# RFG: An Interactive Fiction Game to Stimulate Software Requirements Learning

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***Abstract.*** *Software development begins with the elicitation of different types of requirements. Therefore, students must learn elicitation techniques and the types of requirements to carry out this activity. The teaching and learning process has been described as a challenge. Due to this, Game-Based Learning was created to use games to improve the engagement and learning of students. Different kinds of games have been proposed to improve the learning of requirements. In this paper, we describe a text-based interactive fiction game for learning software requirements.*
***Keywords*** *requirements, game-based learning, requirements elicitation*

## 1. Introduction

The success of software systems begins with the identification of stakeholder requirements [Alexander e Stevens 2002]. To achieve this goal, developers must apply the Requirements Elicitation Activity (REA). During this activity, different kinds of techniques can be used to identify requirements, such as interview, observation, questionnaire, doing the task instead of the user, document analysis, and prototype [Alexander e Stevens 2002, Wiegers e Beatty 2013]. The identified requirements must be classified as functional requirements, different types of nonfunctional requirements, restrictions, or business rules [Wiegers e Beatty 2013]. Therefore, students must learn these subjects to effectively execute REA.

Teaching software engineering knowledge and practices has been a challenge due to the lack of student engagement [Ouhbi e Pombo 2020]. Since two objectives of Game-Based Learning (GBL) are to motivate and engage students [Alves e Battaiola 2011], this approach has been used to improve the learning of requirements subjects [Gonçalves et al. 2011, Lemos et al. 2020, Petri e C. Chiavegatti 2015, Monteiro et al. 2022]. However, the use of games to teach requirements subjects needs to be more explored [Santos et al. ]. Moreover, more evidence is necessary to conclude that GBL really improves the learning of Software Engineering knowledge [Souza et al. 2018a].

This paper aims to introduce a text-based interactive fiction game for students to learn what stakeholder means, the types of requirements, and the activities that can be applied to software requirements elicitation.

## 2. Background

The skill of an expert to think about problems and solve them depends on the body of knowledge about the subject matter [Bransford et al. 2004]. This means that requirement

engineers need to have a knowledge of REA to effectively perform this activity. This knowledge encompasses knowing the concept of stakeholders' classes, types of requirements, and techniques that can be used for requirements elicitation.

Game Based Learning (GBL) is a teaching and learning approach based on the use of games [Jan L. Plass e Kinzer 2015]. Games are motivating, increase interest, stimulate the brain [Kober et al. 2020] and can be used to simulate real scenarios [Shaffer et al. 2005]. Therefore, educational games (also known as serious games) are developed to stimulate students to learn and acquire skills [Boyle et al. 2015]. Due to the benefits of GBL, it has also been applied to education in Software Engineering [Kosa et al. 2016, Souza et al. 2018a].

Interactive Fiction (IF) is the current name used for the genre of computer games in which player interaction occurs primarily through text and commands [Monfort 2011, Hausknecht et al. 2020]. This means that the scenery and actions that the players have to do are described in a text. For example, a text can be used to describe what is inside a room and the player can type commands to examine and get things in the room. At first glance, this kind of game may appear to be boring and old-style. However, although text-based games are not as visually appealing as graphic games, these games stimulate more the imagination of the player [Mehta et al. 2010]. Moreover, IF also helps students develop higher-order thinking skills (analysis, evaluation and creation) [Harshitha 2022].

## 3. Related Work

The related works were selected from a literature review. The following search engines were used: IEEE[1], ACM[2], and Google Scholar[3]. Systematic reviews that encompassed the use of games to teach Software Engineering [Caulfield et al. 2012, Kosa et al. 2016, Souza et al. 2018b, Ivan et al. 2020] and REA [Carvalho Rosa et al. 2018] were also analyzed. Only works related to teach REA subjects were selected. The selected works were evaluated according to the following criteria: (1) stimulus to the learning of stakeholder and stakeholder classes concepts, (2) stimulus to the learning of requirements types, (3) stimulus to elicitation techniques learning, (4) stimulus to classify requirements, and (5) support to learn requirements engineering subjects during the game, and (6) scenarios based on software requirements. The evaluation results are shown in Table 1.

