MATH PARTNERSHIP PROJECT EVALUATION
YEAR 3

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Executive Summary

Observations of teachers participating in the Math Partnership Project were conducted in order to determine how teaching techniques change over the school year. Staff of Delaware Education Research and Development Center conducted 33 observations of math lessons during fall 2006 and 36 observations during spring 2007. All the teachers observed in spring were also observed in fall.

The observations conducted included three main components: The design and implementation of the lesson, Mathematics Content, and elements of classroom culture. The data gathered indicate a positive change towards better teaching techniques; especially in design and implementation of the lesson and the component of classroom culture. In the component of mathematics content there is still room for improvement.

Introduction

This evaluation report, prepared by the Delaware Education Research and Development Center, includes a description of the performance of a group of mathematics teachers who participated in the Secondary Mathematics Partnership Project in the school year 2006-2007 in the state of Delaware. This is the third year of evaluation.

This report includes four sections. The first section describes briefly the project and gives an overview of its main domains. The second section includes the methodology of the evaluation. The third section includes the results of the fall and spring observations. Finally, a summary is presented in the fourth section.

Delaware Secondary Mathematics Partnership Project

The Delaware Secondary Math Partnership Project targets at-risk math students in grades six to 10. High-school and middle-school teachers videotape one another as they instruct their classes and then they watch and critique their own and others' techniques. The main goal of the Delaware Secondary School Math Partnership is to help students through observation, considering which kind of instruction is reaching them and which is not. The three main components of the projects are:

1. The *Design and Implementation of the Lesson* which encompasses a range of factors including communication of purpose, effective allocation of time to critical lesson components, and effective questioning and formative assessment technique;

2. *Mathematics Content* which addresses both rigor and appropriateness of the mathematics, assessing level of challenge *and* accessibility. Elements of mathematical abstraction, connections within mathematics and between mathematics and the phenomena it represents are elements of interest;

3. Elements of *Classroom Culture* which include factors that are believed to enhance effective mathematics discourse including high expectations for all students and a privileging of mathematical argumentation.

Methodology

An observation protocol was developed by University educators from the Mathematics & Science Education Resource Center in conjunction with researchers from the Delaware Education Research and Development Center. The observation protocol called "Determining the Quality of Mathematics Instruction" was adopted as the main measure of teaching quality. The protocol consists of the three main components in which the Secondary Mathematics Partnership Project is interested: The design and implementation of the lesson, mathematics content, and classroom culture. The items or questions for each of the components are as follows:

The design and implementation of the lesson:
1. Teacher clearly defines and communicates a purpose of the lesson.
2. Teacher effectively engages students with important ideas.
3. Teacher provides adequate time and structure for investigation and exploration.
4. Teacher provides adequate time and structure for "wrap-up."
5. Teacher achieves a collaborative approach to learning.
6. Teacher enhances the development of student understanding.
7. Teacher assesses the students' level of understanding.
8. Teacher plans and/or adjusts instruction based on students' level of understanding.

Mathematics content:
1. The content is balanced between conceptual understanding and procedural fluency.
2. The content is challenging and accessible to the students.
3. Teacher provides content information that is accurate.
4. Elements of mathematical abstraction are included when appropriate to do so.
5. Appropriate connections are made to other mathematics and/or to real world content.

Classroom culture:
1. Active participation of ALL is expected and valued.
2. There is a climate of respect for students' ideas, questions, and contributions.
3. Teacher's classroom management style/strategies enhance productivity.
4. The classroom climate is encouraging to students
5. Intellectual rigor and/or the constructive challenge of ideas are evident.

Using the "Determining the Quality of Mathematics Instruction" protocol a group of observers was trained until they achieved an adequate inter-rater reliability. In October of 2006 and May of 2007, as part of the third year of the Secondary Mathematics Partnership Project evaluation, observers were sent into math classrooms to gather data about math

instruction across the state. We gathered data from the same 33 teachers during the October and May observation periods. In addition, three more teachers were observed in May.

