# Chapter 4
# (Re)Imagining an Elementary Preservice Science Methods Course as Inquiry-Based

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## ABSTRACT

*In response to research findings that elementary teachers are underprepared to teach science due to lack of both science content knowledge (SCK) and science pedagogical knowledge (SPK), the author restructured a teacher-centered, pedagogically focused elementary science methods course into one in which SCK and SPK were the primary foci of the class. SCK was provided via explanations that occurred after in-class and extended inquiry-based investigations, during active learning experiences, and after assigned readings and associated discussions, while SPK was provided through observations and analyses of practicing elementary science teachers teaching, modeling of strategies by the instructor, and development and delivery of two 5E lesson plans in area elementary school settings, all approaches deemed effective in increasing elementary preservice teachers' science pedagogical knowledge.*

## BACKGROUND

Shulman's 1986 seminal work stressed the criticality of providing three interconnected knowledge types for preservice teachers to ensure their success as future teachers: content knowledge (CK), pedagogical knowledge (PK), and pedagogical content knowledge (PCK). CK is usually obtained in preservice teachers' general education

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coursework, PK is garnered in generic education courses such as classroom management and curriculum while PCK will often be gained in specific methods courses. PCK addresses teaching strategies specific to content areas. All three types of knowledge are usually equally addressed in teacher education programs, but for the purposes of this book chapter, the focus will be on science content knowledge (SCK) and pedagogical content knowledge (PCK).

## SCIENCE CONTENT KNOWLEDGE

Elementary level teachers are considered generalists who must be prepared to teach multiple subjects to include reading, mathematics, social studies, science, and more but are often woefully underprepared to teach science primarily due to a lack of a command of science content knowledge, science pedagogical skills/knowledge, and/or a lack of interest in science (Cervato & Kerton, 2017; Kind, 2009; Kisiel, 2013; Santau et al., 2014). Further, when elementary teachers lack proficient science content and science pedagogical knowledge, their confidence, competence and comfort levels for teaching science fall (Kind, 2009) and their science teaching self-efficacy also dips (Al Sutton et al., 2019). In fact, a 2013 study revealed that only 40% of elementary school teachers felt prepared and confident to teach science (Trygstad, 2013).

When elementary teachers lack science content understanding, they are more likely to develop science misconceptions (often in the physical sciences) which can be transferred to their students (Aydeniz & Brown, 2010; Bursal, 2012). While leading science class discussions, underprepared elementary teachers are also more likely to ask lower-level questions of students, are less likely to demand higher levels of student participation in science (Carlsen, 1987), are more likely to deliver low-quality science teaching (Santau et al., 2014), and are less likely to provide inquiry investigation opportunities for their students, instead often choosing to impart science facts (Newton & Newton, 2001) and rely on science textbooks and lecture-based pedagogy (Abell, 2007).

When elementary teachers are provided opportunities to improve their science content understandings, they are more apt to lead class discussions that involve critical thinking that are connected to real-world scenarios/experiences (Davis, 2004). Additionally, when preservice teachers participate in inquiry-based science investigations in their content or methods courses and are involved in active learning in science, they are more likely to gain conceptual science understandings and duplicate the inquiry-based methodology in the classes they currently or will teach (Nowicki et al., 2012) and their future students will be more likely to experience greater science learning gains (Krall et al., 2009).

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