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Honors Research Thesis

A Study of TPACK in Elementary Mathematics

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Purpose Statement

According to the U.S. Department of Education (2010), most classrooms have up to one computer per 5.3 students. In this case, you might assume that technology is utilized effectively. However, teachers and students are only using their available computer technology 29% of the time spent in the classroom (U.S. Department of Education, 2010). This low figure implies that technology is not integrated frequently or effectively in most classrooms even though it is available to them. Studies suggest that the use of technology (computers) advances student achievement on standardized tests, enhances student thinking and learning, and bolsters student self-confidence (Hew & Brush, 2006). Furthermore, research has shown that technology use in elementary math curricula has greatly enhanced student learning when used effectively (Linder, 2012). Students formulate deeper conceptual understandings when technology is used to enrich math lessons, especially when it is introduced early on in education (Linder, 2012). Further research suggests that effective use of technology strengthens student achievement in content area learning, higher-order thinking and problem-solving skill development, and workforce preparation (Cradler et al., 2002). Although technology can be used effectively to enrich student learning, many teachers experience barriers that inhibit accessibility to technology, which makes the implementation much more challenging (Keengwe et al., 2010).

Technology has become more modern, digital, accessible, and vital to the foundation and structure of today's classrooms. The modern phrase used to describe the integration of technology in a classroom setting is called Technological Pedagogical Content Knowledge (TPACK), which recognizes the connections and complex relationship between content, pedagogy, and technology (Mishra & Koehler, 2006). Mishra and Koehler analyzed the meaning of each complex relationship by breaking it up into parts. Content Knowledge (CK) is an

elaborate understanding of the subject matter, including the teaching and learning standards for education. Pedagogical Knowledge (PK) is an intricate understanding of the methods and processes of teaching and learning, including the stages of student learning, classroom management strategies, lesson planning, and student assessment strategies. Pedagogical Content Knowledge (PCK) was developed by Lee S. Shulman, who suggested that teachers develop a deeper understanding of how to teach by blending their knowledge of content and their knowledge of the ways in which to teach content, which can only be achieved by paying the same amount of attention to each aspect (Shulman, 1986). TPACK originated from Shulman's concept of PCK, which involved a complex understanding of both subject matter and of the ways in which to teach subject matter. Mishra and Koehler continued to outline the elements of TPACK by expressing that Technology Knowledge (TK) is the understanding of hardware and software, the Internet, the use of software programs, and how to install them. Technological Content Knowledge (TCK) is the understanding of how technology can increasingly enhance instruction when applied to the subject matter being taught. Technological Pedagogical Knowledge (TPK) is the knowledge of how to adapt instruction or teaching methods when applying various types of technology. Technological Pedagogical Content Knowledge (TPACK) is knowledge of each complex relationship all pieced together, including knowledge of subject matter, how to teach subject matter, how to apply technology to the subject matter, and how to adapt the teaching style to accommodate for technology use. All aspects of TPACK must be addressed in order to effectively integrate technology in the classroom.

Teachers find that the implementation of TPACK becomes especially challenging when barriers exist. Barriers to technology include: lack of time, lack of teacher training, lack of equipment or lack of access to equipment, unreliability of equipment, and lack of technical

support (Keengwe et al., 2010). They also include: ineffective technological leadership, possible differences in the organizational culture of the school, and the potential differing beliefs and opinions held by administration and faculty about teaching with technology, which may include resistance to change (Keengwe et al., 2010).

While research has shown that there are effective ways to integrate technology, few have expressed the ways in which elementary teachers have been able to overcome the barriers that exist, effectively implement technology in their math instruction, and provide what their instruction looks like, including the types of technology used. While overcoming barriers and finding ways to effectively implement technology in elementary math classrooms fits the purpose of this study, I also looked at the ways in which technology integrated instruction meets the TPACK criteria.

Using TPACK as the theoretical framework, the following research question guided my study: What are the ways in which elementary teachers are able to overcome the existing barriers, adapt their content knowledge, and adapt their instructional strategies, in order to implement technology in their classrooms? In addition, the following research questions support the main purpose:

> In what ways do elementary teachers purposefully integrate technology in their math curricula? How do they decide which technology works best? How does TPACK guide their decision-making? What systematic issues and barriers influence teachers' decisions?

Analyzing these inquiries through the use of a qualitative research design helps to inform teachers, administrators, and educational leaders of the ways in which technology can be purposefully integrated in elementary mathematics instruction.