Chapter 4
A Theoretical and Methodological Approach to Examine Young Learners' Cognitive Engagement in Science Learning

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ABSTRACT

Children start learning science in formal school settings as early as kindergarten ages. Scientific literacy is an essential component in forming science curriculum for students' knowledge and understanding of scientific concepts across grades and with different scientific disciplines. Students' cognitive engagement is displayed through different levels of cognitive processes involved during their knowledge construction. Much of the research in students' cognitive engagement of science learning focuses on older students and the use of self-report measures on their cognitive strategies. Research on young learners' cognitive engagement in science learning is missing in current literature. Part of the reason may be young learners are just beginning to develop a repertoire of cognitive strategies as well as lacking sufficient linguistic competence to accurately articulate the cognitive strategies involved in their science learning. The chapter introduces a theoretical and methodological approach, quantitative content analysis, to fulfill the gap. The chapter manifests the approach through three perspectives: (a) methodological approaches being employed in current studies of cognitive engagement in science learning, (b) the need for a different methodological approach for young learners, and (c) how this particular approach can be adopted in future research on young learners' cognitive engagement in science learning.

OUTLINE OF THE CHAPTER

The chapter contains five sections based on the three perspectives proposed. The first section provides a theoretical framework covering the definition of cognitive engagement, its related theories, and statement of the problem elicited on the issue of the chapter. The second section provides an overview of current methodologies used in the studies on students' cognitive engagement and instructional discourse that promotes this engagement in science learning. Thirdly, a methodological approach and the employment of the approach are then introduced followed by a discussion at the end of the chapter.

THEORETICAL FRAMEWORK

Definition of Cognitive Engagement

Academic engagement is defined as students' commitment or investment in school and is thought to influence students' task management, classroom behaviors (Greenwood, Horton, & Utley, 2002), motivation (Linnenbrink & Pintrich, 2003), science attitudes, and academic achievement (Singh, Granville, & Dika, 2002). Cognitive engagement is originated from school engagement that includes three types of engagement: behavioral, emotional, and cognitive (Fredricks, Blumenfeld, & Paris, 2004). Behavioral engagement is defined as students' behaviors identified in relation to their engagement such as school attendance, and participation in school activities. Emotional engagement is defined as students' affective reactions to classroom such as happiness, sadness, and anxiety. Thirdly, cognitive engagement is defined as the students' psychological investment in learning. Pintrich and Schrauben (1992) defined cognitive engagement as to include cognitive and motivational component. Motivational components include expectancy, value, and affect. Cognitive components include knowledge,

learning strategies, and thinking strategies. Other researchers specifically view students' self-regulation of their use of cognitive and metacognitive processes during acquisition and transformation of knowledge as a form of cognitive engagement (Corno & Mandinach, 1983; Mandinach & Corno, 1985). Therefore, cognitive engagement has been studied with different constructs such as motivation (Greene & Miller, 1996; Meece, Blumenfeld, & Hoyle, 1988; Walker, Greene, & Mansell, 2006) and perceptions of classroom tasks (Greene, Miller, Crowson, Duke, & Akey, 2004). Since cognitive engagement is defined and studied differently with disparate constructs by researchers, in this chapter, we adopt the definition by Fredricks et al. (2004) and Dole and Sinatra's descriptions of levels of information processing during knowledge construction, to discuss the issue on examining young children's cognitive engagement in science learning.

Cognitive Engagement and Related Theories

Perspectives of Children's Development

Dole and Sinatra (1998) draw upon Piaget's notion that the process of knowledge construction involves the active transformation and organization of knowledge by the learner (Gallagher & Reid, 2002; Piaget, 1977) through processes of assimilation and accommodation. Knowledge acquisition involves ongoing mental constructions consisting of reorganization and reconstruction that occur when there is disequilibrium within children's current schemes. Developmental research suggests that children undergo important forms of cognitive development through the school years (Flavell, 1999). Their content knowledge becomes better organized with age (Gallagher & Reid, 2002; Siegler, 1989) and children develop increased control over their cognitive processes. Children's ability to use metacognitive knowledge and reasoning also develops with age (Brown, 1987;

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