Learning Object for Conceptual Learning

Introduction

A conceptual model is a particular type of a learning object from a classification consisting of the following types: presentation objects, practice objects, simulation objects, information objects, contextual representation objects and conceptual models (Churchill, 2007). A conceptual model is designed to represent one or more related concepts (e.g., triangle, acceleration, inflation, volcano, and migration). Primarily, the conceptual model is a multimedia representation designed to facilitate development of learners' conceptual knowledge, and support learning tasks where relevant conceptual knowledge is required. Learning should not simply include remembering facts but also the development of conceptual knowledge. The conceptual model might serve as a useful tool to support conceptual learning. If appropriately designed, the conceptual model can be effectively delivered to a variety of learning environments via computers, personal digital assistants and mobile phones. The conceptual model can be provided to teachers, who must then decide how to integrate it in instructions, to students for use in their independent learning, or to instructional designers to use as a media object for integration in larger structures such as computer-based instructional packages.

Examples of Learning Objects for Conceptual Learning

Here are some examples of conceptual models (Churchill & Hedberg, 2008):

- a representation that enables a learner to construct an internal model of a rule to be used in solving algorithmic problems, such as a representation of how to divide two numbers
- a conceptual model that allows a learner to explore if-then or cause-and-effect scenarios (e.g., effect of spread of bird flu in Asia)
- a representation of a concept that guides an expert in diagnosing a problem and proposing a solution, like a concept of Ohm's Law
- a representation of a value system held by an expert that supports his or her judgment (e.g., value system of a movie producer who produced a controversial film)

A more descriptive example of a conceptual model is presented in Figure 1. This conceptual model contains information about a number of important river parameters, enables calculations of river discharge, presents the impact on flow rates caused by the shape of a riverbed, and allows identification of common bedrocks at different locations along the river. Various items of information are presented based on a learner's interaction with the conceptual model. A student can arrive at an understanding of the issues affecting the river through interaction and manipulation of specific parameters, such as how the cross-section of the river changes as one moves down the river, and by systematic exploration of specific information (e.g., how the river discharge is calculated based on values of width, depth and velocity).