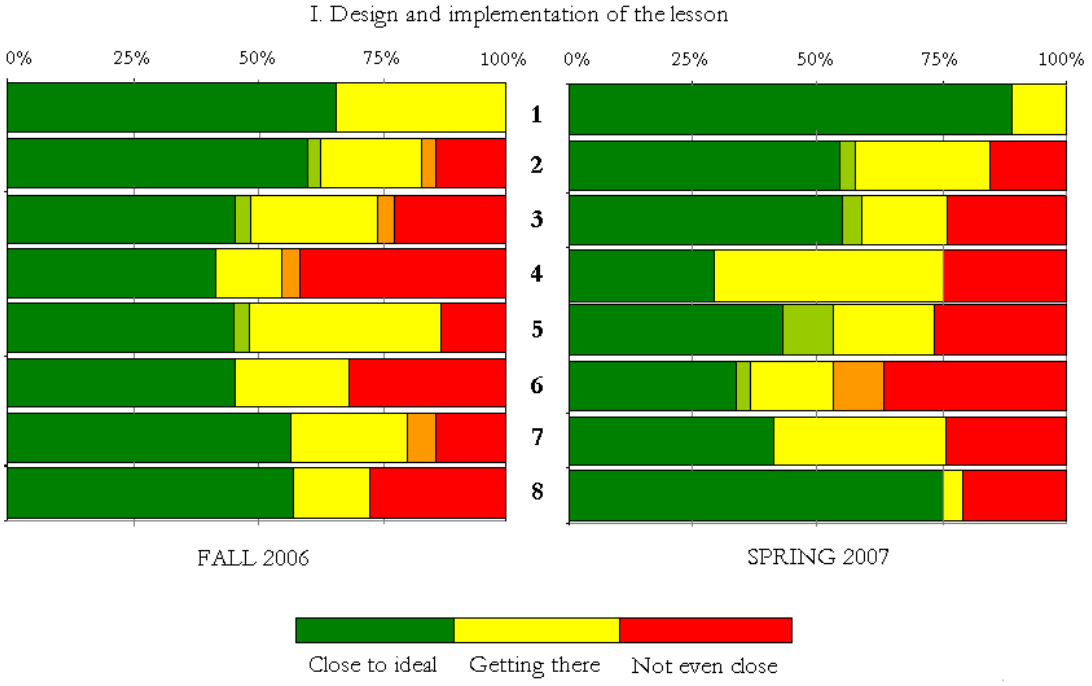
The lessons observed occurred in sixth to tenth grade classrooms. The lessons observed ranged from 40 to 100 minutes in length. The observers looked for specific evidence regarding three main components. They were instructed to categorize the concepts using three principal descriptors, "close to ideal," "getting there," and "not even close." While these concepts are illustrated through examples within the context of each of the separate indicators, it is possible to characterize them in more general terms. An indicator is rated as "close to ideal" if there is a good bit of strong supporting and little or no contradictory evidence. "Getting there" suggests a convergence on exemplary practice but also an incomplete realization thereof. Practices that are clearly at odds with the ideal within an indicator may still be present but no longer represent the norm. Teaching that is rated as "not even close," however, is consistently impoverished with little indication of progress toward the exemplary.

Results

The results of the fall and spring observations are presented in this section. Percentages of teachers rated in each category: "close to ideal," "getting there," and "not even close" as well as instances where teachers rated in the middle of the categories (e.g. in between "close to ideal" and "getting there") are represented in graphs throughout this section. The graphs portray fall and spring observations side by side for the three components. It is desirable that the category "close to ideal" increases from the first to the second observation. In the same manner, the category "not even close" would decrease from the first to the second observation in the best case scenario.

