

SYMPOSIUM: MIDDLE SCHOOL MATHEMATICS PROFESSIONAL DEVELOPMENT IMPACT STUDY

Paper #1: Middle School Mathematics PD Study: Study Design and Methodology

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Background/context:

Student achievement in mathematics has been a focal concern in the United States for many years. The National Research Council's 2001 report and the recent report of the National Mathematics Advisory Panel (2008) both called attention to student achievement in mathematics, and both called for all students to learn algebra by the end of eighth grade. Reports have argued, further, that achieving this goal requires that students first successfully learn several topics in rational numbers—fractions, decimals, ratio, rate, proportion, and percent. These topics are typically covered in grades 4 through 7, yet many students continue to struggle with them beyond the seventh grade. The PD program evaluated in this study is designed to address the problem of low student achievement in topics in rational numbers. The study focuses on seventh grade, the culminating year for teaching those topics.

Currently, through the Elementary and Secondary Education Act, the federal government provides significant resources for PD, but little rigorous evidence is available on the impact of PD on teacher and student outcomes. Hundreds of studies have addressed the topic of teacher learning and PD (for reviews, see Borko 2004; Clewell, Campbell, and Perlman 2004; Kennedy 1998; Richardson and Placier 2001; Supovitz 2001; Yoon, Duncan, Lee, Scarloss, and Shapley 2007). The most recent review of studies of the impact of teacher PD on student achievement revealed a total of nine studies that have rigorous designs—RCTs or certain quasi-experimental designs—that allow causal inferences to be made (Yoon et al. 2007). Four of the nine studies focused on the effect of a PD program on mathematics achievement, and none focused on mathematics at the middle school level.

Purpose / objective / research question / focus of study:

The Middle School Mathematics PD Impact Study is the first rigorous test of the impact of a PD program focused on teachers of middle school mathematics. The study has three central research questions:

1. What impact did the PD program provided in this study have on teacher knowledge of rational number topics? Teacher knowledge was measured in the fall and in the spring using a specially constructed *teacher knowledge test*. The test was designed to measure two constructs aligned with the purpose of the PD program: knowledge of rational numbers content typically taught in seventh grade (common knowledge of mathematics, or CK) and additional knowledge that may be useful for teaching rational number topics (specialized knowledge of mathematics for teaching, or SK). Each form was equally

divided between CK and SK and equally divided between: (1) fractions and decimals and (2) ratio, rate, proportion, and percent.

2. What impact did the PD program provided in this study have on teacher instructional practices? To measure instructional practice, one *classroom observation* was conducted for each teacher when they were teaching rational number topics. The observations produced three primary measures of instructional practice: *teacher elicits student thinking*, which encompassed such behaviors as asking other students whether they agree or disagree with a student's response; *teacher uses representations*, which counted the number of times the teacher explained a visual representation of mathematics, and *teacher focuses on mathematical reasoning*, which counted the number of times the teacher asked questions such as "Why does this procedure work?" or "Why does my answer make sense?"
3. What impact did the PD program provided in this study have on student achievement in rational number topics? A customized, computer-adaptive *student achievement test* was constructed for the study by a major test publisher. The test was restricted to positive rational numbers content and drew on a customized item base that contained nearly 1,200 rational numbers items.

Setting / Population / Participants / Subjects:

The study randomly assigned 77 mid- and high-poverty schools from 12 districts to treatment and control conditions and collected outcome data on teachers and students. The PD was delivered by two provider organizations, each of which worked with half of the participating districts. Seventh-grade teachers in the treatment schools had the opportunity to receive the PD program offered by the study and could also continue to participate in the PD activities that they would have received in the absence of the study. Seventh-grade teachers in the control schools received only the PD that they would have received in the absence of the study.

Intervention / Program / Practice: (See paper 2 in this symposium)

Research Design:

The study randomly assigned 77 mid- and high-poverty schools from 12 districts to treatment and control conditions and collected outcome data on teachers and students. The PD was delivered by two provider organizations, each of which served the treatment schools in six of the 12 participating districts. Seventh-grade teachers in the treatment schools had the opportunity to receive the PD program offered by the study and could also continue to participate in the PD activities that they would have received in the absence of the study. Seventh-grade teachers in the control schools received only the PD that they would have received in the absence of the study.

Data Collection and Analysis: (See Paper 3 for a more detailed description of analysis)

Data were collected from teachers and students in the study schools in the fall, winter, and spring of the 2007–2008 school year. We also gathered background data on the amount and type of PD teachers participated in during the study. Study staff obtained information on the implementation of the PD by observing the institute and seminars and by reviewing logs maintained by coaches that recorded the nature of each coach interaction with each teacher.

Data were also collected to document the total amount and type of mathematics-related PD (including study PD and other PD) that teachers participated in during the first year of the study. Study staff also obtained information on the implementation of the study PD by observing the institute and seminars and by reviewing logs maintained by coaches.

The basic analytic strategy for assessing the impact of the PD program was to compare outcomes for schools that were randomly assigned within each district to each of the two study conditions. Because we used data on students nested within teachers' classrooms nested within study schools, three-level models were used to estimate the impact of professional development on student achievement and two-level models were used to estimate impact on the teacher measures.

Findings / Results: (See paper 3 in this symposium)

Conclusions: (See paper 3 in this symposium)