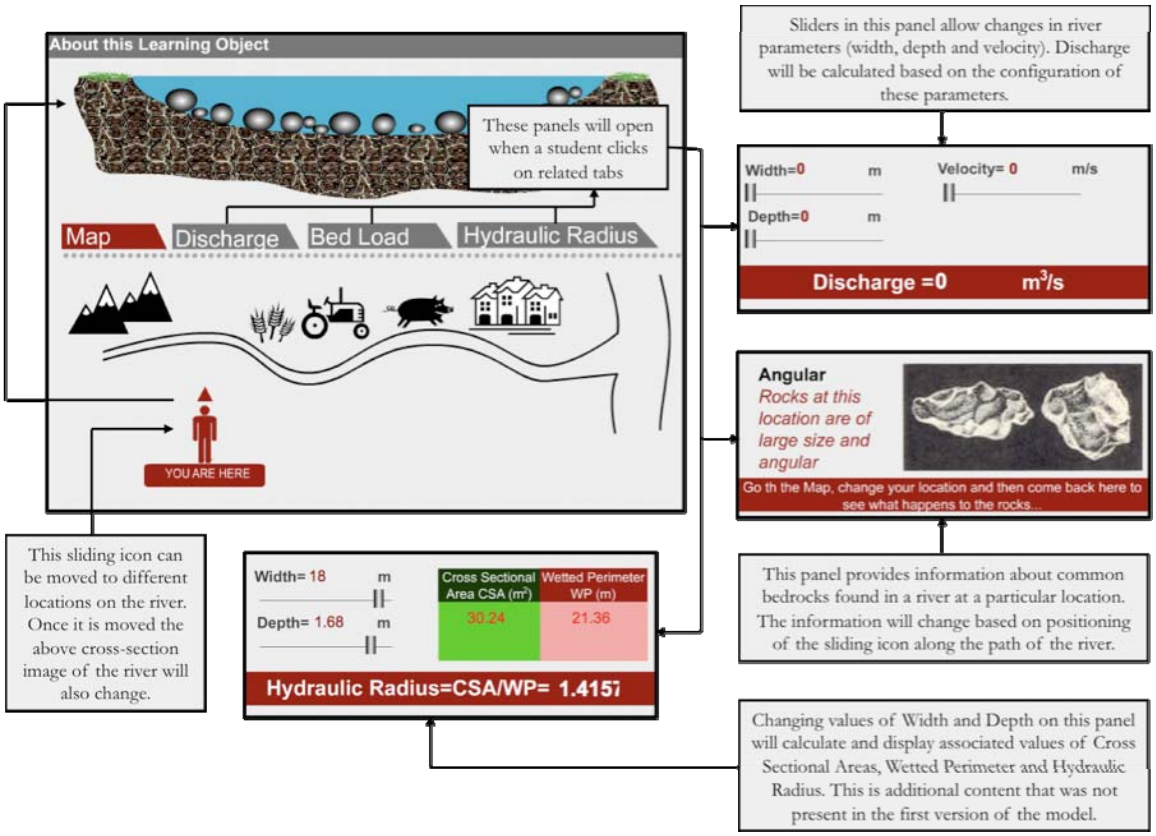

Figure 1: "River" conceptual model

Models for Teaching and Learning – Theoretical Background

Models have been described as powerful tools for learning, and their educational use has been described as model-centered learning and instruction (e.g., Seel, 2003, Gibbons, 2008). Lesh and Doerr (2003) define a model as a conceptual system "consisting of elements, relations, operations, and rules governing interactions" that are used to "construct, describe, or explain the behavior of other system(s)". For Dawson (2004), a model is "an artifact that can be mapped onto a phenomenon" and that is "easier to understand than the phenomenon being modeled". Johnson and Lesh (2003) more specifically discuss technology-based representational models and suggest that these models can be used for communicating, modeling, describing, or experimenting with other system(s). The term conceptual model was used by Norman (1983), who refers to it as a representation of a target system designed to serve as a the conceptual model as a representation designed for teaching and learning purposes, and writes that such a representation "highlights the major objects and actions in a system as well as the causal relations among them".

Contemporary technology enables design of conceptual models in a effective multimedia form. This form is predominantly interactive (sliders, buttons, hot-spots, text-entry) and visual (diagrams, illustrations, pictures, videos, animations). It can also contain other modalities such as text and audio. This idea of a conceptual model as visual and interactive digital representation is influenced by theoretical work such as: external multimedia representations (Schnotz & Lowe, 2003), dynamic visualization (Ploetzner & Lowe, 2004), information visualization (Bederson & Shneiderman, 2003), visual explanations and envisioning information (Tufte, 1990; Tufte, 1997; Tufte, 2001), visual and multimedia displays and conceptual models (Mayer, 1998; Mayer 2003), conceptual models (Norman, 1983), multiple

representations (Van Someren, 1998), modality and multimodality (De Jong et al. 1998; van Someren et al. 1998) and pedagogical models (Fraser, 1999). Overall, the literature suggests that technology creates opportunity for design and application of conceptual models and other forms of technology-based representations that can effectively support teaching and learning (e.g., De Jong et al., 1998; Fraser, 1999; Norman, 1983; Johnson & Lesh, 2003; Van Someren, 1998). It is also suggested that learning with these representations is supported through activation of certain cognitive processes such as mind modeling and linking between internal representations (Churchill, 2008; Seel, 2003; Mayer, 1989; Mayer, 2003).

Overall, when appropriately designed, the conceptual model can support development of more advanced forms of knowledge such as conceptual knowledge and mental models. Curriculum content can be analyzed to identify key concepts. These concepts can be represented through conceptual models that can serve as powerful tools for teaching, learning and instructional design, and that can be effectively delivered to learning environments via a variety of technologies, such as computers, handheld personal devices or mobile phones.

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