An Educational Evaluation of Games for Requirements Engineering Learning: A Rapid Review

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***Abstract. Introduction**: Requirements engineers must combine technical and interpersonal skills to elicit, analyze, and manage software requirements. Consequently, students need opportunities to develop both conceptual knowledge and practical competencies in Requirements Engineering (RE). However, maintaining student motivation and engagement during learning activities remains a challenge, and Game-Based Learning has been explored to create more engaging learning environments. **Objective**: The objective of this study was to investigate how educational games have been designed to support RE learning. **Method**: A rapid review with snowballing was conducted to identify studies on games for RE learning. **Results**: Most games focus primarily on requirements elicitation and employ a limited set of learning techniques. These findings highlight opportunities for designing more comprehensive educational games that support a broader range of RE concepts and skills.*

***Keywords** Requirements Engineering, GBL, serious games*

1. Introduction

Requirements Engineering (RE) is taught to prepare students to deal with software requirements. RE involves both technical competencies and soft skills [SWEBOK 2024]. Technical competencies include activities to effectively elicit, analyze, specify, validate, and manage software requirements. Soft skills involve abilities such as communication, negotiation, and collaboration.

An important challenge in education is maintaining student motivation and engagement while they practice learning activities. To address this challenge, Game-Based Learning (GBL) has gained increasing attention [Plass et al. 2019]. GBL leverages the motivational and engaging nature of games to support the learning process. Given these advantages, GBL has been used to support learning across multiple knowledge domains, including Computer Science [Battistella and Wangenheim 2016], Software Engineering [Kosa et al. 2016], and Requirements Engineering [Daun et al. 2022].

In RE education, games enable students to engage in simulated project scenarios where they can practice RE activities. Such environments allow learners to experience realistic development situations without real-world consequences. As a result, educational games can support the development of higher-order cognitive skills, such as analysis, evaluation, and problem solving, rather than focusing solely on memorization tasks [Freitas and Levene 2004, An and Cao 2016]. Furthermore, these games are particularly effective in fostering soft skills relevant to RE [Daun et al. 2022].

Previous reviews have focused mainly on the technical design of educational games for software engineering [Javed et al. 2022, Daun et al. 2022, De Almeida Souza et al. 2017, Castro et al. 2020]. However, few studies analyze these games from an educational perspective, considering cognitive levels, learning objectives, and assessment strategies [Caulfield et al. 2011, Kharbouch et al. 2025].

This study employed a Rapid Review (RR) methodology [Cartaxo et al. 2020] to evaluate the educational aspects of games used for RE education. The RR had the following objectives: (1) identify the RE topics addressed and practiced; (2) evaluate the scope of RE topics covered by the studies; (3) identify the interpersonal skills addressed; (4) investigate knowledge transmission; (5) examine the explicit use of learning objectives based on Bloom's taxonomy; (6) verify the types of assessments and the implementation of actions to improve learning; and (7) identify the approaches to developing educational games. Therefore, this study contributes by systematically analyzing how educational games address RE knowledge and by identifying research gaps and opportunities.

The remainder of this paper is organized as follows: Section 2 presents background information on objectives and assessments. Section 3 describes the Rapid Review methodology. Section 4 discusses the results. Section 5 presents the threats to validity. Finally, Section 6 presents the conclusions.

2. Background

The teaching process involves planning, implementing learning activities, assessing students' performance, and providing feedback that helps learners understand their mistakes and improve their learning. During the planning of a course, instructors must define students' learning objectives. These objectives describe the knowledge, skills, and competencies that learners are expected to acquire and serve as a reference for designing learning and assessment activities. Based on the results of these assessments, instructors should provide feedback aligned with the learning objectives, helping students understand their performance and identify areas for improvement.

One of the most widely used frameworks for structuring learning objectives is Bloom's Taxonomy [Anderson et al. 2001]. It provides a hierarchical classification of cognitive processes involved in learning. The revised version of the taxonomy has the following categories [Anderson et al. 2001]: remember, understand, apply, analyze, evaluate, and create. The *remember* level involves recalling previously learned information, while *understand* requires interpreting or explaining concepts. At the *apply* level, learners use knowledge to solve problems or perform tasks in specific contexts. The *analyze* level requires breaking information into components and identifying relationships among them. At higher levels, *evaluate* involves judging the quality of ideas or solutions based on criteria, and *create* involves generating new artifacts, models, or solutions.

