

Chapter 12

Integrating XML Technologies and Open Source Software for Personalization in E-Learning

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ABSTRACT

E-learning that emphasizes learner-centered activity and system interactivity provides a pedagogic opportunity to deliver a context for individual learning options. In the past decade, e-catalog standards based on learning object models have facilitated the design of e-learning systems. This study addresses issues for e-learning in a professional setting to foster the development of computer skills in students. In particular, personalized templates generated according to student and learning object models are proposed for instructors to provide practice exercises. Standardized XML technologies and open source software are integrated to create information filters and user interfaces to achieve personalization. The students use open source software that acts as a new type of Web client other than a browser. A case study that applies personalized templates for the learning of computer programming students with different skill levels is presented.

INTRODUCTION

Web-based distance learning, which is commonly referred to as e-learning, emphasizes learner-centered activity and system interactivity. Therefore, remote learners can potentially outperform

traditional classroom students (Zhang, Zhao, Zhou, & Nunamaker, 2004). The development of an e-learning system typically requires the use of standardized Web technologies to transmit dynamic content to students. To facilitate content creation and customization on the Web, it has been suggested that course materials be edited with XML (Extensible Markup Language)

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tools (Li, Shi, Shang, & Chen, 2003; Koohang, 2004). XML specifies learning objects that are used systematically to form teaching units, modules, or courses. The key advantage of learning objects is their potential sharability, which has motivated organizations to develop standards for their large-scale application. Following this trend, the Advanced Distributed Learning (ADL) initiative of the U.S. Department of Defense has taken the XML specification further and provided the Shareable Content Object Reference Model (SCORM) standard to enable the interoperability, accessibility, and reusability of Web-based learning content (Lee & Su, 2006; Wang & Hsu, 2006).

The requirements of e-learning standards for educational institutions are similar to those of e-catalog standards that address the inter-organizational exchange of catalog data in e-business (Schmitz & Leukel, 2005). However, instead of profitability, a key emphasis in the development of e-learning systems is personalization to help every student succeed. For example, the University of Hong Kong has developed the Web-based SmartTutor to provide personalized advice to students based on their individual backgrounds and experience (Cheung, Hui, Zhang, & Yiu, 2003). Personalization refers to information that is customized for each user and is personally relevant. Kamba, Sakagami, and Koseki (1997) reported a project in which personalization was applied to an online newspaper, and they highlighted the importance of user interfaces and information filtering in achieving this. In their personalized newspaper system, a Web server managed the article data and each user's profile, scored all of the articles, and sent an interaction agent to run in a client's browser. This agent monitored user operations and created personalized newspaper pages automatically. Recently, the research on Web-based personalization has advanced to apply personal information to the generation of individual paths of reading material or assessments in e-learning systems (Ceri, Dolog, Matera, & Nejdl, 2005; Chen, Lee, & Chen, 2005).

To support the personalization of Web applications, technology is usually employed to store as much historical user data as possible and then to query that data as users navigate through a Web site (Datta, Dutta, VanderMeer, Ramamritham, & Navathe, 2001). However, the implementation of personalization in e-learning systems is still challenging because of the following technological issues.

- Although the configuration of personalized services can be developed, it lacks flexibility in the accommodation of domain-specific requirements (Ardissono, Goy, Petrone, & Segnan, 2005).
- Although reading on the Web can be personalized to provide effective learning through the adaptation of navigation directions to the abilities of learners, browser-oriented Web systems limit learning activities to reading.

These issues are evident when an e-learning system is constructed to teach advanced computer skills because (a) the teaching of constantly changing computer technologies requires flexibility for the frequent update of curricula, and (b) computer skills are developed and learned by doing.

These constraints of the personalization technologies used in conventional e-learning systems are addressed in this study. The solution is system architecture that generates personalized templates (custom learning objects) on the open source software that is used as a learning tool. In this architecture, the personalized templates are created through the application of emerging XML tools. This template-based approach emphasizes learning by doing, which motivates students to learn and produces more effective learning outcomes than do passive approaches, such as traditional lectures (Wang, 2003). The architecture provides valuable features for both instructors and students. Instructors are able to set up XML-based rules to determine dynami-

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