Chapter 5.12
Integrating the LMS in Service Oriented eLearning Systems

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ABSTRACT

Learning management systems are routinely used for presenting, solving and grading exercises with large classes. However, teachers are constrained to use questions with pre-defined answers, such as multiple-choice, to automatically correct the exercises of their students. Complex exercises cannot be evaluated automatically by the LMS and require the coordination of a set of heterogeneous systems. For instance, programming exercises require a specialized exercise resolution environment and automatic evaluation features, each provided by a different type of system. In this paper, the authors discuss an approach for the coordination of a network of eLearning systems supporting the resolution of exercises. The proposed approach is based on a pivot component embedded in the LMS and has two main roles: 1) provide an exercise resolution environment, and 2) coordinate communication between the LMS and other systems, exposing their functions as web services. The integration of the pivot component in the LMS relies on Learning Tools Interoperability (LTI). This paper presents an architecture to coordinate a network of eLearning systems and validate the proposed approach by creating such a network integrated with LMS from two different vendors.

1. INTRODUCTION

The architecture of eLearning platforms is moving from centralised, component based systems to de-centralised platforms assembling multiple services (Dagger, O'Connor, Lawless, Walsh, & Wade, 2007). These services can participate in several learning processes that are easily reconfigured to meet changing requirements and demands. We are particularly interested in networks of eLearning

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systems providing services related to automatic evaluation.

The motivation for this work reflects the experience gained by the authors in several educational projects such as Mooshak and EduJudge. Mooshak (Leal & Silva, 2003) is a contest management system for computer programming contests that is being used since 2002 also as an e-Learning tool in programming language courses. EduJudge (Leal & Queirós, 2009) is a system developed for enabling the use by LMS of the collection of programming exercises of the UVA (University of Valladolid) on-line judge (Regueras, Verdú, Castro, Pérez, & Verdú, 2008). Both these systems require a programming exercise evaluation feature. This is a complex feature that cannot be easily integrated as a component in a general purpose Learning Management System (LMS) such as Moodle, Blackboard or Sakai, that already provide other important features such us content sequencing and grade books.

Our research objective is to manage and coordinate a network of eLearning system where students can solve exercises in complex domain such as computer programming. Networks of this kind include systems such as evaluation engines, repositories of learning objects and exercise resolution environments. The LMS has also an important role in this network of systems since it is the natural place to assign exercises to students and to collect grades. However, the coordination of a network of such disparate systems is rather complex. Some of these systems expose their functions as web services, such as the repository of learning objects or the evaluation engine, but others have their own web interfaces for students and teachers, such as the LMS and the exercise resolution environment.

The goal of the research described in this paper is to explore the possibility of embedding a pivot component in an LMS that acts as exercise resolution environment and coordinates the communications between the LMS and the web services. The integration of this component with the LMS is supported by the IMS Basic Learning Tools Interoperability (LTI). This standard provides a framework for integrating applications with educational platforms such as LMS, portals, or other systems from which applications can be launched. An integration component developed with LTI can be used in any LMS that supports this standard.

The remainder of this paper is organized as follows. Section 2 presents the state of the art of the automatic evaluation of programs, including the current application profiles used to describe programming exercises and the systems to manage them such as the learning objects repositories and the evaluation engines. In this section we focus also in the interoperability efforts made by educational organizations to connect these and other applications into the LMS. In the following section we start by presenting the proposed architecture for a network of eLearning systems supporting the resolution of programming exercise. Then, we highlight the pivot component that acts as exercise resolution environment followed by the other eLearning services. In the following section we validate the proposed solution by integrating the pivot component in two LMS - Moodle and Sakai. Finally, a summary of the main contributions and a perspective of future research conclude this paper.

2. STATE OF ART

The current generation of eLearning platforms values the interchange of learning objects and learners' information through the adoption of standards that brought content sharing and interoperability to eLearning. Learning Objects (LO) are units of instructional content that can be used, and most of all reused, on web based eLearning systems. Despite its success in the promotion of the standardization of eLearning content, it is not enough to ensure interoperability, which is a major user concern with the existing systems. The