The design and implementation of the lesson

The first domain pertaining to the design and implementation of the lesson is represented in Figure 1 for fall and spring. In half of the questions an improvement was observed from fall to spring. When defining and communicating the mathematical purpose of the lesson, almost all the teachers observed were right on target (Question 1) by spring. Teachers remained as successful engaging students with important ideas related to the focus of the lesson in the spring as in the fall (Question 2). Three-fourths of the teachers stimulate investigation and exploration by providing an adequate structure and enough time (Question 3). Similarly, by the spring, three-fourths of the teachers achieved a collaborative approach to learning. Interaction among students was observed often as a group dynamic (Question 5). In addition, three-fourths of the teachers were "close to ideal" regarding adjusting their lessons to the students' level of understanding (Question 8).



1. Teacher clearly defines and communicates a purpose of the lesson.
2. Teacher effectively engages students with important ideas.
3. The teacher provides adequate time and structure for investigation and exploration.
4. Teacher provides adequate time and structure for "wrap-up."
5. The teacher achieves a collaborative approach to learning.
6. The teacher enhances the development of student understanding.
7. The teacher assesses the students' level of understanding.
8. Teacher plans and/or adjusts instruction based on students' level of understanding.

FIGURE 1. Design and implementation of the lesson FALL and SPRING

Conversely, we found three areas that need more work to improve the design and implementation of the lesson. First, almost 60% of the teachers assessed students' level of understanding to accommodate their teaching by taking into consideration prior experiences, how prepared the students were, and how they adjusted to different students learning styles in the fall (Question 7). By spring this number was reduced to almost 40%. Second, even when about 40% of the teachers in the fall were categorized as "not even close" at providing adequate time and structure for "wrap-up" (Question 4) and this number was reduced to 25% by spring, there is still room for improvement in this area. This matters since this is the phase of the lesson during which conceptual closure may be achieved for the majority of the students. "Summing it up" represents an opportunity for the teacher to orchestrate the presentation of student ideas that have resulted from the exploration phase and, in so doing, to draw out the important mathematical ideas from the lesson. This is where mathematical connections are often made and may be a final opportunity for the teacher to assess the impact of the day's lesson. Finally, the last area to improve is enhancing the development of students' understanding (Question 6). Research has found that higher order questions are correlated with increased student achievement, particularly for conceptual understanding (see Redfield, D. L. & Rousseau, E. W. (1981). A meta-analysis of experimental research on teacher questioning behavior. *Review of Educational Research*, 51, 237–245). In both occasions, fall and spring, a third of the teachers were in the category of "not even close" on this matter. Higher order questions offer opportunities to learn and think about the mathematical ideas in many different ways. In standards-based mathematics instruction, it is desirable that the design of the lesson promotes an inquiry-based framework.

Mathematics content

Items regarding mathematics content of the lesson are represented in Figure 2. The only big change from fall to spring was observed in only one area: by spring, almost all teachers demonstrate conceptual accuracy when teaching their lessons (Question 3). Other

than that, the pattern of performances remained similar. On the question regarding how challenging and accessible the content was to students, three out of four teachers were "close to ideal" or "getting there" (Question 2). Also, three-fourths of the teachers made appropriate connections to other mathematics and/or real world content (Question 5).

