Study (TIMSS) *Explorations of Algebra Teaching* online course. A total of 43 teachers participated in the summer institutes.

Measuring Student Learning Impacts

We analyzed the student performance on the norm-referenced test Terra Nova by CTB McGraw-Hill. This Terra Nova measures student knowledge by compiling subscale scores in reading, language arts, and mathematics. It also computed a total score based on these three separate subscale scores. Test score data from 2005 was compared to 2004 data to determine whether there were any statistically significant gains in the test scores of students whose teachers attended the graduate math classes. These gains were compared to the test score gains of students

within the same school whose teachers did not attend the classes. We used the t-test for independent samples to determine whether there were any statistically significant differences. Only two of the four middle schools in the district were considered in the analysis since too few teachers participated from the other two schools. (Grip, 2005)

When analyzing all students in the first middle school, students in the treatment group did not have any statistically significant higher gains when compared to students in the control group. However, students in the treatment group outperformed students in the control group on the mathematics subscale. The results are shown in Table 1 below.

Table 1: Terra Nova Comparison of Middle School #1 Students for 2004 and 2005

	Control				Treatment					
	All Students				All Students					
Subject	**N**	**2004 Scores**	**2005 Scores**	**Gain/ (Loss)**	**n**	**2004 Scores**	**2005 Scores**	**Gain/ (Loss)**	***t* statistic**	***p* value**
Reading	240	637.1	639.0	1.9	68	665.2	658.7	(6.5)	-1.823	0.069
Language	240	639.8	646.6	6.8	68	665.8	664.7	(1.1)	-2.053	0.041*
Math	230	642.6	646.2	3.6	67	670.9	678.5	7.6	1.091	0.276
Total	228	641.1	645.2	4.1	66	667.7	668.8	1.1	-1.073	0.284

Note: *$p \leq 0.05$

When analyzing all students in the second middle school, students in the treatment group had statistically significant higher gains when compared to students in the control group on the mathematics subscale, as shown in Table 2. The gain in the mathematics test score that was statistically significant was 12.4 points in the treatment group compared to 4.5 points in the control group.

Table 2: Terra Nova Comparison of Middle School #2 Students for 2004 and 2005

	Control				Treatment					
	All Students				All Students					
Subject	**N**	**2004 Scores**	**2005 Scores**	**Gain/ (Loss)**	**n**	**2004 Scores**	**2005 Scores**	**Gain/ (Loss)**	***t* statistic**	***p* value**
Reading	258	637.2	639.1	1.9	55	650.7	649.8	(0.9)	-0.728	0.467
Language	258	640.7	643.5	2.8	55	646.6	650.5	3.9	0.299	0.765
Math	243	638.3	642.8	4.5	51	643.8	656.2	12.4	2.541	0.012*
Total	242	639.0	642.1	3.1	51	647.0	653.1	6.1	1.182	0.238

Note: ***$p \leq 0.05$**

Measuring Teacher Attitudinal Impact

Three methods were used to assess teacher attitudes. The first measure was calculated using the National Mathematics Education survey (Horizon-Research, Inc., 2000). Survey items

such as: “I enjoy teaching mathematics”; “I am very enthusiastic about my math knowledge through professional development”; and “I am very enthusiastic about providing professional development in math to my colleagues” were included. Results of the Teacher Attitude Scale are reported in Table 3.

Table 3: Measuring Teacher Attitudinal Impacts

Category	Entry Mean	Exit Mean	*t* statistic	*p* value
The school district provides me with enough opportunities for professional development.	2.61	1.77	-3.453	0.001**
I am very enthusiastic about enhancing my math knowledge through taking college level math courses.	2.51	1.35	-4.765	0.000**
I am very enthusiastic about providing professional development in math to my colleagues.	2.66	2.09	-2.277	0.024*

Notes: $^{*}p \leq 0.05$, $^{**}p \leq 0.01$
Scale ranges from 1 being the highest to 5 being the lowest.

