Available online at www.sciencedirect.com

ScienceDirect

Procedia - Social and Behavioral Sciences 228 (2016) 436 – 442

Procedia Social and Behavioral Sciences

2nd International Conference on Higher Education Advances, HEAd´16, 21-23 June 2016, València, Spain

Software Engineering Management Education through Game Design Patterns

Nuno H. Flores[ab]*, Ana C.R. Paiva[ab], Pedro Letra[a]

[a]*INESC TEC, Portugal*
[b]*Department of Informatics – Faculty of Engineering of the University of Porto, Portugal*

Abstract

Software engineering (SE) is an area with a wide range of concepts and knowledge. Such diversity of topics, requires the application of different teaching and learning techniques for an effective education. Serious Games is one of such techniques, yet its design tends to be complex, currently lacking a map of game design standards that comply with SE education requirements. This paper presents a process to identify the game design patterns that can be effective for teaching software engineering, specifically the software project management topic. Firstly, it begins by identifying the relationship between game design patterns and teaching and learning functions based on literature review. Secondly, it filters which of those teaching and learning functions is most relevant to software project management education, according to SE education specialists. Finally, it validates the relationship between game design patterns and software project management education through an empirical study conducted with master students. The results can be used as a basis for designing and developing serious games for teaching software project management.

Peer-review under responsibility of the organizing committee of HEAd´16

Keywords: Software Engineering Education; Software Engineering Project Management; Game Design Techniques; SimSE.

* Corresponding author.
E-mail address: nuno.flores@fe.up.pt

Peer-review under responsibility of the organizing committee of HEAd´16
doi:10.1016/j.sbspro.2016.07.067

1. Introduction

Software Engineering (SE), as a domain area, encompasses a wide and dense range of concepts and knowledge. The SWEBOK (Swebok, 2014), an organizational structure proposed by the IEEE, promotes a common and consistent understanding of those concepts, and how they relate to other areas. Effectively acquiring such diverse knowledge relies on a considerable amount of learning and teaching techniques (Claypool, 2005)(Schilling, 2012)(Yu 2014). One such technique is the use of *serious games*, but the inherent complexity of designing such games prevents its use on a large scale (Westera, 2008). Furthermore, the requirements for an effective and successful game do not always match the requirements for a proper SE learning task. This paper describes the applied process to elicit the learning and teaching functions (Grosser, 2007) relevant for SE education, focused on its *management* sub-area (according to the Swebok), as well as the identification of game design patterns (Bjork, 2004) that cover those specific functions. The resulting set should promote a more focused and effective design of game-based techniques for teaching SE topics. Validation of results relied on empirical methods, namely surveys and questionnaires to SE teachers and a case study performed with students, using a serious game designed for SE education (Navarro, 2006).

The results presented in this paper come from a second iteration of the presented process, performed to confirm and consolidate the preliminary results obtained in a previous iteration (Letra, 2015). This second iteration allowed the process to be refined in order to eliminate some bias thus improving the results quality, and to evaluate the game experience individually, instead of in pairs.

2. The ABC of Game-Based Software Engineering Management Education

When designing a game for teaching any kind of subject, the main concern should be to, not only keep the learner in a "flow" state (Csikszentmihalyi, 1975), but to meet the cognitive needs and nurture the player's learning. The theoretical statement behind the work presented in this paper can be visualized as a triangle. In one vertex there is the cognitive aspects of learning, on another vertex, there are the game design best practices that create an effective gaming experience and on the other vertex there is the specific knowledge domain to be taught (or learned). Combining and connecting these 3 key aspects should provide a viable framework for developing game-based education solutions for any specific topic. To instantiate with each of these elements, the authors surveyed the literature in search of existing solutions.

2.1. Learning and Teaching Functions

To cope with the cognitive aspects of learning, the authors reviewed the work of Grosser (2007). Based on the contribution of Shuell and Muran (1994), Grosser created a list of 22 learning and teaching functions (LTFs) that cover all the pedagogical scope. In its definition, a *learning function* (*LF*) regards the learner's point of view on how to link new information to prior knowledge, how to organize information, and how to acquire cognitive and meta-cognitive knowledge. A *teaching function* (*TF*) defines the teacher's goal at ensuring the learner has the proper equipment (i.e., using the proper learning functions) in order to engage with the learning material in a meaningful way. Thus, an important TF is to identify and thoroughly analyse those LFs executed by learners, assisting them in acquiring and executing those LFs. LTFs can be grouped in 5 distinct categories (Figure 1).