

## Chapter 9

# A Model for Examining the Criteria Used by Pre-Service Elementary Teachers in Their Evaluation of Technology for Mathematics Teaching

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### ABSTRACT

*Multiple existing frameworks address aspects of teachers' knowledge for teaching mathematics with technology. This study proposes the integration of several frameworks, including TPACK (Mishra & Koehler, 2006), MKT (Ball, Thames, & Phelps, 2008), and technology evaluation criteria (Battey, Kafai, & Franke, 2005) into a new comprehensive model for interpreting teachers' knowledge of the use of technology for teaching mathematics: the T-MATH (Teachers' Mathematics and Technology Holistic) Framework. The study employed quantitative and qualitative methods to examine 144 pre-service elementary teachers' evaluations of technology for future mathematics teaching. The proposed model and its application to this group of pre-service teachers suggest that there are multiple dimensions to understanding teachers' knowledge of uses of technology for mathematics teaching, and that teachers' self-identified evaluation criteria reveal the dimension in which their knowledge resides. Understanding teachers' progressions through these dimensions may provide insights into the types of experiences that support teacher development of the knowledge necessary to teach mathematics using appropriate technologies.*

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## **INTRODUCTION**

Pre-service elementary teachers come to mathematics methods coursework with a variety of backgrounds and experiences in using technology. Some identify themselves as extreme technology users, using multiple technologies regularly as an integral part of their daily lives. Other pre-service teachers are limited technology users. They may use email and basic software packages, but other technologies are not essential to their daily activities. Because technology knowledge varies among pre-service teachers, there are multiple factors that influence pre-service teachers' selection and use of technology for mathematics teaching and learning. Typically experiences in mathematics methods courses introduce pre-service teachers to various types of technology tools for mathematics teaching. Pre-service teachers often create lesson plans which integrate technology, or they may evaluate technology tools for mathematics learning during their pre-service experiences.

This chapter proposes an integrated model of teachers' use of technology for teaching mathematics and uses that model to examine pre-service teachers' evaluations of technology for use in mathematics teaching. The chapter integrates relevant literature on technology for teaching mathematics including: TPACK (Technological Pedagogical Content Knowledge) as it applies to the teaching and learning of mathematics (Mishra & Koehler, 2006; Niess, Suharwoto, Lee, & Sadri, 2006); the TPACK framework proposed by Mishra and Koehler (2007); the Domains of Mathematical Knowledge for Teaching (MKT) framework proposed by Ball, Thames, and Phelps (2008); and, the mathematics and technology evaluation criteria proposed by Battey, Kafai, and Franke (2005). We suggest that integrating these frameworks and evaluation criteria may help researchers better understand how pre-service teachers develop in their evaluation of technological tools for mathematics teaching. We then apply this model to the examination of a group of 144 pre-service

teachers as they evaluated technology tools for their future teaching of elementary mathematics. From this analysis, we provide recommendations that teacher educators approach teacher training in the teaching of mathematics with technology as a more integrated and multi-dimensional task, which is more closely aligned with the characteristics of TPACK and MKT.

## **Current Frameworks and Theories on Technology, Pedagogy, and Content Knowledge**

Kersaint, Horton, Stohl, and Garofalo (2003) note that pre-service elementary and middle-school teachers don't necessarily receive specific instructions or engage in activities designed to assist them in technology integration in their own future mathematics lesson plans. Teacher knowledge of mathematics teaching supported by technology is critical when evaluating tools for use in lesson plans. If pre-service teachers are confident in their knowledge of mathematics, then they will create classroom environments that allow students to use technology freely (Doerr and Zangor, 2000). Conversely, if teachers' knowledge of mathematics is weak, or if they do not understand the output of the technology, they might be hesitant to use the technology with students (Monaghan, 2004). Kurz, Middleton, and Yanik (2004) studied pre-service teachers who were engaged in activities in which they were introduced to technology tools for mathematical learning and subsequently classified the tools according to five different categories. As a result of the required coursework, the elementary pre-service teachers not only identified the features of the tool, but were able to explain how these features could benefit student learning.

There are currently several theoretical and graphical frameworks used to explain relationships among technology knowledge, pedagogical knowledge, and mathematical content knowledge as these variables are used in teaching mathematics. One such framework is TPACK. TPACK

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