# ERQuiz: A Multiplayer Multiplatform Instant Messaging Game for the Competitive Assessment of Requirements Engineering Knowledge

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***Abstract*—Educational games work with the interaction of virtual educational elements, capable of attracting and bringing the student attention to learning different subjects. ERQuiz is a multiplayer multiplatform digital quiz based on instant messaging resources that seeks the competitive assessment of Requirements Engineering (ER) knowledge. This paper presents the obtained results with the ERQuiz game, describing the configuration pattern for the proposed questions, the developed game mode approaches as well as the final results with the game usage. As a result, a fast and easy-to-use platform for assessing ER knowledge has been obtained, which can be quickly extended to work with different disciplines covered by software engineering classes.**

***Keywords*-software engineering; requirement engineering; education; digital games; chatbots**

## I. Introduction

The digital game use in teaching activities lies in their ability of entertain the students, to express real world activities to be executed, and to be simple to play and understand [1]. In general, these are well-planned play activities that are able to provide a greater openess to dealing with the new, unexpected and real-world difficulties, which is quite common in many software projects [2].

Digital games have been gaining space in Software Engineering (SE) teaching [3], providing an interaction with virtual educational elements capable of attracting and directing their players attention to form better software engineers [4]. However, still exists a large deficit of digital games aimed to this area [3], since SE disciplines do not usually applies learning systems in the SE teaching process [5].

Digital games for SE teaching are mostly associated with simulation games, representing development environments of software projects inside a previous established budget, deadline and scope [5]. As a result, it is understood that the presented SE games cover only part of the contents proposal of the discipline, leaving aside unequal items that are also part of the subject [5].

Regarding Requirements Engineering (RE), researches points that 85% of software development problems originate in the requirements elicitation activity [6]. The Project Management Institute (PMI) also highlights that 47% of the developed software projects fail because of problems associated with the RE process applied [7].

As a result, RE has a big importance stage for the software development, where the final product quality strongly depends of the elicited requirements quality [8]. In this sense, it is fundamental to train professionals in the ER process, capable of performing such activity with quality, seeking to avoid future failures in software development projects [6].

In this field of RE and digital games importance for SE, this article presents ERQuiz, a multiplayer and multiplatform quiz digital game based on Instant Messaging (IM) that seeks to provide a competitive evaluation of RE knowledge. It is a chatbot [9] that offers a gamified solution of RE teaching support, in a fast access and easy-to-use platform that seeks to expand the range of digital gaming options in the RE teaching to beyond of the environment simulation games available for SE.

## II. Related Work

For game quizzes developed for computer teaching, LectureQuiz [10] is a multiplayer game that presents questions from Software Architecture subject topic, which can be answered by the players via computer of a mobile phone. The game Age of Computers [11] allows the player to live the computer history through the solution of different types of problems focused in the computational fundamentals teaching. Finally, PMQuiz [12] presents a web based quiz game in the Kahoot platform developed to review and reinforce knowledge in software project management, where the player must answer to each presented question inside the limited time in multiplayer sections.

## III. Methodology

### A. Modeling

Regarding the ERQuiz game, three different game styles have been modeled to execute designed RE questions from the literature, where the player can choose between **Play by Time**, **Best of 5** and **Can't Miss**. In the **Play by Time** mode, the player has 5 minutes to hit at least two possible

questions, in the **Best of 5**, the player checks his knowledge in a 5 questions short game.

Both **Can't Miss** and **Play by Time** have a help system with he possibility of jump questions or eliminate answer options of a presented question. They also allow the player to put the score in the "Hall of Fame" from the game, if the player obtains in the match a score capable of putting his name in the ranking.

For multiplayer game modes, they can be real time (**Play by Time**) and turn-based (**Best of 5**). In the **Play by Time**, the first to correctly answer two questions wins the game and tells the other players that he is the winner. Already in **Best of 5** mode, each player waits his turn to make the current move. If the player takes more than 1 minute to respond, it loses the turn, and the system registers as a wrong answer to him.

In both game modes, when the player hits/misses a question, he will advise the other opponents to indicate if it is close to the condition of victory or defeat in the game. In this way, it creates a context of competitiveness among the players, thus increasing immersion and the possibilities of fun with it.

### B. Construction

Due the simplicity and applicability of quiz games in different contexts, there are a number of frameworks and tools capable of provide and evaluate educational quiz games in an automatic and configurable way [13]. For the ERQuiz game, the AsKMME production environment was used [14], which is a multiplayer derivation of the AsKME Software Product Line (SPL) that allows the rapid configuration and production of multiplatform quiz games [15].

Through AsKMME, there is a quick reuse of configured single player and multiplayer game modes, automatically managing the game event flow, as well as presenting randomly configured questions. AsKMME also controls the player interactions in choosing the answers options presented, transmitting to the other opposing players the obtained results during the match, and continuously checking whether the conditions of victory or defeat have been achieved.

