Impact of Revised Standards-Based Mathematics Courses
(2006-07 and 2007-08)

Executive Summary

Why were mathematics courses revised?

A renewed vision for mathematics professional development was expressed in the *Principles and Standards for School Mathematics*, published by the National Council of Teachers of Mathematics (NCTM) in 2000. This was based on a realization that the need to understand and use mathematics in everyday life and in the workplace have never been greater, and it resulted in NCTM's guide for focused and sustained efforts to improve school mathematics curricula by outlining key principles needed to bring about necessary change. These new NCTM principles were used as a screen against which professional development training courses at the Schultz Center were reviewed to determine the need to revise or develop them. Restructuring of standards-based mathematics program was also influenced by research and best practices evidence around the most successful combinations of published textbook curricula with features of standards-based learning environments. In addition, lessons learned from the Japanese method of *lesson study* were incorporated to emulate the *most skillful and purposeful* forms of teaching. These features included the use of high level and challenging problems for students to solve while providing them with supports in the curriculum to help them make connections and reach higher levels of understanding. Finally, a variety of adult learning methods in use at the Schultz Center were evaluated in order to optimize the learning of teachers. Among these approaches, developers of revised mathematics courses selected a set of strategies called *asset-based instruction* developed by Boston Public Schools. Using these principles in re-designing courses make it necessary to consider multiple layers of support and interaction when planning professional development. By doing so, models for mathematics instruction include recognizing students' strengths, and helping students to think about and consciously plan for their own educational growth. The same considerations hold true in the way curriculum in mathematics training courses are planned, including the use of multiple layers of support and interaction with teachers provided by mathematics coaches. The use of coaches in this way is intended to help teachers implement new knowledge and practices learned professional learning experiences as they are integrated into classroom instruction.

What courses were evaluated and how?

The first course in the mathematics program to be revised was Mathematics 101. It represented new understandings about the learning needs of students, and the related needs of teachers to improve and enhance their teaching practice. Math 101 was revised in 2006-07 and was first implemented in its revised form in the spring of 2007. After the first year of implementation, teacher participants were surveyed to obtain feedback about the quality, relevance, and content of the course. Since a major emphasis in the revised curriculum of Math 101 was the teaching of content and use of the *Mathematics Workshop Model* method, it was also very important to assess the extent to which new methods were being implemented in the classrooms of teachers

who completed the course. A survey was created to measure both aspects of content knowledge and implementation at a single point in time in the spring of 2007. Because the capturing of *pre-test* data individually from all participants is sometimes problematic, a method called the *retrospective pre-test post-test design* was used to gain participant perspectives about the degree to which their learning of knowledge and skills and implementation of practices had changed prior to and following the training.

What did participants (teachers) learn in (revised) Math 101?

The Math 101 survey addressed four areas: *Understanding of Concepts and Skills; Implementation of Concepts and Skills; Artifacts, Rituals & Routines*; and *Reflections of Professional Development Opportunities*. After formative changes and refinements were made to the content of Math 101 in 2007, the implementation survey was conducted again in the spring of 2008. Results of these surveys were used to determine teachers' reported levels of implementation of concepts and skills addressed in the Math 101 content. Although both *content* and *implementation* showed large increases from *pre-test* to *post-test* timeframes, there was a tendency for the increases in implementation levels to lag somewhat behind increases in knowledge and understanding. After training:

- the overall total for responses to knowledge items was **90%**
- the overall total for responses to implementation items was **87%**
- increase in percent reporting "high" degree of knowledge was **73%**
- increase in percent reporting "high" degree of implementation was **67%**

Another group of items on the survey measured teachers' responses to questions about using *Mathematics Workshop Model* artifacts in their classrooms. After training, participants reported using artifacts in their classrooms at **86.5%**, an *increase* since the beginning of the course of 21.6%. Similarly, the level of reported use in classrooms of Rituals & Routines was **96.2**% following the training, an increase of 23.2%. The survey also asked several questions about characteristics of school-based professional development opportunities in schools. As a whole, **64%** of teachers completing Math 101 reported positive features of a professional learning environment present currently in the schools they represented. This finding was not reflective of the quality of the course content itself, but rather an indication that more sustained work is needed to create fully functioning professional learning communities in schools characterized by ample opportunities for teachers to collaborate to discuss student work and instructional practice in meaningful ways.

