

# Chapter 5

## Transforming Preservice Mathematics Teacher Knowledge for and With the Enacted Curriculum: The Case of Digital Instructional Materials

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### ABSTRACT

*In a curriculum system, instructional materials and their enactment impacts students learning of school mathematics. In this chapter, the authors re-examine enacted curriculum in light of research on Digital Instructional Materials (DIMs) and the critical role of the mathematics teacher. This chapter documents research from two different studies suggesting that, while effectively leveraging digital materials may require teachers to think outside of their traditional views of how mathematics content is learned and communicated, doing so requires more than the resources themselves. In order to seize upon the potential for DIMs to support student learning in mathematics, teacher preparation must offer opportunities for teachers to develop and transform their technological pedagogical content knowledge (TPACK) knowledge for and with DIMs. To this end, the authors propose specific recommendations for teacher preparation programs in the digital age.*

### INTRODUCTION

Curriculum has long served as a change agent for mathematics education in the United States. Dating to the New Math era of the 1960s, the “math wars” of the 1990s and 2000s, and most recently, the introduction of the *Common Core State Standards for Mathematics* (National Governors Association Center for Best Practices and Council of Chief State School Officers, 2010), curriculum standards and

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materials have demonstrated the power to shape national conversation about mathematics and how it is taught. As Ball and Cohen (1996, p. 6) observed:

*Unlike frameworks, objectives, assessments, and other mechanisms that seek to guide curriculum, instructional materials are concrete and daily. They are the stuff of lessons and units, of what teachers and students do... Not only are curriculum materials well positioned to influence individual teachers' work but, unlike many other innovations, textbooks are already 'scaled up' and part of the routine of schools. They have 'reach' in the system.*

Likewise, curriculum materials often play an important role in mathematics teacher preparation as teachers engage in comparison, analysis, selection, and enactment of textbooks and instructional materials to support effective teaching practice and student learning.

In addition to curriculum, technology has played an important role as a change agent in mathematics education and teacher preparation, as advocated by many professional organizations. In 2006, the Association of Mathematics Teacher Educators stated, (p. 2):

*With the needs of future teachers in mind, mathematics teacher educators should provide opportunities for teacher candidates... to explore and learn mathematics using technology in ways that build confidence and understanding of the technology and mathematics... model appropriate uses of a variety of established and new applications of technology as tools to develop a deep understanding of mathematics in varied contexts... make informed decisions about appropriate and effective uses of technology... [and] develop and practice teaching lessons that take advantage of the ability of the technology to enrich and enhance the learning of mathematics.*

In order to fulfill this vision, programs in teacher education must stay current with regards to developing practitioners' knowledge of continually evolving technology and its applications for student learning (Blume & Heid, 2008; Heid & Blume, 2008; Nelson, Christopher, & Mims, 2009; Pierce & Stacey, 2010; Sowder, 2007; Zbiek, Heid, Blume, & Dick, 2007).

While both curriculum and technology have impacted mathematics education, they have largely done so in parallel. Technologies for teaching and learning mathematics have often been developed and used in classrooms primarily independent from print texts. Furthermore, when print materials intend or suggest technology integration, one cannot assume that appropriate technology is sufficiently available or utilized in the classroom (Heid, 1997, 2005). It has typically been the role of the classroom teacher to meaningfully integrate curriculum and technology, a role that necessitates teacher knowledge and facility with technology, pedagogy, and mathematics. Yet, research in mathematics education suggests that teachers require support and opportunities to develop the complex technological pedagogical content knowledge, or TPACK (Mishra & Koehler, 2006) needed to provide rich mathematical learning experiences that integrate technology and the mathematics curriculum. That is, in order to unify and harness the potential of two complementary change agents in mathematics education, curriculum and technology, mathematics teacher educators must thoughtfully and carefully provide ample opportunities for teachers to develop TPACK in context of the curriculum.

This chapter examines existing educational opportunities from research on Digital Instructional Materials (DIMs) and proposes new opportunities for teacher preparation programs to leverage the affordances of merging mathematics content, pedagogy, and technology in the context of DIMs. Results from

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