

Chapter VII

Computer Tools for Learning: Concept Maps, Mindtools, Computer Programming

One way of looking at the advantage of the use of computers in education is to see them as assisting with the organization and development of thinking structures in the mind of students. Concept maps offer one specific answer to the challenge of creating effective navigational schemes for educational software, while at the same time facilitating the organization of the user's thinking. Mindtools are another set of software tools that assists learners in their thought processes. Additionally, some have argued that the process of learning a computer language in and of itself leads to important cognitive development in the student. In this chapter, I consider these specific tools and the educational purposes they serve.

CRITICAL THINKING

When one talks about these various approaches to the use of computers in educational environments often the discussion centers on a supposed advantage in teaching students higher order types of thinking, sometimes called "critical thinking." However, the concept of critical thinking lacks a common definition and most higher education institutions have not defined or assessed critical thinking in a substantive

way. Cook et al (1975) define critical thinking as the “reflective, systematic, rational, and skeptical use of cognitive processes.” Others see three major components of critical thinking: knowledge, thinking skills, and attitudes (Aretz, Bolen, & Devereux, 1997). However, when looking at specific assessment efforts, critical thinking is a complicated notion and probably cannot be measured in a single way.

A great deal of inference is involved in the measurement of higher order thinking skills generally because they are not easily quantifiable (Reeves, Laffey, & Marlino, 1996). Furthermore, cognitive assessment is difficult to perform because it is relatively easy for students to mimic conceptual knowledge without really understanding the web of meaning. Rather than trying to make large claims about a learner’s overall critical thinking or cognitive abilities, concept maps, mindtools, and computer programming might assess a learner’s ability to make meaningful connections between individual ideas and concepts, and both encourage the development of higher order thinking and reveal patterns of student thinking or cognitive structure.

CONCEPT MAPPING

A concept map is a graphical representation of the cognitive structure of an individual learner—a map of how the learner sees the different elements of a given subject and their interrelationships. Concept maps have potentially great utility in the distance learning delivery format because they are graphic representations and are built on a cognitive model in line with the associative thinking used in hypertext. The idea behind hypertext is that the human brain operates in an associative manner in moving from one thought to another. These associations and their network of connections can easily be drawn in a concept map form. Furthermore, concept maps are used both in instructional delivery and in assessment, and thereby may serve as an integrated model for distance learning delivery in the future. In fact, there are already efforts to create graphic user interfaces (GUIs), based on concept maps. Since academic quality is a continual issue in distance learning format courses, measuring student learning outcomes is very important. Furthermore, as distance learning continues to expand, the importance of analyzing higher level thinking outcomes is going to increase.

Concept maps, also known as semantic networks and mind maps, are spatial representations of concepts and their interrelations as stored in the human mind. The cognitive theory underlying concept mapping is known as semantic networking theory which hypothesizes that human memory is organized according to meaningful relationships between ideas in memory (Jonassen, Reeves, Hong, Harvey, &

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