

## Chapter 2.12

# Learning Object Model for Online Laboratories

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### ABSTRACT

Online learning environments provide the students access to the course content at any time and from anywhere. Most of the existing e-learning systems are designed for content-based subjects that deliver course content such as text, images, video, audio, and simulation to the student through the Internet. In recent years, several online or remote laboratories have been developed to bring the e-learning concept to the lab-based courses. These systems, mainly Web-based, allow students to conduct real laboratory experiment, as opposed to computer simulations, from anywhere and at any time. In this chapter, we introduce a model for providing lab-based lessons as learning ob-

jects (LOs). The learning object model has been widely used in content-based e-learning systems. We then propose a learning management system (LMS) framework that helps students to remotely access the lab-based learning objects (LLOs). We will also present some experimental results and implementations.

### INTRODUCTION

The term *e-learning* refers to a mixture of different preferred learning methods, which delivers to the learner through the use of information technology and is supported with instructional design and engaging content. The trend of using e-learning as an educational platform is increasing in corporations, universities, and industries. The

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dream of teaching and learning from anywhere, at anytime becomes reality with the construction of the e-learning infrastructure. Great attention has been paid to apply e-learning strategy for the future education. However, seldom research can be found in the literature for the e-learning subjects that involve hardware (i.e., lab-based experiment courses).

LOs are discrete units of learning resources based on agreed e-learning standards. However, there are some difficulties to apply the LO concept to the lab-based course due to the different nature of their content. For the lab-based course, it uses the real hardware that is actually not considered in the existing e-learning standards.

In this chapter, we propose a framework for online laboratories to facilitate the design and deployment of lab-based courses. The framework is an extension of the Sharable Content Object Reference Model (SCORM), which handles and processes the lab apparatus in a standard and uniform e-learning environment. We will introduce a LO model applied to lab-based lessons. The framework is then used as a container to facilitate access to the lab-based LOs.

## BACKGROUND

An e-learning system that uses learning object model consists of three components: the LO itself, which is the actual content (text, graphic, animation, etc), meta-tags, which describe the

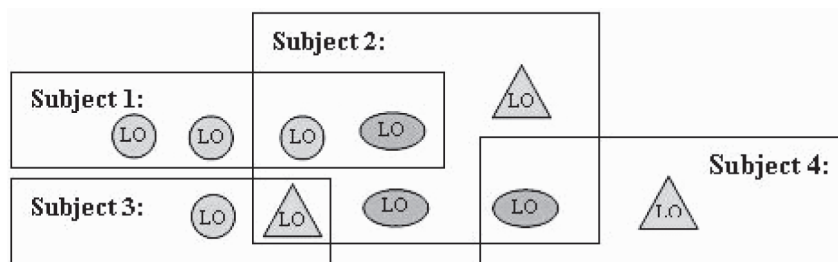
object, and finally a learning content management system (LCMS), which stores, tracks, and delivers content. The metadata is used to describe and index the LOs. This helps learners to seek and retrieve the specific material that they are looking for from a repository.

In this section, we provide some background relevant to understanding of an e-learning system, which is based on the LO model and LCMS. A short review on the related research and key organizations engaged in developing related standards will be presented.

## Reusable Learning Objects

The term *learning object* was first popularized by Wayne Hodgins in 1994 (Polsani, 2003). The main idea is to have learning material broken down into smaller pieces that could be later combined by instructors, learners, and eventually computers into larger structures to support learning. The LO is any entity, digital or non-digital, which can be used, re-used, or referenced during technology supported learning (IEEE Learning Technology Standards Committee, 2002). It is commonly viewed as the smallest element of stand-alone information required for an individual to achieve an enabling performance objective or outcome. As these entities can be reused in other subjects, they are often called *reusable learning objects*. Figure 1 illustrates the concept of reuse of LO in different learning content.

*Figure 1. Reusing learning objects in different learning content*



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