Chapter 21
Preparing Teachers to Implement Technology:
The CCMS Experience

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ABSTRACT

The Classroom Connectivity for Mathematics and Science (CCMS) program was a randomized control trial to examine the efficacy of Classroom Connectivity Technology (CCT) in Algebra I. CCT is a type of technology that allows the teacher to wirelessly communicate with his or her students' handheld calculators. Students in the classes that implemented CCT outperformed their comparison counterparts with effect sizes ranging from 0.19 to 0.37 (Irving et al., 2014; Pape et al., 2013). In this chapter, the professional development program that supported participating teachers to implement the technology is described. Categories of professional development activities including pedagogical instruction, modeling pedagogy, technological pedagogical instruction, technology instruction, student role-play, practice, small-group instruction, and participant presentation are presented in relation to their potential for supporting teacher participants' knowledge growth. Recommendations for the training of teachers to implement technology will be explicated.

INTRODUCTION

As early as 2001, researchers noted that despite the rich availability of technology, an ongoing issue of low technology implementation within K-12 educational settings persists (Cuban, Kirkpatrick, & Peck, 2001). With districts moving toward increased technology implementation, a considerable need has ensued to understand barriers to technology integration as well as effective models of professional development to impact teachers' implementation. Typically, school reform has resulted in instructional practices that often reflected the combination of old and new pedagogies with limited, long-term impact (Cuban, 2013).

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Technology integration within the mathematics classroom in the 1980s used software as a different backdrop for repetition and drill with the hope that a more entertaining context might entice learners to dedicate time to practice (Niess et al., 2009). While students may have been more intrigued by the game-like features of the contemporary software, the emphasis remained on a traditional learning environment focused on low cognitive demand that resulted in superficial knowledge for students and teachers. Early studies with audience response systems also showed no impact on student outcome other than enthusiasm in the absence of significant pedagogical changes (Bapst, 1971; Judson & Sawada, 2002). This dilemma was followed in the early 1990s with concerns that human capability for technology implementation including the distance between teachers' present pedagogy and changes needed to implement technology effectively would be the limiting factor related to technology implementation (Kaput, 1992). In essence while digital technologies have evolved, strategies for their effective integration into learning contexts have not evolved as rapidly.

Early research with similar technology more broadly known as Audience Response Systems produced enthusiastic student response but limited conceptual gains when coupled with traditional lecture (Judson & Sawada, 2002). However, when innovative instructional practices were used in college contexts, several outcomes were found: increased class attendance and participation (Burnstein & Lederman, 2001), collaborative learning and student engagement (Dufresne, Gerace, Leonard, Mestre, & Wenk, 1996), and conceptual gains (Judson & Sawada, 2002; Mazur, 1997). An emergent research base indicates that classroom connectivity technology (CCT) facilitates mathematics teaching, enhances student outcomes by promoting active participation, provides opportunities for inquiry lessons, and facilitates formative assessment (Roschelle, Penuel, & Abrahamson, 2004).

CCT is an audience response system that affords teachers the opportunity to wirelessly communicate with their students' handheld calculators. The purpose of this chapter is to describe and theorize about professional development that supports powerful use of CCT (i.e., TI-Navigator system). The focus of the study was a professional development and research program that supported Algebra I teachers who participated from across the United States and Canada in a program called Classroom Connectivity for Mathematics and Science (CCMS). This randomized control trial examined the efficacy of CCT in Algebra I. Students in the classes that implemented CCT outperformed their comparison counterparts with effect sizes ranging from 0.19 to 0.37 (Irving et al., 2016; Pape, Irving et al., 2013).

In this chapter, we provide a description of the professional development activities and share categories of activity that aimed to foster growth in teachers' technological pedagogical content knowledge or TPACK. These categories include pedagogical instruction, modeling pedagogy, technological pedagogical instruction, technology instruction, student role-play, practice, small-group instruction, and presentation. In addition, we share feedback from participants after the first iteration of the professional development. Then finally we illuminate some of the adjustments made to the professional development between the two years of the program based on the study participants' feedbacks. Based on this description, recommendations for supporting teachers to effectively implement technology are discussed.

BACKGROUND

While over 80% of teachers express a desire to implement technology effectively in their classrooms, low-level tasks (e.g., typing essays, searching the Internet) have dominated the landscape in K-12 classrooms broadly (Banilower et al., 2013; U.S. Department of Education (DOE), 2003). A majority of secondary

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