CLASSIFIQUI [Monteiro et al. 2022] is a multiplayer digital card game for requirement classification. Students receive a set of requirements and have to use cards to classify them. To play the game, students must first learn the types of requirements. This means that students do not learn about this subject during the game. This game does not deal with other concepts of REA, such as stakeholder classes and requirements elicitation techniques.

The Land of Requirements (Ilha dos Requisitos) [Gonçalves et al. 2011] is another game proposed to teach requirements engineering. This game is based on challenges that the students must overcome. They must specify the correct sequence of requirement engineering activities, select the abilities a requirements analyst must have,

[1]https://ieeexplore.ieee.org/Xplore
[2]https://dl.acm.org
[3]https://scholar.google.com

| Subject | Classifiqui | Land of Requirements | EAReq-Game | AD-RPG | Biyubi | ERQuiz | RFG |
|---|---|---|---|---|---|---|---|
| Stimulus to the learning of stakeholder and classes of stakeholder concepts | N | N | N | N | S | S | S |
| Stimulus to the learning of requirements types | S | S* | N | S* | N | S | S |
| Stimulus to elicitation techniques learning | N | S* | S* | S* | S* | S | S |
| Stimulus to classify requirements | S | S | N | S | N | S | S |
| Support to learn requirements engineering subjects during the game | N | N | N | S | N | N | S |
| Scenarios based on software requirements | S | N | S | N | S | X | S |

*Partially attended.

**Table 1. Related works**

select requirements, and specify the sequence of requirement change activities. The game is not based on software requirements. The requirements are classified as functional and nonfunctional. There is no resource to help the student learn the subjects necessary to complete the challenges.

EAReq-Game [Petri e C. Chiavegatti 2015] is a Role-Playing Game (RPG) created to stimulate students to put into practice concepts of requirements elicitation and analysis. The student has to use the scenario analysis technique for requirements elicitation. Requirements must be identified and classified as mandatory, desirable, or out of scope. This game does not take into consideration the classification of requirements as functional requirements, different types of nonfunctional requirements, restrictions, and business rules. The game also does not include other types of requirements elicitation techniques. Moreover, there is no resource for the student to learn about the topics that are approached during the game.

Ad-RPG [Lemos et al. 2020] was also developed to support teaching and learning of software requirements elicitation. The first mission is to read a receipt book and identify the actions necessary to prepare a secret receipt. In other words, the student has to use the document analysts technique do elicit the functional and nonfunctional requirements necessary do prepare the receipt. The second phase consists of using the interview technique to find out the requirements of a blacksmith to shape a sword. The student has to select a set of questions to ask a NPC (non-player character) and write the requirements in a notebook. The game have resources to the student learn about requirements. According to the authors, the requirements are automatically evaluated. The game do not encompasses other types of RE techniques. Moreover, it is not clear if nonfunctional requirements are classified in a more detailed fashion. Finally, the game is not based on software requirements.

Biyubi [van Garcia et al. 2019] is a game proposed to complement traditional

teaching to facilitate learning of requirements elicitation. The game simulates a library scenario. The student needs to observe and interact with the NPCs through interviews to identify stakeholders and their requirements. Therefore, the student has the opportunity to explore the interview and observation techniques. Moreover, the student also practices the creation of a software requirements list. The game stimulates the student to assess quality attributes for the software requirements. The requirements list is sent to the professor for evaluation and feedback. However, the learning of requirements types, other kinds of REA techniques and requirements classification are not addressed in the game. The is no support for learning REA subjects during the game.

ERQuiz [Sarinho et al. 2021] is a mobile game based on instant messaging sent by a chatbot. The objective is to provide a competitive environment in which students have to answer questions about requirements engineering. The game has three models. The first mode is called *Play by Time*. If the student selects this mode, he/she has 5 minutes to answer as many questions as possible. The second mode is called *Best of 5*. In this mode, the student has to answer 5 questions to check his/her knowledge. Finally, the third mode is *Can't Miss*. In this mode, the game lasts as long as the student answers the questions correctly. The learning process of this game is based on trial and error since the student has to know the subjects to make correct answers. Moreover, the game does not have the objective of immersing the student in a real scenario.

