

# Chapter 1

## Preparing Elementary Pre-Service Teachers to Be Effective STEM Teachers

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### **ABSTRACT**

*Nelson Mandela (1990) stated “[e]ducation is the most powerful weapon which you can use to change the world.” This has never been truer as we live in a world in need of strong teachers. We live in a world that underappreciates teachers and their role in educating the next generation often goes unnoticed. Teaching children to become literate in math and science is a concern as these disciplines can lead to increased employment opportunities, higher pay, and a higher quality of life. Having a scientifically literate citizenship is critical to fostering innovation, improving the quality of life, and solving crises such as pandemics and climate change. Unfortunately, interest and motivation in STEM disciplines often decline after early grades which illustrates the important role that these teachers have in math and science education. This chapter combines research-based practices and activities that the author has used to promote STEM learning in preservice teachers. It combines these with narratives from former students who add evidence for their value.*

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## **INTRODUCTION**

Preparing teachers to be stewards in the creation of the next generation of science and math-literate citizens requires multiple partners. There is a wealth of research that examines the “leaky pipeline” of science and math students at the college level and beyond which then limits how many future mathematicians, engineers, doctors, and scientists (Blickenstaff, 2005). Other lines of research point to events that occur in middle and high school that trigger students to be turned off to math and science and thus never even consider futures in them and may harbor poor attitudes as a result (Sadler et al., 2012; Watkins & Mazur, 2013). One additional problem is that decades of research also illustrate that women and minority groups continue to be underrepresented in STEM careers (Seymour et al., 2019). This research is unfortunate as it illustrates that things are occurring within our educational system that is making these subjects uninviting and/or uninteresting to many of our bright students, despite the fact that secondary and college teachers have strong backgrounds in their fields and are typically enthusiastic about their areas of expertise. At the K-5 level, any observation of these children will reveal enthusiastic and curious minds that are often very excited about STEM subjects (Tippett & Milford, 2017). Unfortunately, problems also exist here and appears to focus on teachers that may be hesitant to teach STEM because they a) may lack confidence or self-efficacy in these topics (Kelley & Knowles, 2016), b) often are not as interested in these areas (Nadelson et al. 2013), and c) may be limited in their content preparation, particularly in science and engineering (Kang et al., 2018).

These issues leave STEM education in the position of making decisions on where to “best” intervene and some, including myself, argue that the most important place to begin is at the elementary education level. Research by DeJarnette (2018) demonstrates that not only can early STEM instruction build interest and enthusiasm in the children but can also support increased self-efficacy in the teachers. Even though elementary teachers typically have the lowest mastery of content knowledge in the K-16 pipeline, they often have superior teaching skills (Midgley et al., 1995). In addition, they work with children at such a fertile age where interest can be fostered and nurtured if the subjects are taught properly. The question remains, how do we instill confidence and pedagogical content knowledge in elementary teachers so that they can carry these into their teaching of the STEM disciplines?

At my former university, which is located in the 17th largest school district in the United States, we experienced a persistent need for STEM teachers. Every year that I can remember, the district has included STEM teachers on their list of high need teachers (<http://cmshighimpact.com/high-need-subjects>). In addition, I would receive dozens of personal emails requesting assistance with spotting graduates that will excel in these positions. Like many other school districts, finding skilled

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