Chapter 57
Logs Analysis of Adapted Pedagogical Scenarios Generated by a Simulation Serious Game Architecture

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ABSTRACT

This paper presents an architecture designed for simulation serious games, which automatically generates game-based scenarios adapted to learner's learning progression. We present three central modules of the architecture: (1) the learner model, (2) the adaptation module and (3) the logs module. The learner model estimates the progression of the development of skills targeted in the game. The adaptation module uses this estimation to automatically plan an adapted sequence of in-game situations optimizing learning. We implemented our architecture in Game of Homes, a simulation serious game, which aims to train adults the basics of real estate. We built a scripted-based version of Game of Homes in order to compare the impact of scripted-based scenarios versus generated scenarios on learning progression. We qualitatively analyzed logs files of thirty-six adults who played Game of Homes for 90 minutes. The main results highlighted the specificity of the generated pedagogical scenarios for each learner and, more specifically, the optimization of the guidance provided and of the presentation of the learning content throughout the game.

INTRODUCTION

Serious games can be defined as computer-based learning environments, which are built as video games. Their purpose is to train the learner[1] to a specific domain of expertise, while making learning fun. As their use continues to grow in education and training (Girard et al., 2013), few researchers have studied

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their architecture to date (e.g., Amory, 2007; Arnab et al., 2015; Kiili, 2005; Peirce et al., 2008). But none of proposed architecture for serious game offers enough details on their software implementation. Moreover, few allow game logs extraction and their analysis, which provide educators with details about learners' learning process. The architecture must offer tools to help them analyze extracted logs after a game session. Generating logs and developing logs analysis tools constitute main research objects in the learning analytics field (Baker & Inventado, 2014).

Simulation serious games are serious games which use a simulation to convey learning content. Simulations can be defined as simplified environments of reality, where learner can assimilate learning content without any risk (Sauvé & Kaufman, 2010). Simulation games are appropriate to develop expertise in a domain by generating realistic real-world scenario in which gamers are cognitively as well as motivationally engaged at a deep level (Wouters et al., 2013).

In this article, we present a simulation serious game architecture, which automatically generates pedagogical game-based scenarios adapted to the learner progression throughout the play as well as logs that could be retrieved and analyzed by trainers after the play. We hypothesized that automatically generating scenarios in simulation serious games improve and accelerate learning among adults.

This paper is organized as follow. We first present the theoretical framework of our work. Our proposed architecture is detailed in the second section. We then explain how we implement our architecture in a single-player simulation serious game called *Game of Homes*, which aims to train adults to the basics of real estate. Finally, we report and discuss the results of an empirical evaluation of our architecture, which was conducted to (1) verify that our implemented architecture allowed logs retrieval, (2) read generated pedagogical game-based scenarios, and (3) compare learning progression between scripted-based scenarios and automatically generated scenarios.

THEORETICAL FRAMEWORK

Simulations offer a simplified version of reality, but remain complex and dynamic, and preserve crucial pedagogical features (Garris et al., 2002). Galarneau (2005) mentions that a simulation serious game must, in addition, include play and fun features. The latter maintain learners' motivation and learners' engagement at a high level, using for example scoring or competition. Figure 1 shows simulation, video game and pedagogical features, which all need to be integrated in a simulation serious game architecture.

Simulation Key Features

Simulation games complexity and dynamism lie in simulation variables, which are controlled and adjusted by the game system. These variables represent real-life elements interacting with each other, according to learners' actions in the simulation serious game (Gredler, 2004). Each action represents an input, which triggers targeted variables adjustment in the simulation. Visual indicators are then displayed to learners, as outputs as well as feedback, giving learners some piece of information about the interaction mechanisms between variables.

While controlling and changing variables values, simulations can also reproduce specific contexts or real-life situations. This feature is strongly related to game and pedagogical features, as changing in-game situations can increase or decrease difficulty, as well as challenge and learners' curiosity. Moreover, presenting a wide range of real-life situations can raise learners' awareness of the learning content.