## 4. The Game

The Requirements Fiction Game (RFG) (Figure 1) is an IF. This game was created in Inform7 [Reed 2010], which allows the implementation of an IF using natural language. The objective of RFG is to stimulate the learning of requirements elicitation subjects. The contents addressed in the game are: stakeholder definition, types of requirements, elicitation techniques, and requirements classification. The following elicitation techniques are considered: interview, observation, doing the task instead of the user, document analysis, questionnaire, and prototype. The type of software requirements addressed are functional requirement, non-functional requirements (security, usability, performance, reliability, and availability), and business rules.

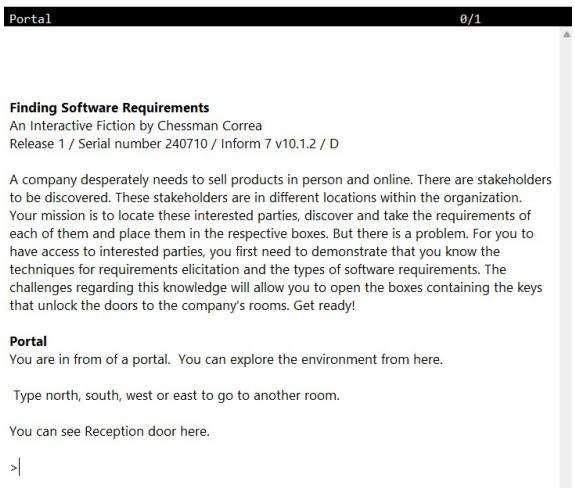


**Figure 1. The Requirements Fiction Game (RFG)**

The game scenario is a company that needs to control face-to-face and online sales. This company has the following classes of stakeholders: owner, manager, salesman, and cashier. The company has different rooms, and the stakeholders are inside them. These rooms also have *requirements objects* that represent different types of requirements. The doors to the rooms are closed, and the student needs to find the keys to open them. These keys are inside closed chests spread out around other rooms.

The game begins with the Requirements Engineer (the student) in front of a portal. From there, the student can go to the *Requirements Room*. This room has seven chests. Each chest represents a type of requirement. There is also a table in this room. On the table there is a special book called *Book of Requirements*. This book has explanations about stakeholders, the types of requirements, and elicitation techniques. The student can put the book in the inventory.

From the *Requirements Room*, the student needs to go to other rooms and look for locked chests that contain the keys to the locked doors. The student has to correctly answer a question related to REA to unlock a chest. The student can use the *Book of Requirements* to learn about the question's subject, if necessary. After unlocking the chest, the key must be taken and put in the inventory. Therefore, the student can go to the company and unlock the doors. After unlocking a door, the student needs to go into the room and to talk to the stakeholder inside it to find out his/her requirements. According to the conversation, the student must take all requirements objects he/she thinks are the correct ones and put them in the inventory. After that, the student has to go back to the *Requirements Room* and put the requirements objects in the correct chests. The game ends when the students put all the requirements objects collected in the chests.

Each correct answer is worth 50 points. If the student gives an incorrect answer, the next attempt will be 10 points less. Each correct requirement object selected is worth 100 points. Each incorrect requirement object select results in a 50-point loss. Each correct requirement object not selected also results in 50-point loss. Each requirement object put inside the correct chest is also worth 100 points.

## 5. Conclusion

The GBL has been proposed to motivate and engage students to learn concepts and acquire skills. Due to these benefits, we propose an interactive fiction and text-based game to stimulate the learning of elicitation techniques and types of requirements. The scenario mixes fiction and reality simulation. Therefore, students can learn REA concepts in a context that remembers a real requirements specification scenario.

It is important to mention that the game is not intended to make students have fun, but rather to stimulate the learning of the subjects addressed in the game. Students can gain some skill about REA, but it is not an objective of the game. The idea is to make students acquire REA knowledge so they can put them into practice more easily when executing this activity.

The next step of this work is to evaluate the game. The objective of the evaluation will be to verify if a text-based game helps students to learn more about requirements elicitation. We also intend to compare this text-based game with a graphic based-version to find evidences about which one is better for requirements elicitation learning. Another future work is to encompass software requirements engineering in a more detailed fashion.

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