Chapter 10
Technology-Supported Inquiry in STEM Teacher Education: From Old Challenges to New Possibilities

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ABSTRACT

The chapter describes the implementation of collaborative educational technologies in STEM teacher education to support teacher-candidates in acquiring inquiry-based teaching skills and positive attitudes about inquiry learning. The focus is on five different collaborative technology-enhanced pedagogies: (1) Peer Instruction, (2) collaborative design of conceptual questions with PeerWise, (3) data-driven STEM inquiry via using live data collection and analysis, (4) computer modeling-enhanced inquiry, and (5) collaborative reflection on peer teaching. Teacher-candidates experienced these pedagogical approaches first as learners, then reflected on them as future teachers, and lastly incorporated some of them during the practicum. As a result, teacher-candidates gained experience in promoting technology-enhanced inquiry in STEM education and began developing positive attitudes towards technology-enhanced inquiry-based STEM education.

INTRODUCTION

This chapter explores how modern collaborative educational technologies can be implemented in STEM teacher education in order to support teacher-candidates in (1) acquiring inquiry-based teaching skills, (2) forming positive attitudes about inquiry-based STEM education, and (3) building resiliency in the face of initial

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failure of inquiry-based pedagogies (Milner-Bolotin, 2016b). The last two points are especially important, as there is ample research evidence that when instructors lack adequate support, they are likely to give up on implementing innovative research-based pedagogies in the face of early adoption failure (Lasry, Guillemette, & Mazur, 2014; Mazur, 1997a; Wieman & Perkins, 2005). Thus, inadequate support for K-12 and post-secondary STEM educators for reforming their teaching coupled with the limited opportunities for teacher collaboration result in an ever growing gap between research-informed and classroom-enacted educational practices (Cole & Knowles, 2000; Milner-Bolotin, 2014a). This explains why increased access to educational technologies does not necessarily guarantee a wider adoption of inquiry-based pedagogies and improved learning. In order to promote inquiry-based learning and active student engagement in STEM, K-12 and post-secondary instructors have to be supported in adopting new pedagogical approaches (Harris & Hofer, 2011; Shelton, 2015). This requires reimagining STEM teacher education, pedagogical preparation of post-secondary instructors, as well as in-service professional development (Lee & Tsai, 2010; Niess, 2005). If we fail to do so, many instructors will continue to ignore the mounting research evidence about how students learn and how STEM subjects can be taught more effectively (Bransford, Brown, & Cocking, 2002). Moreover, a large number of STEM instructors will inevitably revert to much safer but also less effective teacher-centered pedagogies they had experienced as students (Shelton, 2015; Wieman, 2012; Wieman & Perkins, 2005). This is one of the key reasons why the substantial governmental investments and half-a-century long education reform efforts in North America and in Europe aimed at promoting inquiry-based education have rarely brought the desired outcomes (Feder, 2010; Krajcik & Mun, 2014; National Research Council, 2012; Pollock, 2004).

The goals of STEM education, the role of inquiry, the tools available to modern students, as well as the population of students in K-12 STEM classrooms have changed dramatically over the last few decades (Cuban, 1990; National Research Council, 2013). In the 21st century we cannot afford to leave the majority of our population outside of STEM fields, as every student who disengages from STEM in K-12 closes multiple future opportunities for themselves inside and outside of STEM-related professions (Chachashvili-Bolotin, Milner-Bolotin, & Lissitsa, 2016; Let's Talk Science, 2013, 2015). In the current economic reality, STEM engagement should not be limited to a select few students, as it was common in North America during the post-Sputnik era, but should become an integral part of K-12 education for all (DeBoer, 1991; Let's Talk Science, 2012).

In this chapter we investigate how modern educational technologies can help to prepare the next generation of teachers who will be open to and capable of engaging