Chapter 1

The Nature of Third Grade Student Experiences with Concept Maps to Support Learning of Science Concepts

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EXECUTIVE SUMMARY

To support effective science teaching, educators need methods to reveal student understandings and misconceptions of science concepts and to offer all students an opportunity to reflect on their own knowledge construction and organization. Students can benefit by engaging in scientific activities in which they build personal connections between what they learn and their own experiences. Integrating student-constructed concept mapping into the science curriculum can reveal to both students and teachers the conceptual organization and understanding of science content, which can assist in building connections between concepts and personal experiences. This chapter describes how a class of third grade students used concept maps to understand science concepts (specifically, "watershed systems"). During class discussions and interviews, students revised concept map content and structure as their ideas developed. The study's results demonstrate how students' critical thinking (self-reflection and revision) was supported as misconceptions were revealed through their construction of concept maps over time.

INTRODUCTION

This chapter details the benefits of using concept mapping to support students in their investigations into the study of watershed systems and the local watershed's natural history. Watershed systems were a concept the students in this study had yet to encounter in their science investigations. Improvement in critical thinking, which is foundational for the growth and development of higher thinking skills, revealed itself over time as students became more involved in the process of self-reflection while questioning their prior assumptions about science content. Additionally, this teaching approach presented a way to increase discourse between teacher and students enriching the learning experience for all. Participating students reported a growth in awareness of personal and content-focused connections leading to a strong sense of ownership over both the process and outcomes of learning.

A concept map is a hierarchical diagram made up of concepts that demonstrate the builder's understanding. The concepts are related by linking words which are placed on connecting lines between concept boxes. Linking words reveal the learner's knowledge and label the connecting lines while explaining the learner's understanding of the main concept in the concept map.

Ownership over learning can lead to increased motivation within the classroom. Motivation, which can lead to increased effort, trumps intelligence in academic achievement and is fundamental to success in school (Dweck, 2008). Student understanding of science concepts was complex as their concept maps' content and structure revealed. In the study referenced in this chapter, connections between science concepts and personal knowledge within the individual concept maps were developed as students enhanced each newly revised concept map with additional concepts. Establishing connections between content and personal experiences contributes to building student investment in learning.

Student-constructed concept maps can support cognitive change leading to meaningful learning within the domain of the natural sciences (Jonassen, Howland, Mara, & Crismond, 1999; Hay, Kinchin, & Lygo-Baker, 2008; Novak, 2002) from which the learner is then able to construct new understanding (Ausubel, Novak, & Hanesian, 1978; Novak, 2002). Through reflection on individual concept map content and structure, each student critiques his own work and is then able to construct new understanding through revision of the map by adding, deleting or rearranging concepts.

Constructivism, where all experience filters through the existing lens (perspective) of the learner, supports knowledge modification over replacement, a process which guides the learner in restructuring understandings (Smith, diSessa, & Roschelle, 1993). Gains in proficiency have more to do with cognitive restructuring, which is