

## Chapter 34

# Enhancing Adaptive Learning and Assessment in Virtual Learning Environments with Educational Games

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### ABSTRACT

*The rising acceptance of Virtual Learning Environments (VLE) in the e-Learning field poses new challenges such as producing student-centered courses that can be automatically tailored to each student's needs. For this purpose digital games can be used, taking advantage of their flexibility (good video games always try to adapt to different players) and capabilities to stealthily track players' activity, either for producing an accurate user model or enhancing the overall assessment capabilities of the system. In this chapter, the authors discuss the integration of digital games in Virtual Learning Environments and the need of standards that allow the interoperable communication of games and VLE. Authors also present a middle-ware architecture to integrate video games in VLEs that addresses the technical barriers posed by the integration. The chapter presents a case study with the implementation of the architecture in the "e-Adventure" game authoring platform, along with three examples of video game integration in educational settings.*

### INTRODUCTION

Schools, universities and corporations are becoming increasingly dependent on e-Learning systems for their distance or blended learning programs. State-of-the-art e-Learning systems are no lon-

ger mere content repositories but fully featured Virtual Learning Environments (e.g. *Moodle*<sup>TM</sup> (Dougiamas & Taylor, 2003), *Sakai*<sup>TM</sup> (Farmer & Dolphin, 2005)) that support all the activities related to learning. Modern VLEs comply with different e-Learning standards to ensure content interoperability (e.g. SCORM (ADL, 2006)), which is important to protect investments in con-

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tent production. Therefore the courses created may combine VLE's built-in tools (e.g. chat, forum, questionnaires, etc.) with a wide range of learning contents. However, in many cases standards only cover content deployment, leaving the active integration of tools and contents to VLE developers' own judgment.

Among the new educational tools to be used in education, video games and simulations are gaining acceptance as learning tools as contents that foster learning by doing (Aldrich, 2005), problem solving skills (Rieber, 1996) and improve motivation and engagement (Garris, Ahlers, & Driskell, 2002). Video games has also potential because of their high level of interactivity, which allows providing fine-grained adaptive experiences, and player's activity tracking capabilities (Tang, 2007; Moreno-Ger, Burgos, & Torrente, 2009). Ideally these features could be used to enhance what the VLE knows about the student. This opens new possibilities for improving the assessment methodologies and to adapt the learning process for each student.

Nevertheless, for this to be a reality games and VLE need to establish an active and bidirectional communication that can cope with an intense exchange of interaction data. Current e-Learning standards were not designed to support this kind of communication. Some e-Learning standards address the communication between VLE and content (e.g. SCORM) or the adaptation of the learning flow (e.g. IMS Learning Design (IMS Global Consortium, 2003) but we still need to deal with the current diversity of VLE and with a lack of specific standardization support for the peculiarities of game-based learning.

In this chapter we present a general architecture to integrate games in VLE specifically focused on supporting adaptation and assessment features. Through the use of a middle-ware, game designers can develop adaptive educational games defining the interaction with the VLE without committing to any specific VLE or standard and without the

need of technical knowledge on this matter. Thus the games created could be integrated in different VLEs and contexts, even if they support different families of standards (or even no standards at all). To test the feasibility of this approach, we've implemented the architecture in the "e-Adventure" game authoring platform. For the last two years we have evaluated the implementation and the conceptual framework in the development of several games for different educational settings.

In this chapter we first identify the barriers and the state of the art 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 three experiences of video game integration in VLE and finally, we present some conclusions and outline future lines of work.

## **VLEs: ASSESSMENT, ADAPTATION AND STANDARDS**

Current VLEs aim to provide support tools for all aspects of the teaching-learning process, from course creation to student evaluation features (Govindasamy, 2002). Common assessment tools include tests and questionnaires. However, there is a lack of well-defined methods to assess student progress from how the student interacts with content. While the VLE can usually know when a user accessed the content, in many cases contents behave as black boxes for the VLE.

An additional notion is how to establish relations among the activities in a course so that they can result in an adaptive learning flow in which the outputs of some activities affect the behavior of the learning experience (Henze, 2000). Even though there are several examples of systems that include adaptation features (e.g., AHA, ALFANET, etc.),

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