What did participants experience in the Academy of Mathematics (AoM)?

The Academy of Mathematics (AoM) was designed to combine characteristics of *asset-based instruction*, reflective teaching and learning, and principles of Stigler's *lesson study* into a program that was keenly focused on *how students learn*. The delivery mechanism for AoM was a combination of face-to-face, group participation, and the use of state-of-the-art video streaming technology that allowed teachers to "virtually" observe in their colleagues' classrooms. Following several sessions of AoM carried out in 2006-07 and 2007-08, an implementation evaluation was carried out which

included two major activities: the content analysis of participant (Reflections) form completed on-site daily at the conclusion of each training session and the administration of an electronic survey.

Reflections forms were collected from all participants attending AoM sessions in the spring of 2007, fall of 2007, and spring of 2008 (N=394). Feedback was provided from participants in narrative form, and was organized in terms of their positive or negative slant on the information given, and arranged in categories according to topic. Key findings from the content analysis of *Reflections* forms were that:

- teachers like the neutral vehicle afforded them for observing and discussing instruction around video-streamed lessons
- teachers are feeling more capable of identifying key characteristics associated with Mathematics Workshop Model lesson components
- video-streaming was enthusiastically received as an opportunity to observe in actual classroom settings

Surveys of AoM participants (N=128) were also conducted to ask more substantive questions about the value that participants perceived they had gained from the collaborative work carried out in the Academy of Mathematics. The majority of participants (**80%**) found the video streaming to be an essential part of the AoM experience. In addition, two-thirds of participants thought the use of the Blackboard online discussion board was a helpful tool. The survey also identified several areas in which they *felt they had benefited most* in as a result of the AoM experience:

- **85%** identified modeling of effective questioning strategies
- **81%** listed learning more about looking at student work, and
- **80%** identified the use of higher levels of questions to guide instruction was most valuable.

Areas listed by teachers as those in which they most need and *would like more opportunities to view and discuss* teaching practice:

- **64%** want to learn more about *developing and using classroom assessments*
- **63%** want to see more examples of *differentiated instruction in lessons*
- **62%** request more opportunities to *view student work that address standards*

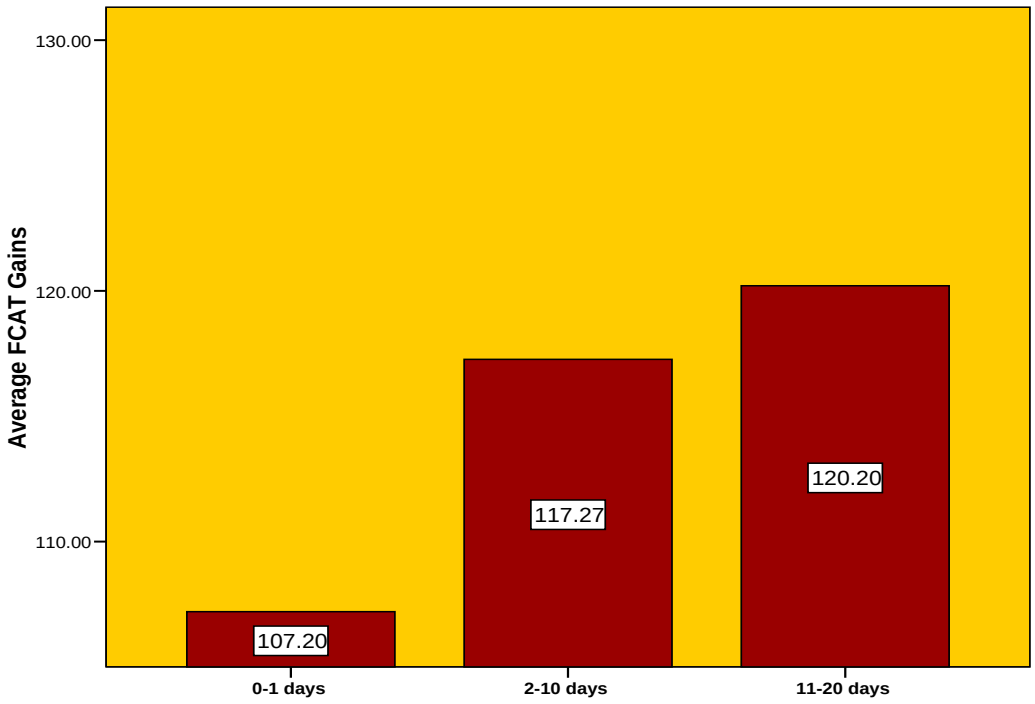
The most difficult aspect of the AoM experience for participants was completing the *Task and Transfer* activity. These tasks documented the use of new strategies and pedagogy learned through AoM, and therefore were instrumental in determining the extent to which teachers were implementing new skills and strategies learned as a result of AoM into classroom instructional practice.