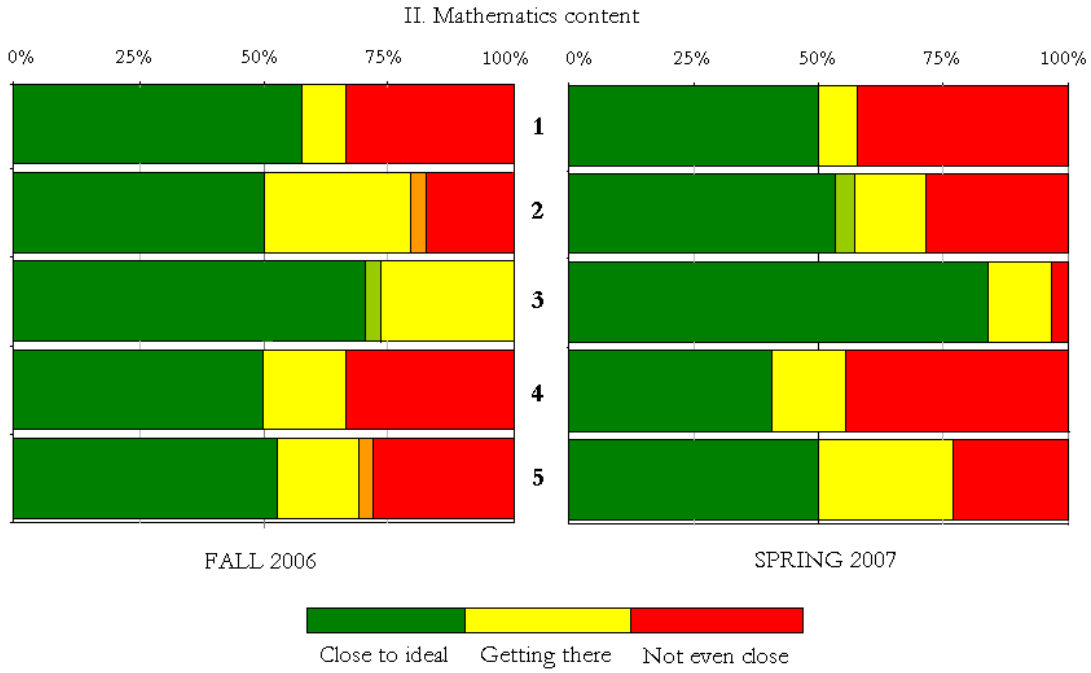


FIGURE 2. Mathematics content FALL and SPRING

We found two areas with room for improvement in the *Mathematics content* section. Firstly, half of the teachers did not master the practice of balancing content between conceptual understanding and procedural fluency (Question 1). Most of the time procedural skills are emphasized. Secondly, even a poorer performance was observed when almost half of the teachers failed to include elements of mathematical abstraction when appropriate (Question 4).

From fall to spring we observed a polarization in behaviors for some of the items. In other words, the percentages of the "close to ideal" and "not even close" classifications both increased. Questions 2 to 4 are in this group.