To the game modes configurations and the presented questions, it was used the JSON model proposed by AsKME [15] (and reused by AsKMME), which describes the game mode identification text (*gamePlayMenuOption* and *gamePlayMenuText*), the messages and events to be handled during a match (*initialMessage*, *winnerEndMessage*, *conditionsToWin*, etc.), data for punctuation control, help system to be applied (*playerHelps*, *numberOfCorrectAnswersToWinAHelp*, etc.), and questions to be answered. Because the questions are fixed, varying only in the answers order presented to the player, they are represented by the properties *questionText*, *answer*, *option1*, *option2* and so on [15].

Regarding the representation of multiplayer game modes, they will be added to the **Play by Time** mode: *gameStyles* settings for *real-time* matches; multiplayer messages for correct response (*correctMessage*), wrong answer (*errorMessage*) and win (*winnerEndMessage*) events; and the *performedByEvent* code putting all players to status "*dead*" after a player wins.

For the **Best of 5** mode, the following will be added: *gameStyles* configurations for *turn-based* matches; multiplayer messages for a question error (*errorMessage*) and defeat (*loserEndMessage*) events; and *performedByEvent* code indicating the next player of the turn (*turnClient*) after getting a correct or wrong answer from the current player, and putting the current player to status "*dead*" after completing all 5 proposed questions.

### C. Application

For the purpose of verifying the produced digital game, it was used in the classroom with undergraduate and master's students in Software Engineering disciplines (Figure 1). In these activities, students were invited to try out the ERQuiz single player and multiplayer modes available. The average time of the game application was approximately 20 minutes, which was done after the completion of the Requirements Engineering class.

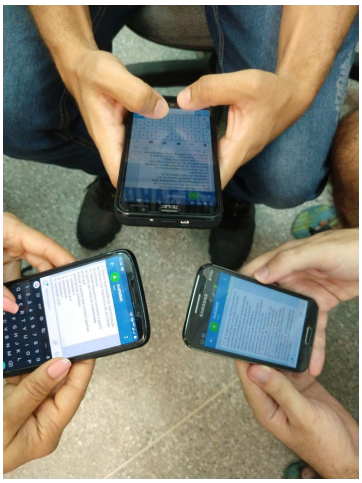


Figure 1. Multiplayer match execution of ERQuiz game with master students in Software Engineering subject.

For validation purposes of the digital game, a usability questionnaire was also applied [16] in each evaluated class. It is a questionnaire that is concerned with evaluating how satisfactory was the user experience in use the proposed game. For this, 30 questions were applied, with answers comprehended on a scale of 1 to 7, were 1 means strongly disagreeing and 7 means strongly agreeing, referring to utility (questions 1 to 8), easy of use (questions 9 to 19), easy to learn (questions 20 to 23) and satisfaction (questions 24 to 30) of the investigated software.

## IV. Results and Discussions

Regarding the final game produced, Figure 2 illustrates the a ERQuiz match execution in a active version that can be found at https://t.me/AsKMMEBot address for use via IM Telegram platform. It is a version hosted in a free cloud that receives redirects from Telegram via configured *webhooks*.

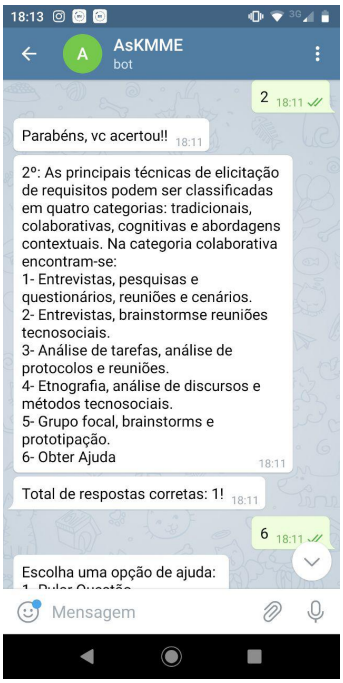
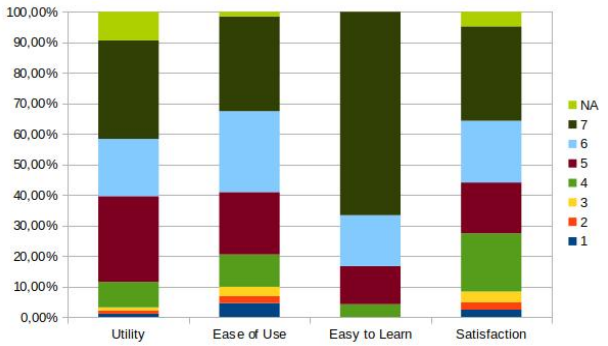



Figure 2. ERQuiz game available at Telegram platform.

