Integrating Adaptive Games in Student-Centered Virtual Learning Environments

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ABSTRACT

The increasing adoption of e-Learning technology is facing new challenges, such as how to produce student-centered systems that can be adapted to each student’s needs. In this context, educational video games are proposed as an ideal medium to facilitate adaptation and tracking of students’ performance for assessment purposes, but integrating the games in the educational flow presents technical and practical challenges. Moreover, their eventual integration should be accomplished according to the current standardization trends in e-Learning to simplify general adoption. Barriers still exist between the gaming and e-Learning communities, preventing their mutual interaction. In this work, the authors present a middle-ware to bridge this gap, integrating adaptive educational video games in e-Learning environments with a special focus on the ongoing standardization efforts.

Keywords: Adaptive Learning, Assessment, Educational Video Games, SCORM, Virtual Learning Environments

INTRODUCTION

The use of e-Learning is increasing as both industry and educational institutions embrace blended learning models in which traditional education is complemented with web-based e-Learning environments. At the same time, e-Learning systems have evolved from the original repositories of static content into richer Virtual Learning Environments (VLE), such as Moodle™ (Dougiamas & Taylor, 2003) or Sakai™ (Farmer & Dolphin, 2005), that comply with different standards and specifications to assure the interoperability of the materials (e.g., SCORM (ADL, 2006)). The new student-centered features being adopted (such as VLE-driven adaptation of the learning experience or user tracking and assessment) demand further standardization efforts and raise new technical challenges.

DOI: 10.4018/jdet.2010070101
Besides, there is an emergent trend in Technology-Enhanced Learning advocating for the use of educational video games and game-like simulations (Tang, 2007; Torrente, Lavin-Mera, Moreno-Ger, & Fernández-Manjón, 2008). Educational video games present advantages such as their suitability to convey concepts (Hamid, 2001) or to increase students’ motivation (Gee, 2003). Games also provide short feedback cycles that foster constructivist learning approaches in which students implicitly formulate and test hypothesis, receiving immediate feedback from the system (Pivec & Dziabenko, 2004).

However, games are not only interesting for those reasons. Another key feature of educational games is that their high level of interactivity can provide very fine-grained user adaptation and performance-tracking mechanisms (Moreno-Ger, Burgos, Sierra, & Fernández-Manjón, 2008). This aspect can open new possibilities for student-centered VLEs. On the one hand, this allows collecting detailed data about the activities of the students. On the other hand, it allows providing learning experiences adapted to the needs of each student.

Nevertheless, in order to leverage this fine-grained assessment and adaptation potential, it is necessary to allow the games to exchange information with the VLE. While the exchange of information between active content and the VLE is addressed in standards such as the SCORM framework, we still need to deal with the current diversity of VLEs and with a lack of specific standardization support for the peculiarities of game-based learning.

This article presents a general architecture to integrate games in VLE with special emphasis on supporting adaptation and assessment. This architecture is designed to provide an abstraction middle-ware that allows game designers to create adaptive educational games that are not compatible with a single VLE and are not committed to a specific educational standard. This offers the possibility of reusing the games in different VLEs and contexts, even if they support different families of standards (or even no standards at all).

This article is thus organized as follows. First we analyze the current state of the e-Learning field focusing on assessment, adaptation and standards; second, we discuss how video games can contribute to assessment and adaptation in e-Learning and the challenges behind this approach. Then we describe the proposed architecture and its implementation in the <e-Adventure> platform as a case study and finally, we present some conclusions and outline future lines of work.

**VLEs: ASSESSMENT, ADAPTATION AND STANDARDS**

VLEs are rapidly evolving, giving the instructor more support and advanced tools to create complex online learning experiences. However, the increasing complexity of the content, including highly interactive materials such as educational video games, requires further support for the instructors. The new VLEs need to facilitate tasks such as tracking the progress and the skills acquired by the student within the games, as well as to adapt the learning experiences to the specific needs of each student.

Another important issue in e-Learning is the interoperability of contents. E-Learning standards try to deal with the different aspects of e-Learning processes. At the present time, compliance to e-Learning standards is a crucial factor when selecting a new VLE implantation within a corporate or educational environment. This allows the reutilization of existing contents and protects the investment in developing new contents against future platform migrations.

E-Learning specification and standardization initiatives are numerous and diverse, involving different organizations and consortiums such as the IEEE or IMS Global Learning Consortium. Most of these contributions target the concept of allowing the creation of courses as aggregations of simple units of content, an approach usually referred to as the Learning Objects Model (Balatsoukas, Morris, & O’Brien, 2008). To achieve this kind of aggregation, it is important to package the contents in a standard-
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