Abstract Title Page

Title: Partial Fidelity of Implementation as a Predictor of Student Achievement Among Teachers Using a Pre-Algebra Supplemental Program in Rural Mississippi

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Background / Context:

Research suggests that success in mathematics courses increases college and career options and prospects for future income (Horn & Nuñez, 2000; Horowitz, 2005; NMAP, 2008). In particular, success in high school mathematics through Algebra II or higher correlates with future success, including improved college access (Horn & Nuñez, 2000; Horowitz, 2005), improved chances of college graduation (Achieve, 2006; Adelman, 1999; Evan, Gray, & Olchefske, 2006), and higher future earnings (Achieve, 2006). Middle school serves as a key milestone for pre-algebra mastery, enabling students to be successful in high school algebra. Yet, at the point when students should be transitioning from learning arithmetic to learning mathematics, many are unprepared in fundamental mathematics concepts that strongly predict algebra achievement (Reeves, 2008).

Purpose / Objective / Research Question:

Because mastering pre-algebra concepts in middle school provides a foundation for future success, we examined the impact of a supplemental mathematics curriculum on student achievement called *Everyday Counts Algebra Readiness* (EDC) using a cluster randomized design. Previously, we presented the finding from the intent-to-treat impact study, which failed to yield statistically significant impacts of the EDC program on student achievement. For this presentation, we turn to the issue of implementation. Specifically, our exploratory research questions are: Does the EDC program (in a treatment on the treated analysis) have a significant impact on student achievement when implemented with at least partial fidelity? Does the level of implementation among treatment group teachers predict student achievement?

Population / Participants / Subjects:

This study involved 2,031 students in grades 6-8 in 36 rural Mississippi schools. Middle school is an important timeframe for learning basic algebraic concepts and for preparing to succeed in high school Algebra. Students in Mississippi are required to pass Algebra I to graduate high school, yet previous research shows that students in rural Mississippi schools are underperforming in mathematics – Mississippi has the largest rural state-national score gap in mathematics on the National Assessment of Educational Progress.

Intervention / Program / Practice:

EDC is a widely-used supplemental program that provides curriculum supports for preparing middle school students for success in high school algebra (Houghton Mifflin Harcourt, 2009). The program consists of an interactive bulletin board containing visual models around which teachers conduct whole-class activities for 10-15 minutes per day, including a Calendar (geometry and algebraic relationships), Counting Tape (equivalent fractions and decimals), and Percent Circle (fractions, decimals, and percentages) to lead students in consistent, incremental daily practice designed to help them express conceptual thinking about mathematics and to understand critical algebra readiness concepts and skills (Clark, 2006b; Houghton Mifflin Harcourt, 2009).

Research Design:

The original study used a cluster randomized trial wherein 36 schools were randomly assigned to either treatment or control conditions. Teachers in treatment schools received training on EDC and were instructed to implement the supplemental EDC curriculum every day for at least 10-15 minutes according to the program design. The original intent to treat design compared math achievement of students in treatment schools to that of students in control schools. The current exploratory research design accounts for implementation fidelity using a treatment on the treated quasi-experimental design, which includes only those EDC teachers who implemented the program with at least partial fidelity (at least 10 minutes, in 50 percent of observations). We also examined the relationship between level of implementation among treatment teachers and student achievement.

Data Collection and Analysis:

The study used two proximal student achievement outcome measures: 1) a McREL-developed assessment aligned to EDC content and 2) the Iowa Algebra Aptitude Test (IAAT), Fifth Edition (Schoen & Ansley, 2005), a standardized test of pre-algebra mathematics achievement. We also included a baseline covariate of average school level math achievement on the Mississippi state standardized assessment. To conduct our exploratory treatment on the treated analysis, we utilized a two-level hierarchical linear regression model with students nested in schools. This model compared the math achievement of students in treatment schools (n=9) to students in control schools (n=19). In regard to assessing whether the level of implementation among treatment teachers predicted student achievement our model included 15 schools.

Findings / Results:

Results suggest that there were no statistically significant differences ($p > .05$) between treatment 145.42 (SD=13.79) and control 143.06 (SD=14.42) conditions scores on the IAAT when EDC was used with at least partial fidelity. This was also true for the McREL developed assessment. When examining the percentage of observations when EDC was used as a predictor of student achievement among only treatment teachers, results suggest a negative relationship, with more class time spent on EDC predicting lower achievement scores on the IAAT (β = -16.30, p = .00) and McREL assessment (β = -18.32, p = .00).

Conclusions:

By taking implementation fidelity into account (in a treatment on the treated design), we gained a better understanding of the impact of the intervention when it was used during class time, rather than what happens when teachers are merely provided the materials without being held accountable for their use. Taken together, the main impact analysis and the exploratory implementation analysis fail to provide evidence of benefits of EDC on mathematics achievement. Though speculative, these results call into question the use of a supplemental curriculum that is administered for only a short period of time at the beginning of class, and suggest that this practice may even be detrimental due to disruption or time taken away from the regular curriculum.

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