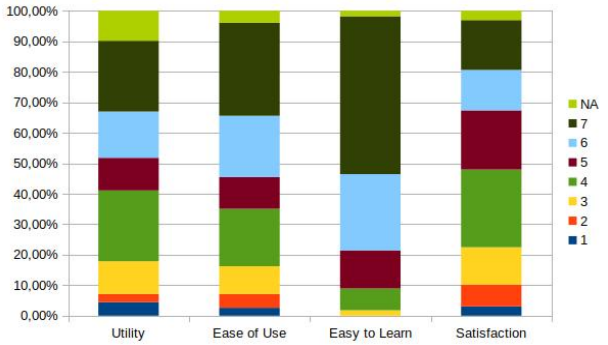
About the usability questionnaires, these were collected in the 2 groups that used the ERQuiz game, where the first group was formed by 12 students of Computer Engineering graduation class, and the second group formed by 14 Computer Science master degree students. The results of the answers were distributed horizontally and vertically based on the percentage of the answers obtained by the groups analyzed according to the usability categories evaluated by the questionnaire (Figure 3). Answers considered to be invalid, unmarked, with more than one mark, or misspelled were indicated as Not Applicable (NA) (Figure 3).

As a result, in both classes it is possible to observe the great majority of the answers agreeing with the utility, ease of use, easy to learn and satisfaction presented by the developed digital game. In the undergraduate class, the best results obtained are in the following order: 1) easy to learn; 2) utility; 3) ease of use; and 4) satisfaction. In the masters class, the best results were: 1) easy to learn; 2) ease of use; 3) utility; and 4) satisfaction.

Both classes agreed about the easy learning of the tool, and both classes faced problems in the execution of the game multiplayer matches due to limitations of real-time execution caused by hosting the game on a free server. As a result, both classes scored worse for game satisfaction, with emphasis on the masters class, which is made up of more experienced students who questioned the simplicity of the IM interface and the presented connection *bugs*. The graduation group also presented a more positive result for the utility question when compared to the result obtained in the master students class, something justified by the inexperience and their first contact with concepts of RE presented in the discipline.




(a) Graduation students evaluation.




(b) Master students evaluation.

Figure 3. Percentages of answers obtained by category of usability in each evaluated class.

Positive points, negative points and general suggestions for the system were also collected by the usability questionnaire, providing a qualitative analysis of the developed digital game. Among the positive are: “facilitates and flexible learning”, “very instructive”, “easy to use”, “exercise knowledge”, “work the mind” and “playful learning”. Among the negative, are: “short time for responses”, “repetition of questions”, “text interface is not pleasant”, “long texts of questions”, “connection failures” and “few questions”.

As a result, recognition of the importance, coverage of issues, and ease of use of the game for playful and entertaining learning of RE is noticeable in the collected responses. However, it is also clear that: a) are problems and *bugs* due to the use of the free server in the cloud; b) it needs to increase the number of questions as well as to simplify question texts; and c) it needs to improve the

control interface as well as its organization in the display of asynchronous messages received in response to the actions of the player in the game.

## V. Conclusions and Future Work

This article presented ERQuiz, a multiplayer multiplatform digital quiz style game that applies IM features in the competitive assessment of RE knowledge. It is a fast and easy-to-use platform that follows the worldwide advance in the use of IM for communication between people as well as the current demand in the production of digital games for teaching SE and RE.

In fact, with the resumption of large-scale use of IM technologies in recent years, there has been a opportunity for the development of dedicated chatbots for a variety of purposes, including IM educational games. Thus, ERQuiz presents itself as a differentiated solution of high availability in supporting the competitive evaluation of RE concepts, relying on a Product Line architecture capable of being used both in dedicated environments (Arduino, console, mobile, web) as in various IM based platforms (WhatsApp, Telegram, Facebook Messenger, among others).

Regarding to the final game produced, the execution of configured game question and game modes for the competitive evaluation of RE was successfully obtained. However, despite the possibility of applying other multimedia resources to the presented questions, it was decided to work initially with textual content in the questions, which proved to be well applicable to the asynchronous IM environment.

The ease of learning and use confirmed by students also shows that the game follows the standard of simplicity employed in IM applications. However, because of this simplicity that the game has the greatest user experience dissatisfaction, since multimedia features available on certain IM platforms have not been exploited.

As future work, it is intended to simplify the current questions available for use, to elaborate more questions for both RE and other SE subjects, and to explore the other multimedia resources available in the current IM platforms. Important activities such as the correction of connection failures and other bugs identified in the current version, the insertion of the cooperative game mode as well as the application in different SE classes will also be carried out in the near future.

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