Chapter 8
Reshaping Preservice Teachers' Pedagogical Content Knowledge With Primary Source Documents

Donna Governor
University of North Georgia, USA

David Osmond
https://orcid.org/0000-0003-4384-3983
University of North Georgia, USA

Sanghee Choi
University of North Georgia, USA

April Nelms
University of North Georgia, USA

Max Vazquez-Dominguez
University of North Georgia, USA

ABSTRACT

The Authoritative Science Publications for Education Majors (ASPEM) project was a textbook transformation program for elementary and secondary science education majors developed at the University of North Georgia (UNG) in 2017. The primary goal of this project was to build a curriculum for pre-service science methods students utilizing online publications of the National Academies of Sciences through the National Academies Press (NAP) and other resources to completely replace a traditional text. This course redesign was necessitated by changes in state science standards, introduced at the same time, that were built on the instructional implications presented in the Framework for K-12 Science Education. Pre-service students in the methods course indicated that the use of these resources, in lieu of a traditional text, provided a richer learning experience for them.

DOI: 10.4018/978-1-7998-1200-5.ch008

INTRODUCTION

In this chapter, the authors explain the process of reshaping the science methods course using free online National Academies Press (NAP) documents and other OER documents through the Affordable Learning Georgia (ALG) Textbook Transformation Grant to address the most current standards/benchmarks in relation to the needs of the preservice teacher population in science education. This paper starts with a brief history of the evolution of the standards, the explanation for the need of change before discussing project implementation, the evaluation methods and results, and finally, the implications for practice.

BRIEF HISTORY OF THE EVOLUTION OF SCIENCE STANDARDS

The release of the 2012 *Framework for K-12 Science Education* by the National Research Council (NRC, 2012) was the beginning of a new paradigm in science education. Prior to the release of this report, science teaching was often focused on content, with the "Nature of Science" seen as a secondary strand of learning. Research that informed this document included the National Science Education Standards (NSES), produced by the NRC (1996) and the Benchmarks for Science Literacy produced, by the American Association for the Advancement of Science (1994), as well as subsequent investigations and reports published since. Implications from this report suggest that both knowledge and practice are critical to developing students' understanding of science. The *Frameworks* stresses that, "Science is not just a body of knowledge that reflects current understanding of the world, it is also a set of practices used to establish, extend and refine that knowledge" (NRC, 2012, p. 27). Effective instruction in science requires students participate in investigations using a "three-dimensional" approach. The resulting framework for instruction recommended integrating three integral dimensions of science: core content ideas, science and engineering practices, and cross-cutting concepts (NRC, 2012). Science and engineering practices are the activities and practices specific to how science and engineering is conducted and how scientists and engineers engage in their work. These include conducting investigations, using models, analyzing data and evidence-based argumentation. Cross-cutting concepts are cognitive tools that are linked across all fields of science. Included are such ideas as patterns, causality, structure and function, systems and stability and change (NRC, 2012).

The *Next Generation Science Standards (NGSS)* were subsequently developed and released in 2013 and based on the *Framework* (NRC, 2012), presenting a cohesive sequence of standards that integrated all three dimensions proposed in the *Frameworks.* As of 2019, 20 states have adopted these standards and another 21 states have built new standards on the *Framework* (NGSS, 2019). These new standards include aspects of three-dimensional learning that may be unfamiliar to educators. According to the *Science Teachers' Learning (2016),* this latest reform in science education "represents a significant departure from current teaching approaches," and "all teachers, regardless of their preparation or experience - are asked to acquire some new knowledge and skills" to implement this reform in their classrooms (Council & NAS, 2016, p. 93). This is especially true for beginning and preservice teachers, who have not been exposed to the concept of three-dimensional learning in their own education and require special considerations to develop evidence-based, just-in-time knowledge, skills, and practices, which are defined as teachers' pedagogical content knowledge (PCK). Pre-service teachers are future educators who are working toward certification and not yet entered the teaching field.