The second measure of teacher attitude was the final evaluations for each graduate-level mathematics course. Examples of teacher responses are:

> The course has, as silly as it sounds, given me the confidence to move to the next teaching level—to want to make teaching math better.
>
> This course is an eye opener for some of us. There are some skills I haven’t used since school. I’ve had fun learning again. I’m looking forward to the next course.

The final method of assessing teacher attitudinal impacts was through follow-up telephone interviews of teachers who attended the courses. Five teachers were interviewed. All teachers stated that they liked teaching mathematics before the courses. One teacher stated:

> I’m better able to understand the math and I have a better attitude toward my teaching. I ask better questions. I know where it’s [the math content] is coming from and where it’s going. I know how my curriculum fits into the overall picture.

Another teacher stated:

> I’ve always loved math. Now I am more confident. I know more. I trust my instructor wholeheartedly.

Discussion

The type of professional development offered by the college partners to the district is unique in that we provided graduate courses where the teachers had to invest time and effort outside of the actual professional development contact time. In typical professional development workshops, even if it is an ongoing experience, teachers do not need to do anything other than attend the workshop. The teachers who participated in these courses read books and articles, completed homework assignments and projects, and studied for tests. They also had to try to apply what they learned in the courses when they taught revised lessons in their classrooms as part of their final project. As a result, they invested a great deal in this professional development experience, and there was a direct link to their classroom.

The teachers had pride in what they were doing. They would talk about showing their homework for the course to their students or telling their students that they received an A on a test. Some teachers spoke about their students being anxious to include their work in a project for

the course. Some felt that they could better identify with their students since they were also experiencing learning and being students themselves.

Through this intense, sustained professional development experience, teachers developed a trusting relationship with the College partners. They often turned to the professor for advice or help with an issue at their school. Teachers who have taken all four courses, which was the number originally proposed in the grant, asked for more courses. As a result, we developed fifth and sixth courses, Discrete Math for Middle School Teachers and Concepts of Calculus for Middle School Teachers. The teachers also enjoy the camaraderie that developed among those who took courses together semester after semester. The weekly classes gave them an opportunity to discuss events happening in their schools and classrooms, share their ideas and concerns, and learn together. They worked together in and out of class on projects and explorations. The graduate courses have become a learning community for the teachers and professor.

Conclusion

The results of this study have implications for other school districts that want to enact change in middle school mathematics. Connecting professional development to the curriculum is not new. However, developing a professional specialization program with in-classroom coaching and mentoring tied to the curriculum is a new idea. Sustaining professional development over the course of several years has a significant impact on teachers and students.

Our research shows that the students in the classrooms of the teachers who took the graduate level courses had higher levels of achievement than those in the classrooms of the comparison teachers. Changes in teacher attitude accompanied this.

Evaluating the impact of professional development is essential. This study has revealed important information for the district studied. This study continues in this district. We are currently replicating it in another high-need school district, as well. We are also refining our methodology. Continued research with better methodology will enable us to gain information that can be generalized to other high need districts across the state and nation. It is our hope that we can continue to increase the knowledge of the effect of sustained professional development on the learning and attitudes of teachers and students.

References

Grip, R.S. (2005). *Year-end evaluation of the (Author) Program.* Statistical Forecasting LLC.

Horizon-Research, Inc. (2000). *2000 National Survey of Science and Mathematics Education Mathematics Teacher Questionnaire.* Chapel Hill: Author.

National Commission on Teaching and America's Future. (2003). No Dream Denied. A Pledge to America's Children, Summary Report. Washington, DC: National Commission on Teaching and America's Future.

Olson, Lynn. "The Great Divide: Quality Counts, 2003." Education Week. Washington, DC: Education Week, January 9, 2003.

U.S. Department of Education's Mathematics and Science Expert Panel. (1999). *Exemplary and promising mathematics programs.* Washington, DC: U.S. Department of Education.