Did revised mathematics courses have an impact on students?

Following two years of implementing revised *standards-based mathematics courses*, and carrying out two rounds of formative evaluation to refine and adjust courses in 2006-07 and 20007-08, it was time to assess the extent to which targeted student achievement outcomes were being influenced positively as planned. The Florida Comprehensive Assessment Test (FCAT) in mathematics is the single most important measure of proficiency used for both students and teachers, and as such provides the high stakes outcome measures that must be used to gauge progress. Since our *theory of action* at the Schultz Center holds that if we provide teachers with high quality

professional learning experiences in a sustained way, then we can expect that classroom practice will be enhanced, and therefore, student achievement will improve. In line with this thinking, analyzing student performance was done by identifying students associated with teachers of mathematics in the most recently concluded school year (2007-08), and determining how much standards-based mathematics training (SBMT) had been completed by each. We then determined whether student gains on the FCAT could be seen to differ on the basis of how much mathematics professional development teachers had completed over the past two years (2006-07 and 2007-08). Over time, this pattern will be re-examined annually, and cumulatively as we are interested in the degree to which *capacity* in the district is being raised to create a highly trained corps of mathematics teachers. As of the current year's study (2007-08), less than half of the teachers (42%) had accrued 2 or more days in training, leaving a large number of teachers just beginning the process. Coupled with the fact that many mathematics teachers have few years of teaching experience (median years experience was 6), the need to provide more and deeper levels of training is clear.

The time period included in this impact study was brief (two years), during which teachers had opportunities to participate in revised mathematics training. When all records were reviewed, the maximum number of hours of professional development taken by math teachers as of the end of 2007-08 was approximately 120. These hours were converted into the number of six-hour days. A total of 605 teachers were identified as teaching mathematics courses for students in grades 4-10 (students for whom two years' of FCAT test data would be available for comparison purposes). The time devoted in mathematics training were then categorized in three groupings: **0-1** days, **2-10** days, and **11-20** days. Results of the student impact analysis indicated that mathematics training had an impact on all teachers, and that discernible results in student achievement could be determined for increasing days of teacher time spent in training. In 2007-2008, this pattern of increasing gains by students, as categorized by the amount of professional development experienced by teachers, was clear:



The graph above illustrates that student achievement gains on the FCAT increase from **107.2** for teachers with 0-1 days of accumulated training, to **117.27** for teachers with 2-10 days of training, to **120.2** for teachers who had completed 11-20 days of training. In terms of the bigger scheme of things and the practical significance of such differences, we must acknowledge that the differences are quite small, although statistically significant. At this early stage in our work to study the impact of professional development on teacher practice and student achievement in mathematics, however, we were interested first in confirmation that the direction and pattern of increasing student scores by increasing mathematics professional development was verified. In the following years, the impact on student achievement will be expected to increase as more teachers are completing more courses in mathematics training, and are going deeper into the work.

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