Chapter 17

Eliciting Pre-Service Secondary Mathematics Teachers’ Technological Pedagogical Function Knowledge

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ABSTRACT

The purpose of this study was to examine the evidence of technological pedagogical function knowledge that preservice secondary mathematics teachers (PSMTs) exhibited through engaging in a module in which they examine artifacts of students’ mathematical thinking with technology. Three cases are presented to describe the evidence of technological pedagogical function knowledge that was elicited through engagement with the module. Findings show that the module was successful in eliciting PSMTs’ function knowledge, technological function knowledge, and technological pedagogical function knowledge. Differences in the manners in which these knowledges were elicited are discussed and implications for teachers of PSMTs are shared.

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INTRODUCTION

Digital technologies have unarguably impacted current trends in education. Many researchers and scholars challenge that an immediate concern for education is that of developing teachers’ knowledge for infusing technology as learning tools (Mishra & Koehler, 2006; Niess, 2005). National organizations focused on mathematics education, including the National Council of Teachers of Mathematics (NCTM) and the Association of Mathematics Teacher Educators (AMTE), have echoed this call for enhanced preparation of pre-service secondary mathematics teachers’ Technological Pedagogical Content Knowledge (TPACK) (Mishra & Koehler, 2006; Niess, 2005). AMTE’s (2017) Standards for Preparing Teachers of Mathematics states that:

well-prepared beginning teachers of mathematics are proficient with tools and technology designed to support mathematical reasoning and sense making, both in doing mathematics themselves and in supporting student learning of mathematics. (p. 11)

NCTM’s (2014) Principles to Action further elaborates that teachers “need to develop deep understandings of how technology and tools can be used to investigate mathematical ideas... they need to reflect on how their students might use these tools” (p. 28).

To better prepare future teachers to teach with technology, an Examining Students’ Technological Mathematical Practice module was developed for pre-service secondary mathematics teachers (PSMTs). The mathematical topic of focus was the concept of function because research shows technology can be effective when developing the function concept (e.g., Dick & Hollebrands, 2011) and because PSMTs often struggle with developing a deep understanding of function (Cooney, Beckmann, & Lloyd, 2010). The module consisted of activities in which PSMTs first examined their own understanding of the function concept through engaging with an online applet and then investigated students’ mathematical thinking with technology through the examination of artifacts of middle school students (henceforth referred to as students) engaging with a similar applet. The purpose of this study was to examine the ways in which the module elicited different aspects of the PSMTs’ TPACK of function and to answer the following research question: What evidence of TPACK do PSMTs exhibit as a result of engaging in a module in which they examine artifacts of students’ mathematical thinking with technology?

BACKGROUND

This section begins with a short review of previous research on PSMTs’ TPACK. Then the section provides previous research on analyzing students’ mathematical work. Finally, the section provides the study’s focus on the function concept and the theoretical framework.

TPACK

Within teacher education, many have built upon Shulman’s (1986) idea of teachers’ pedagogical content knowledge (PCK). PCK laid the foundation for Grossman’s (1989, 1990) identification of specific constructs within PCK, Even’s (1990) work on the essential features of subject matter knowledge in mathematics, and Ball and colleagues’ work on the components of mathematical knowledge for teaching
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