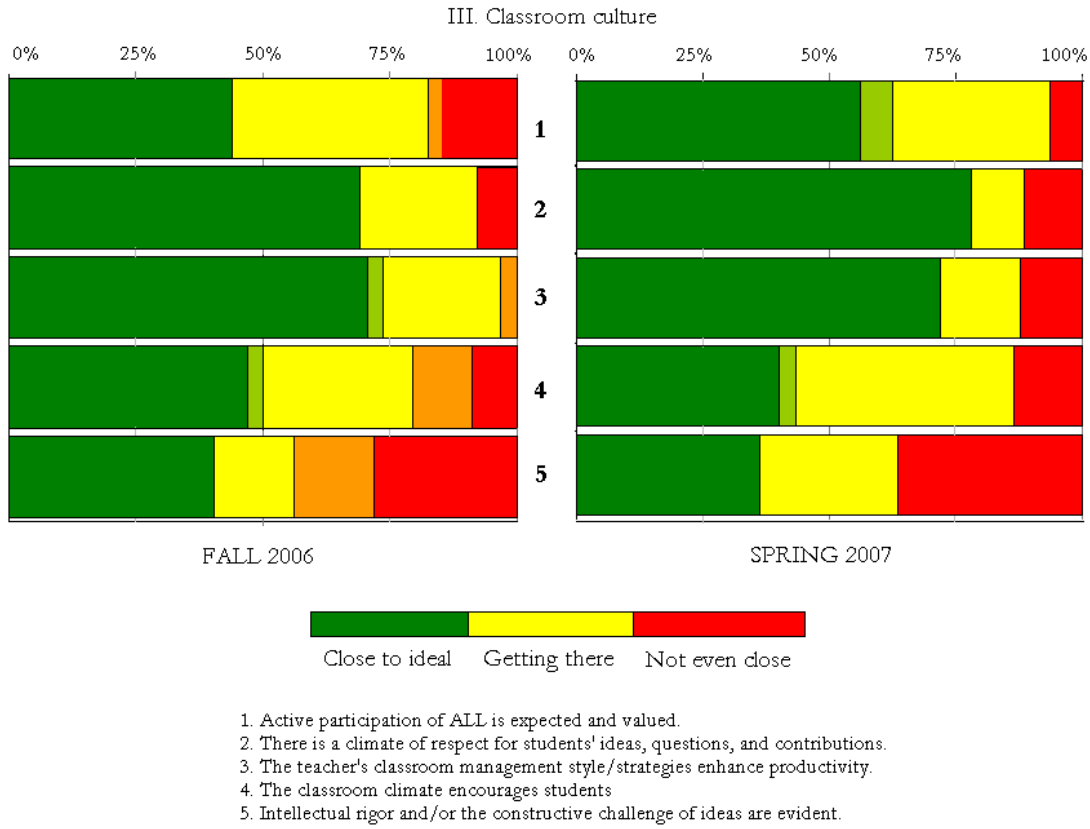


FIGURE 3. Classroom culture FALL and SPRING

Classroom culture

The classroom culture section revealed encouraging results for most of the questions (see Figure 3). First, it is apparent that active participation of all students is almost always expected or valued; a very small percentage of the teachers were rated "not even close" on this statement (Question 1). Then, most lessons showed a climate of respect for students' ideas, questions and contributions. Also, almost all teachers supported generating ideas and questions from students as they solved problems (Question 4). Another case of polarization was found regarding classroom management style (Question 3). For instance, more teachers were categorized as "close to ideal" and "not even close" in the spring than in the fall observational period. Only one area in the *Classroom culture* section needs improvement. Intellectual rigor or constructive challenge of ideas was evident only a third of the time. In other words, students' conjectures were explored and students were held to the standard of justification and proof in only one of three lessons (Question 5).

Summary

There were several strengths observed regarding design and implementation of lessons. The majority of teachers:

- defined and communicated the mathematical purpose of the lesson
- attempted or achieved to make the introduction to the lesson task clear
- provided adequate time for students to engage in problem solving activities
- assessed students' level of understanding to accommodate their teaching
- took into consideration prior experiences, how prepared the students were, and how teachers adjusted to different students learning styles
- facilitated a collaborative approach to learning

Three areas for improvement were also noted from the observations, eliciting students' understanding, using higher order questions, and providing structure. Specifically, teachers could better adjust their lessons to the students' level of understanding, they could use more questioning strategies to improve the conceptual understanding of the lesson, and finally, they could provide a summary or wrap-up of the lesson more often.

Concerning mathematical content again, several strengths were observed. The majority of teachers:

- provided accurate content information during the observed lessons
- made the content challenging and accessible to students
- made appropriate connections to other mathematics and/or real world content

The main areas for improvement regarding mathematical content were elements related to mathematical abstraction and the balance between conceptual understanding and procedural fluency.

Several strengths regarding classroom culture were observed. Specifically the majority of teachers fostered a classroom climate that:

- expected and value active participation of all students
- showed respect for ideas, questions, and contributions
- promoted the production of ideas and questions from students as they solved problems
- enhanced productivity through classroom procedures

One area of improvement was also noted on the subject of classroom culture. Teachers should work more on modeling mathematical rigor.

Closing comments

The data gathered indicate a positive change towards better teaching techniques; especially in the components of design and implementation of the lesson and classroom culture. However, not much change was observed for the component of mathematics content. There is still room for improvement in this area. We need to consider that not all the teachers have been in the program for three years. Some teachers have been in the program for only one year. Even then, it appears to be easier for teacher to adjust the design and implementation of their lessons and to enhance the classroom climate towards a more positive learning environment than to improve the rigor and appropriateness of the mathematical content.