Chapter 1

Teachers’ Knowledge, Beliefs, and Perceptions About Mathematics Teaching: How Do They Relate to TPACK?

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ABSTRACT

Providing a study on mathematics teachers’ technological pedagogical content knowledge (TPACK), the goal of this chapter is to investigate the predictive value of teachers’ beliefs (e.g., self-efficacy) and mathematical knowledge for teaching (MKT) on their level of TPACK. Background variables, gender, ethnicity, certification, experience, and mathematics degree were all controlled for in this study. Two-step regression analysis results by school level (K-5, middle, and high) indicate that standards-based mathematics teaching beliefs positively predict mathematics teachers’ level of TPACK for all teachers. Having a college/graduate mathematics degree is more predictive of TPACK for K-5 and middle school teachers while MKT is more predictive of TPACK for high school teachers. In addition, elementary teachers’ mathematics self-concept and pedagogical preparedness and middle school teachers’ mathematics teaching interest were significantly related to their level of TPACK. The implications for school districts and teacher preparation programs to develop TPACK for teachers are discussed.

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INTRODUCTION

Motivated by the issues that teachers face for an effective use of technology, this chapter focuses on mathematics teachers' technological pedagogical content knowledge (TPACK) and factors affecting their TPACK. The issues that teachers face in their attempt to successfully integrate technology into the classroom are perhaps more nuanced than people think. When trying to integrate technology effectively into their daily instruction, teachers may face several political and financial barriers, such as lack of access to technology, insufficient training, and an unfavorable policy environment (Ertmer, 2005). Although these are important barriers to be addressed, these discussions have been made elsewhere (e.g., Corkin, Ekmecki, & Coleman, 2017). Other barriers involve teachers’ motivational, pedagogical, or epistemic (how knowledge develops in a particular discipline) beliefs (Angeli & Valanides, 2009; Graham, 2011). To address these non-political/non-financial barriers, this study focuses on the factors that belong to or are originating from teachers themselves, or in other words, the “meta-teacher” factors meaning teacher-related factors that may have impact on their own technology integration. Previous researchers have noted the influence of teachers’ beliefs and content knowledge on other outcomes such as instructional practices and effective teaching; yet little research has been conducted to establish a similar link to teachers’ TPACK and/or to their use of technology (e.g., Ertmer, 2005; Stewart, Antonenko, Robinson, & Mwavita, 2013).

The discussion of beliefs in the context of TPACK may primarily be associated with beliefs about technology or technology use/integration itself, which would be a natural and straightforward association (see Abbitt, 2011, Corkin, Ekmecki, White, & Fisher, 2016). However, the authors of this study take a different approach by investigating the link between beliefs related to other aspects of teaching including epistemic beliefs about the content and self-efficacy in general and in content-specific teaching. TPACK provides a framework that is at the nexus of all content, pedagogy, and technology (Schmidt, Baran, Thompson, Mishra, Koehler, & Shin, 2009). Narrowing beliefs and practice down to only technology-related aspects would be an inadequate examination within the TPACK framework. Since the research indicates teachers’ beliefs, content knowledge, and practices are interwoven (Corkin, Ekmecki, White, & Fisher, 2016; Clark, DePiper, Frank, Nishio, Campbell, Smith,... Choi, 2014; Handal, 2003; Pajares, 1992; Schoenfeld, 2016; van Driel, Verloop, & de Vos, 1998), it is conceivable and likely that TPACK is also related to or even affected by teachers’ beliefs and practices in the content area (Rosenberg & Koehler, 2015). For instance, it is possible that self-efficacy in one’s teaching of a subject or in the subject matter itself may also relate to TPACK. This concern raises some relevant and important questions regarding the relationship between beliefs and TPACK. For example, how do teachers’ self-efficacy beliefs about mathematics influence their TPACK? Could a teacher who has availing epistemic beliefs about mathematics (i.e., seeing it as a more dynamic rather than static discipline) have a higher level of TPACK? Could a teacher who has higher levels of confidence and interest in teaching mathematics have more flexibility in technology integration into mathematics instruction?

To shed light on some of these relevant questions, the authors attempt to contribute to the body of research and practice concerning this topic in several means. First, by identifying secondary factors such as beliefs or professional background (Kim, Kim, Lee, Spector, & DeMeester, 2013; Rosenberg & Koehler, 2015), the results are expected to inform, and in turn, enhance, and transform pre-service and in-service teacher-training programs that focus on TPACK. For example, the chapter investigates the effect of self-efficacy beliefs and standards-based mathematics teaching practices on teachers’ TPACK development. Second, this study complements the different widely-used TPACK frameworks by ad-
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