Chapter 16
Technology's Role in Supporting Elementary Preservice Teachers as They Teach:
An Urban STEM Afterschool Enrichment Program

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ABSTRACT

This chapter describes a teacher preparation model incorporating a STEM focused, technology enhanced course and field experiences for preservice teachers. This field-based science method course supports and engages preservice teachers in creating and implementing lessons for early childhood and elementary students enrolled in an afterschool STEM Enrichment Program offered in a diverse urban elementary school. Technology is woven throughout the model, supporting preservice teachers as they build their content knowledge, and research effective practices to teach and assess their students. This model also helps to address the need to enhance STEM instruction in schools and inspire preservice teachers to engage their students in the STEM learning process. Findings from the model's implementation indicates a positive impact on the preservice teachers' understanding of science content and standards, on their pedagogical practices to design STEM lessons based on the revealed understandings of students' knowledge, and on the development of their professional identities.

INTRODUCTION

Advances in science, technology, engineering and mathematics (STEM) are driving our economy and creation of jobs. Understanding this reality leads us to recognize that science literacy is essential to the democratic decision-making that affects our national and global agendas, and that acquiring an inquiring mind is vital to the cultural fabric of society. Yet, according to the World Economic Forum (2011), the

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United States ranks 27th in developed nations in the proportion of college students receiving undergraduate degrees in science or engineering and the 52nd in the quality of mathematics and science education. According to the Federal Science, Technology, Engineering, and Mathematics (STEM) Education 5 Year Strategic Plan (2013), our K-12 educational system as compared to other international systems is in the "middle of the pack." According to the report, the assessment of students' ability to apply reading, mathematics, and science knowledge to real-life situations indicated that out of thirty-three countries "12 countries had higher scores than did the United States in science and 17 had higher scores in mathematics (vii)."

Other realities of research from national and international measures of student performance confirm that in the United States, children are seriously lacking in their understanding of the STEM disciplines. Furthermore, a lack of exposure to these disciplines narrows children's school and life options due to an insufficient background and lack of confidence in themselves as learners of mathematics and science (Archer, DeWitt, Osborne, Dillon, Willis, & Wong, 2012). In addition, many elementary teachers are woefully unprepared and lack the confidence and knowledge to teach these subjects well, particularly in urban schools (Barton, 2007). Yet, nearly all elementary teachers must teach science and mathematics and will thus set the stage for students' interest or disinterest in the STEM disciplines. Based on this research, it follows that STEM education in teacher preparation programs, including those leading to licensure at the early childhood and elementary level, is a national priority.

Preservice teachers (PST) will strongly influence the generation of students that require STEM literacy; therefore, it is critical that their education programs develop their essential content knowledge and effective teaching strategies. The teacher preparation programs are instrumental in changing and molding the PST's knowledge, skills, and dispositions necessary for building STEM literacies for themselves and their students. By its nature, STEM education can inspire PST through its authentic applications in the classroom. As they acknowledge the contributions of science and mathematics to society, it will help PST understand the value of these disciplines in advancing their own students' educational experience. Due to engineering's interdisciplinary nature, math, science and technology are all leveraged for elementary students' motivation and engagement in STEM related investigations. This helps them feel less overwhelmed with the concepts in math and science (Perrin, 2004), and positively impacts their perceptions and dispositions of these subjects (Bagiati, Yoon, Evangelou & Ngambeki, 2010). Elementary students involved in STEM related instruction could possibly develop an interest in pursuing higher level math and science courses as they progress through the grades (DeJarnette, 2012).

So the question remains, how do we effectively address what is needed in teacher education programs that will encourage STEM Education?

BACKGROUND

Many schools of education are ill prepared to provide the training necessary for early childhood and elementary majors to teach inquiry-based science or STEM. Research demonstrates that a one-semester science methods course may be insufficient in developing the skills or experience necessary for effective inquiry-based instruction that supports science investigations (Newman, Abell, Hubbard, McDonald, Otaala, & Martini, 2004). Cotabish, Dailey, Robinson, & Hughes showed a statistically significant gain in science knowledge and process skills after participation in a one year STEM initiative (2013).

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