

Development of a game to support the teaching of Requirements Engineering: The Requirements Island

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Abstract

The Requirements Engineering process has been appointed as the origin of the main failures of software projects. One possible reason for that is because most of the students starts their professional life without the required experience to execute Requirements Engineering tasks. The consequence is the projects cannot reach the customer's expectative and needs, once the application of Requirements Engineering good practices is usually missing. The main goal of this work is to support the teaching of Requirements Engineering in Computer Science courses through an educational game. The game should stimulate the students to review the concepts and understand the execution of tasks related to the Requirements Engineering process. The game background is a playful story, which it shows the consequences of applying or not applying Requirements Engineering tasks to solve problems. The use of a playful background is to offer more ease learning, making this process fun and more natural. We present similar games to evaluate the positive characteristics in order to aggregate value to our game. It is presented the story for the game "The Requirements Island", its rules and its mechanism. We also present the instructional design, showing the relationship between each game challenge and this respective level in Bloom Taxonomy. At last, we discuss the results of two evaluation experiments, where we applied statistical methods to verify the game learning effect and its contribution as a learning tool.

Keywords: Requirements Engineering, educational game, teaching.

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1. Introduction

The Requirements Engineering process is the most critical part of the software development once the quality of the product depends of the quality of its requirements [Ferguson; Lami, 2006]. There is some works saying more than 85% of software problems have its source in the requirements elicitation activity [Fernandes; Machado; Seidman, 2009].

Usually, after three to five years working in the software development area, the professionals realize that the knowledge learned in the Software Engineering discipline is really necessary [Fernandes; Machado; Seidman, 2009]. Before this, software development professionals think topics like Requirements Engineering, Project Management and Software Quality are not relevant because in the begin of their carrier the focus are in technologic knowledge. However, to avoid failures in software development projects it is required to have trained professionals to carry out the requirements elicitation with quality [Fernandes; Machado; Seidman, 2009]. Thus it seems evident the necessity for training professionals in order to allow them to perform the requirements process [Romero; Vizcaíno; Piattini, 2008].

Researches in education suggest the use of games because they can engage students, reinforcing concepts through the practice [El-Shamy, 2008]. The utility of these games is highly coupled to its ability to entertain the students and reflects real world Requirements Engineering activities [Alexander; Beatty, 2008].

This work presents an educational game that was developed to support the teaching of Requirements Engineering in Computer Science graduation courses. This game is used by students as a way for reinforcing concepts and to explore their knowledge, allowing the learning process through a playful game.

2. Related Work

There are few computational games to teach Requirements Engineering. During our research, we found two games: RE_O-POLY and Software Quantum. RE-O-POLY [Smith; Gotel, 2008] is a game based in the popular board game named monopoly and was developed in Pace University of New York. The game main objective is teaching the basic concepts regarding the Requirements Engineering good practices. During the game, the player needs to answer questions regarding Requirements Engineering, which some questions are about general knowledge and others about the application of Requirements Engineering knowledge in a project specific situations. The game board is divided in four parts, it means the four basic stages of the Requirements Engineering process that are: elicitation, analysis and validation, documentation, and changes management.

Software Quantum [Knauss; Schneider; Stapel, 2008] is a simulation game that was developed in the Hannover University. This game was developed to awareness the students the importance of the requirements Engineering, showing that when the Requirements Engineering process is not realized correctly, probably the final result of the project will attends the customers' expectations. Regarding the learning, the game was projected to teach players contents about Requirements Engineering: remember that the requirements must be documented, because this way they have more durability and probably they will not be forgotten; and remember that the requirements must be validated because if they are not it could lead to a wrong interpretation of received information.

3. The developed game

"The Requirements Island" is a game to support the teaching of Requirements Engineering discipline. The game is contextualized in a playful environment, which the goal is to entertain the players, through its story and its characters. During the game, the player will need to carry out a bunch of challenges in order to evaluate the player knowledge about the Requirements Engineering. The main concepts involved in the game are: the requirements process, the requirement analyst role and responsibilities, the requirements classification in functional and non functional, the requirements validation and change management. The game differential when compared with another games are the playful aspects, which makes the game more attractive than others educational games.

