

# Chapter XI

## Semantic Tools to Support the Construction and Use of Concept-Based Learning Spaces

**Terence R. Smith**

*University of California at Santa Barbara, USA*

**Marcia Lei Zeng**

*Kent State University, USA*

### **ABSTRACT**

*We describe a digital learning environment (DLE) organized around sets of concepts that represent a specific domain of knowledge. A prototype DLE developed by the Alexandria Project currently supports teaching at the University of California at Santa Barbara. Its distinguishing strength is an underlying abstract model of key aspects of any concept and its relationship to other concepts. Similar models of concepts are evolving simultaneously in a variety of disciplines. Our strongly-structured model (SSM) of concepts is based on the viewpoint that scientific concepts and their interrelationships provide the most powerful level of granularity with which to support effective access and use of knowledge in DLEs. The SSM integrates a taxonomy (or thesaurus), metadata (or attribute-value pairs), domain-specific mark-up languages, and specific models for learning scientific concepts. It is focused on attributes of concepts that include objective representations, operational semantics, use, and interrelationships to other concepts. The DLE integrates various semantic tools facilitating the creation, merging, and use of heterogeneous learning materials from distributed sources, as well as their access in terms of our SSM of concepts by both instructors and students. Evidence indicates that undergraduate instructional activities are enhanced with the use of such integrated semantic tools.*

## **INTRODUCTION**

In this chapter we describe the design and implementation of a digital learning environment (DLE) that may be organized around sets of concepts selected by an instructor to represent a specific domain of knowledge. While such DLEs are applicable to the whole range of scientific and engineering disciplines, the operational DLE described in this chapter supports a core introductory course in physical geography that is currently being taught at the University of California, Santa Barbara (UCSB). This DLE was designed and implemented as part of UCSB's Alexandria Digital Earth Project (ADEPT). The main goal of ADEPT has been the design, implementation, testing, and application of DLEs that take advantage of digital library (DL) collections and services in the construction and use of learning materials, particularly for undergraduate classes (ADEPT, 2003). A further goal for the development of the ADEPT DLE has been to foster the development of a student's understanding of specific domains of knowledge by organizing and accessing a large array of learning materials drawn from the collections of a DL.

## **DIGITAL LEARNING ENVIRONMENTS (DLE) FOR TEACHING SCIENCE**

### **The Rationale**

A necessary condition for understanding any domain of science is that students possess sufficient familiarity with the concepts, as well as with the interrelationships between concepts, that are employed in representing the phenomena of that domain. Many approaches to teaching and learning at the undergraduate level, however, typically present the concepts that are employed in representing the phenomena in ways that are implicit and relatively superficial.

Traditional courses in physical geography, for example, typically confront students with large arrays of scientific concepts that are introduced sequentially in textbooks and usually "modeled" as lists of keyword terms at the end of chapters and/or described in terms of definitions given in glossaries at the end of the book. Students typically have significant problems in developing and using integrated cognitive representations of these concepts, their interrelationships, and their applications to scientific understanding. Their confusion is well summarized in a common question about the keyword lists at the end of each chapter: "Do we have to remember all of the words in these lists?" In particular, this question indicates a lack of understanding of either the role that concepts play in the representation and organization of scientific knowledge or of the interrelationships between different concepts.

It is clear that students in traditional course environments are rarely presented with much of the information about concepts that is critical to an understanding of their role in representing scientific knowledge. Such information includes, for example, the discovery, the various syntactic representations, the semantics, the manipulation, and the interrelationships of concepts. As a result, students too often emerge from a course of study with: (1) limited notions of the nature of concepts; (2) large, but poorly-structured, memorized sets of terms denoting concepts; (3) incompletely structured associations of relationships between concepts; and (4) partial knowledge of how to use concepts in creating representations of phenomena or how to create new concepts as the need arises in some domain of science.

In relation to learning, there is a growing consensus that science education should be an activity in which students learn to think like scientists rather than solely memorize information. This strongly suggests the importance of students developing an understanding of scientific concepts and their role in the scientific approach, including their representation, creation, use, and evalua-

17 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:  
[www.igi-global.com/chapter/semantic-tools-support-construction-use/9106](http://www.igi-global.com/chapter/semantic-tools-support-construction-use/9106)

## Related Content

---

### Exploring Ideas and Possibilities of Second Life as an Advanced E-Learning Environment

Bo Kyeong Kim and Youngkyun Baek (2010). *Handbook of Research on Practices and Outcomes in E-Learning: Issues and Trends* (pp. 165-181).

[www.irma-international.org/chapter/exploring-ideas-possibilities-second-life/38352](http://www.irma-international.org/chapter/exploring-ideas-possibilities-second-life/38352)

### Online Learning for the Visually Impaired

Mirela Arion and Marius Iulian Tutuianu (2003). *Usability Evaluation of Online Learning Programs* (pp. 387-408).

[www.irma-international.org/chapter/online-learning-visually-impaired/30621](http://www.irma-international.org/chapter/online-learning-visually-impaired/30621)

### Inquisitivism: The Evolution of a Constructivist Approach for Web-Based Instruction

Dwayne Harapnuik (2006). *Enhancing Learning Through Technology* (pp. 125-154).

[www.irma-international.org/chapter/inquisitivism-evolution-constructivist-approach-web/18351](http://www.irma-international.org/chapter/inquisitivism-evolution-constructivist-approach-web/18351)

### E-Learning as Nation Building

Marco Adria and Katy Campbell (2007). *Making the Transition to E-Learning: Strategies and Issues* (pp. 1-16).

[www.irma-international.org/chapter/learning-nation-building/25610](http://www.irma-international.org/chapter/learning-nation-building/25610)

### Collaborative Online Learning and Accessibility

Martin D. Beer, Paul Crowther and Elizabeth Uruchurtu (2008). *Technology Enhanced Learning: Best Practices* (pp. 81-106).

[www.irma-international.org/chapter/collaborative-online-learning-accessibility/30191](http://www.irma-international.org/chapter/collaborative-online-learning-accessibility/30191)