Chapter 22
Concept Mapping and Formative Assessment:
Elements Supporting Literacy and Learning

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ABSTRACT

From the authors observations and those of Kinchin (2001) teachers may know about concept mapping but they do not seem to use it as a consistent, effective strategy. The authors argue that the concept mapping may be better understood by using an expanded definition of traditional literacy, listening, speaking, reading and writing; to include visualizing, visual representation, and technological literacy Sinatra (1986). This ethnographic case study examines the use of concept mapping and collaborative learning strategies in the content area of marine ecology in high school science classrooms. To support students' understanding of science concept and the improvement of writing students began with a field trip to study inter-coastal zones and follow-up laboratory activities, use of digital image analysis, and collaborative group work. Key vocabulary were identified to begin concept maps, and more vocabulary was added to support multiple revisions of concept maps with concept map software, and culminated with students' writing. Concept mapping integrated with collaborative learning was used to engage students

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to construct and re-construct their understanding of a complex scientific concept, the energy cycle. The results showed that students benefited from the combination of collaborative learning and concept maps to focus their writing on key ideas, to organize their ideas, and include specific details. However, the interpretation and integration of quantitative data and laboratory results was not as consistent. Most importantly, initial concept maps and revisions provided the teacher with evidence of student learning in the form of formative assessment products, to guide teachers' focused feedback and clarify specific ideas for re-teaching, as well as students' self-assessment. The authors provide examples of concept maps and graphic organizers as formative assessment of students' knowledge, what Novak (1998) calls heuristic or "facilitative tools," and as visual representations and structures to provide flexible ways supporting learners' meaningful learning through speaking, writing and in visual forms (Sinatra, 2000; Mintzes, Wandersee, and Novak, 2004).

INTRODUCTION

Our aim is to describe the value of concept mapping and graphic organizers for learning in the context of literacy (reading, speaking, and writing, as well as visual representation and technological literacy), and the importance of understanding visual learning strategies as formative assessment. In this paper we discuss 1) the concept of literacy and visual literacy, and visual representation in particular (Sinatra, 1986), and the connection with 2) the role of formative assessment in learning (Black and Wiliam, 1998a). Research reviews on the impact of knowledge and concept mapping (Novak, 1998; Nesbit and Adesope, 2006) indicate moderate to large, positive effects, as does meta-analysis of research on formative assessment (Black and Wiliam, 1998a; Black and Wiliam, 1998b). In order for concept mapping to produce the promised effects on students it must be viewed as formative assessment of students' knowledge, what Novak (1998) calls heuristic or "facilitative tools," and "learning how to learn" (Novak and Gowin, 1984; Black, McCormick, James, and Pedder, 2006). Effective use of visual representations and structures provide flexible ways to support both teachers' and learners' quest to answer three key, instructional questions to support formative assessment: 1) Where do I want to go in my teaching and learning? 2) Where am I now? And 3) What do I need to do to get there? (Black and Wiliam, 1998a; Stiggins, Arter, Chappuis, and Chappuis, 2004) Concept maps are concrete, formative assessment products that promote dialogue and focused feedback among students, and between teacher and students (Sinatra, 2000; Mintzes, Wandersee, & Novak, 2005). Concept mapping and collaborative learning are strategies that can be "thoughtful, reflective, and focused to evoke and explore understanding" (Black and Wiliam, 1998a).

According to the meta-analysis of research by Nesbit and Adesope (2006) which included fifty-five (55), well-designed experimental studies the average effect size estimates for concept mapping were positive, and greatest for collaborative mapping strategies with mixed ability students, for students with lower verbal ability and weak domain-specific background such as sciences like biology or chemistry. In a previous meta-analysis Horton, McConney, Gallo, Woods, Senn and Hamelin (1993) estimated the effects of concept mapping to improve knowledge is 0.42, and the impact on students' attitudes and engagement is 1.57. Effect sizes are quantitative estimates of the impact on specific outcomes like achievement or attitudes, and these estimates help to summarize findings across multiple research