



# Middle School Mathematics Achievement: Effects of Math Teacher Professional Development

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## ABSTRACT

Teacher professional development is often proposed as a means for improving students' achievement; however, few studies have been successful in empirically connecting teacher inservice interventions to their students' achievement gains, and especially in mathematics. The research presents results of a longitudinal study of an inservice teacher professional development that had as its primary purpose to improve middle school students' mathematics achievement. The study utilized a cross-school comparative research approach for the purpose of examining students' math achievement trajectories. Hierarchical linear modeling was used for the study's data analyses. Results of the study revealed that the teacher professional development intervention had positive impacts on both the participating teachers and their middle school students. The participating students' achievement improved significantly for those whose teachers participated in the teacher professional development intervention.

## KEYWORDS

Mathematics Achievement, Mathematics Teaching, Middle School, Teacher Professional Development

## BACKGROUND, CONTEXT, AND PURPOSE

Teacher professional development is often proposed as a means for improving students' achievement; however few studies have been successful in empirically connecting teacher inservice interventions to their students' achievement gains, especially in mathematics. This paper presents results of a longitudinal study of a three-year inservice teacher professional development program that had as its primary purposes to improve middle school students' mathematics achievement and motivation for engaging in math. The study utilized a cross-school comparative research approach to examine students' math achievement trajectories, employing a quasi-control condition in the first year of the program's implementation and multiple rounds of inservice teacher professional development

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interventions in the remaining years. Hierarchical linear modeling was used for the study's data analyses with multiple iterations of model fitting.

## **RESULTS AND FINDINGS**

Results of the three-year study revealed that the teacher professional development intervention had positive impacts on both the participating teachers and their middle school students. The teachers' efficacy for teaching mathematics increased for all participating teachers. Both students' intrinsic and extrinsic motivation were found to positively affect their mathematics achievement, which was measured by standardized math achievement tests and the participating district's mathematics benchmark examinations. The participating students' achievement improved significantly for those whose teachers participated in the teacher professional development intervention.

## **BRIEF SUMMARY, CONCLUSIONS, AND IMPLICATIONS**

In summary, the participating students' achievement in this study improved overall, with greater increases resulting from increased exposure to the teacher intervention across time. This research has positive implications for middle to large size secondary schools in terms of the impact of teacher professional development on students' achievement as it had multiple positive effects on both the participating teachers and their students.

## **MIDDLE SCHOOL MATHEMATICS ACHIEVEMENT: EFFECTS OF TEACHER PROFESSIONAL DEVELOPMENT**

The United States has become increasingly concerned about future workforces, so much so that from 2009 onward, science, technology, engineering, and mathematics (STEM) education has been a major focus of the U.S. federal administration's plans for secondary education. STEM education in K-12 involves the inclusion of technology and engineering in math and science academic programs. Specifically, technology develops skills and abilities in adaptability, complex communication, non-routine problem solving, and systems thinking to "shape our material, intellectual, and cultural world" (Bybee, 2010, p. 31; see also Morgan & Morgan, 2013). These skills and abilities are of primary concern to the team responsible for this research endeavor.

The utilization of curriculum as one of the primary components that prepare students for future workforces in STEM is undoubtedly an effective approach to introduce students to the skills and abilities needed in STEM professions. Various pedagogical approaches have been integrated in curriculum design to improve students' mathematics skills and abilities, such as problem-based learning and reality-focused instruction (Hansen & Gonzalez, 2014; Uygun & Tertemiz, 2014; Fulton, 2012). To design reality-based curriculum, or that which is focused on realistic scenarios embedded in students' lived experiences, contemporary disciplinary content knowledge in addition to pedagogical knowledge and teaching efficacy are necessary (Hashweh, 2009). However, reviews of student achievement data in middle school mathematics call into the question math teachers' disciplinary content knowledge, pedagogical knowledge, and teaching efficacy (Phelps & Howell, 2016; Thanheiser et al., 2010).

This study is part of a broader three-year research project that investigated the effects of a comprehensive teacher professional development intervention on middle school students' mathematics achievement. The enabling structures included in this intervention were: (a) University-based research laboratories; (b) a teacher training leadership team; (c) a content expert math advisory team; (d) math teacher professional development using a summer teacher academy and associated follow-up; (e) use of teacher-centric lesson study; (f) use of diagnostic teaching, inquiry focused math, and data driven

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