The game objective is to help the lead character Jack Reqs to escape from "The Requirements Island", an island inhabited by the cannibal tribes Geeks and Nerds and with a volcano named Big Bug that is about to explode. To complete the adventure, the player will need to solve a set of challenges. Figure 1 presents a screen shot of "The Requirements Island" showing the map of the game, where the player can navigate among the challenges.



Picture 1 - The Requirements Island Game

Each challenge of the game is related to a Requirements Engineering discipline topic. There are seven challenges that are executed in a way to provide the player with an entire pass by all the phases of the Requirements Engineering process. Table 1 presents the description of each challenge.

Nº	Related topic	Description
1	The Requirements Engineering process	The player needs to sort the phases of the Requirements Engineering process.
2	The roles and the responsibilities to the requirements analyst	The player needs to select which activities is responsibility of the Requirements Analyst.
3	Problem analysis	The player needs to distinguish the problem from the solution.
4	Requirements classification	The player needs to classify requirements functional and non functional.
5	Requirements validation	The player needs to present the requirements to the customer and validate them before the construction.
6	The change management process	The player needs to sort the phases of the change management process.
7	Requirements Management	The player needs to select which activities are needed to be done to manage the requirements.

Table 1- Challenges description

To define the learning objectives in the cognitive domain we used the reviewed Bloom taxonomy [Anderson; Krathwohl, 2001] which is subdivided in six areas: Remember, Understand, Apply, Analyze, Evaluate, and Create. These six areas are also classified by Bloom as learning levels, where Remember is the lowest level and Create the higher. The Table 2 presents the topics explored in the game and which level of Bloom Taxonomy each topic is related.

Nº	Requirements Engineering topic	Bloom Taxonomy level
1	Requirements Engineering process	Remember
2	Requirements validation	Remember
3	Requirements Analyst roles	Remember
4	Viability study	Remember
5	Requirements specification	Understand
6	Requirements classification	Understand
7	Verification	Remember
8	Requirements documentation	Understand
9	Requirements Management	Remember

Table 2- Instructional Design

To evaluate the game it was realized two experiments with IT students. The experiments produced quantitative and qualitative results that allow the measurement of how the students learned with the using of the game. The quantitative evaluation was realized through statistics methods using hypothesis tests. It shows that the game have a positive learning effect with 95% level of significance in both experiments.

The qualitative evaluation shows that most of the students liked to play the game and considerate the game relevant for their learning. With the qualitative evaluation it was also possible to check some characteristics that could be improved in future versions. As examples, the difficulty level was appointed by some students as a quite high and some students also asked for more information from the game.

4. Conclusion

This work presented an educational game to support the teaching of Requirements Process and the results of two experiments involving more than 40 students. The experiments demonstrated that games can contribute to improve the leaning of the students. Qualitative research shows that students were highly motivated during the sessions with the games, including the interest in play many times. However, we must avoid the generalization of these results. It is important to evaluate more students in different contexts and professionals from real companies to allow tracing more conclusive analysis.

The use of games with students allowed us to evaluate the possibility of its application in a context professional. Educational games may be applied as a complement to training of professionals, whereas mainly for self-study, a game is much more motivating than one set of traditional exercises or theoretical lessons. In this sense, one of the next steps in this study is to perform experiments with companies that have already accomplished improvement process cycles.

After the development, application and evaluation of game, we realized that playful games could be useful to support the learning process. As a possible future work, we intend evaluate the game in a distance learning environment, where the students could play anytime they want but in a context of a discipline. Considering the evolution of the game, we are studying the use of technologies to improve the graphics and game play. For these new versions, all the instructional design could be reused, as well as the game story and all the textual parts. However, the focus could be the use of more appropriated technologies in the development of digital games, and also in the application of artificial intelligence techniques, making the game more interactive with the player actions. Another work in progress is the development of similar games to different areas from Software Engineering.

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