Chapter XI
IT-Enabled Strategies for Mental Modeling in E-Learning

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ABSTRACT

This chapter examines some ways information technologies (IT) are deployed in higher education courses to help learners create robust mental models. In e-learning, mental models are created through the following: digitally mediated (1) information visualization work; (2) virtual immersion, and (3) human interactivity. For (1) information visualization work, information technologies afford multi-sensory learning channels: texts, visuals, slideshows, screen casts and animations, audio, video, interactivity, immersiveness, and simulations. IT supports the archiving of digital learning artifacts through eportfolios, digital gallery shows, and informational multimedia databases. (2) Virtual immersion has been enabled in 3-D interactive spaces where learners may experience multi-faceted learning. More complex simulations have also been created with animations and long-term continuous learning. To promote (3) human interactivity, IT reifies human intellects and perceptions, and social software uses “swarm intelligence” to support consensus-driven realities. IT creates contexts for co-learning and intercommunications. Collaborative pedagogical strategies—online teaching case studies, mock trials, facilitated games, and various assignments and assessments—highlight the multiple-views, multiple-realities of constructivist learning.

BACKGROUND

With the recent popularization of constructivist ideologies in e-learning, practitioners have found that information technologies may be used to help learners build efficacious mental models. Information technologies (IT) offer three main strengths for creating mental models: information visualization work, virtual immersion and human interactivity. This chapter will open with a brief
definition of constructivism and mental models. Then five main IT affordances or “enablements” supporting the use of constructivist mental models will be introduced and supported with technological examples. Constructivism essentially posits that individuals learn when they self-create mental models and meanings, by visualizing certain roles and relationships, by understanding larger systems, and by engaging in human interactions. Individuals must be motivated to learn with authentic and applied learning situations.

A brief look at constructivism. Moshman (1982) suggests that there are three interpretations of constructivism: endogenous, exogenous and dialectical: The Endogenous focuses on the individualistic and internal nature of knowledge construction, unique to each learner. Here, an instructor facilitates the experiences which may lead to changes and maturation of existing mental models. Exogenous constructivism advocates for formal instruction along with active exercises to help learners develop practical knowledge representations. Dialectical constructivism emphasizes the importance of realistic experience for the creation of sophisticated mental models (Dalgarno, 2001, p. 185). Learning contexts are viewed differently based on varying constructivist approaches: “Ontological. Contexts are constructed socially, in interaction with other agents in the world, and psychologically, in making sense of sense data. Epistemological. Interpretation of context is always constituted within a frame of reference. Pragmatic. Instead of labeling contexts, computers can provide resources for people themselves to create and maintain contexts in their action” (Oulasvirta, Tamminen, & Höök, 2005, p. 195).

Some tenets of mental modeling. A basic definition of a mental model is that it is the learner’s internal conceptualization of a particular system or paradigm, the functions of equipment, or phenomena. A mental model involves the respective learner’s sense-making and may involve both implicit and explicit ideas, both unconscious and subconscious beliefs, and internalized and externalized knowledge. To borrow a concept from Argyris and Schön, a mental model would involve the “theories in use” vs. rather than “espoused theories” (1974, as cited in Argyris, 1993, p. 20). A mental model captures the substructure or underlying theory by which a thing or phenomenon may be understood. Making meaning from a mental model involves “balance, comparison and the reorganization of existing knowledge and the input of information,” assert Lei, Yang and Zhang (2006, n.p.). This incremental and cumulative process of building schemas is context-dependent. “Mental model construction involves mapping active memory objects onto components of the real-world phenomenon, then reorganizing and connecting those objects so that together they form a model of the whole situation” (Derry, 1996, p. 168).

Mental models affect decision-making; therefore, a mental model is also “a hypothetical knowledge structure that integrates the ideas, assumptions, relationships, insights, facts, and misconceptions that together shape the way an individual views and interacts with reality” (Steiger & Steiger, 2007, p. 1). Shared mental models strengthen the work of teams with “the ability to successfully navigate unforeseen situations or problems as they arise” (Thomas & Bostrom, 2007, p. 3). Knowledge structures show relationships among knowledge components and knowledge objects. A symbolic reasoning (instructivist) view would focus more on stored representations, and a situated learning (constructivist) view would focus on “connections, potentials” (Jonassen, et al., n.d., n.p.). “Mental models are particular organizations of memory objects that constitute a specific event interpretation,” writes Derry (1996, p. 169).

The figure “Some Mixed Elements of Constructivism” introduces the central types of constructivism—endogenous, dialectical and exogenous; the ontological, epistemological, and pragmatic. These concepts have implications for different types of e-learning because each high-
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