Assessment plays a central role in the teaching and learning process, as it provides evidence of student learning and guides instructional decisions. Among the most commonly recognized types of assessment are diagnostic, formative, and summative [Brookhart and McMillan 2019]. *Diagnostic assessment* is conducted before or at the beginning of a learning activity with the purpose of identifying the learner's prior knowledge, skills, and misconceptions. This type of assessment allows instructors to understand the learner's initial knowledge state and adapt instruction accordingly. *Formative assessment* occurs during the learning process and aims to support learning by providing feedback that helps learners improve their performance. *Summative assessment* is conducted at the end of a learning activity, module, or course to evaluate whether the intended learning objectives have been achieved. It typically results in a score or grade that represents the learner's overall performance.

Game-Based Learning (GBL) environments offer unique opportunities to integrate learning objectives and assessment mechanisms directly into gameplay [Plass et al. 2019]. Within such environments, learning activities can be designed to address different cognitive levels of Bloom's Taxonomy. Early stages of a game may focus on remembering and understanding concepts, while more advanced stages may require players to apply, analyze, evaluate, or create solutions in complex scenarios.

Furthermore, educational games allow multiple forms of assessment to be integrated into gameplay [Ifenthaler and Eseryel 2012]. Diagnostic assessment can determine whether players possess the knowledge required to start a game or access a specific level, enabling the personalization of the learning experience. Formative assessment can be embedded in gameplay to provide feedback that helps students refine their understanding and improve performance. Summative assessment may occur at the end of levels, missions, or gameplay sessions to verify whether players have achieved the learning objectives required to progress to more advanced challenges.

3. Methodology

A *rapid review* (RR) [Cartaxo et al. 2020] was conducted to identify and evaluate studies related to the use of educational games for teaching and learning RE. Unlike ad hoc literature reviews, RRs adopt a subset of the structured procedures used in systematic reviews for identifying and analyzing primary studies.

To ensure a more comprehensive set of studies, the *backward snowballing* technique [Wohlin 2014] was also applied. This technique consists of an iterative process for identifying additional studies. In the first iteration, studies are retrieved from digital libraries and search engines. From the second iteration onwards, new studies are identified by examining the reference lists of the articles selected in the previous iteration. This process continues until no additional relevant studies can be identified from the references of the selected papers.

3.1. Research Questions

Based on the objectives presented in the Introduction chapter, the following research questions (RQs) were formulated:

- RQ1. Which RE topics were covered and practiced?

- RQ2. What was the scope of topics covered in the games?
- RQ3. Which interpersonal skills were addressed?
- RQ4. Was the game used for content transmission?
- RQ5. Were Bloom's Taxonomy and learning objectives formally used?
- RQ6. How were assessments applied to evaluate learning?
- RQ7. What actions were applied to improve learning during gameplay?
- RQ8. Which approaches to educational game development were used?

3.2. Search Strategy

As the snowballing approach was employed, the rapid review was not restricted to a specific publication time frame.

The search was conducted based on the following topics and keywords:

- **Requirements Engineering**: "requirements engineering", "requirements elicitation", "requirements analysis", "requirements specification", "requirements validation", "requirements verification", "requirements management".
- **Education/Learning**: "education", "learning", "teaching", "training", "computer science education", "software engineering education".
- **Games**: "game", "games", "serious game", "serious games", "role-playing game", "rpg", "simulation game".

The search considered articles published internationally and nationally. The search for articles from an international forum for the first iteration was conducted using the following search string:

("requirements engineering" OR "requirements elicitation" OR "requirements analysis" OR "requirements specification" OR "requirements validation" OR "requirements verification" OR "requirements management") AND
("education" OR "learning" OR "teaching" OR "training" OR "computer science education" OR "software engineering education") AND
("game" OR "games" OR "serious game" OR "serious games" OR "role-playing game" OR "rpg" OR "simulation game")

The search for articles from a national forum for the first iteration was conducted using the following search string:

("engenharia de requisitos" OR "explicitação de requisitos" OR "especificação de requisitos" OR "documentação de requisitos" OR "análise de requisitos" OR "validação de requisitos" OR "verificação de requisitos" OR "gerenciamento de requisitos") AND
("educação" OR "ensino" OR "aprendizado" OR "treinamento" OR "educação em ciência da computação" OR "educação em engenharia de software") AND
("jogo" OR "jogos" OR "jogo sério" OR "jogos sérios" OR "role-playing game" OR "RPG" OR "jogo de simulação" OR "simulação")

The search for international articles was conducted in the Scopus (www.scopus.com) and IEEE (https://ieeexplore.ieee.org/) databases. The search for national articles was carried out on the CAPES periodicals portal (https://www-periodicos-capes-gov-br.ez29.periodicos.capes.gov.br/).

3.3. Inclusion Criteria

The following inclusion criteria were used:

- The paper must be published in the proceedings of a scientific event or published in a scientific journal.
- The paper must be freely accessible for reading.
- The paper must be a primary study.
- The paper must address an educational game.
- The paper must be directed towards the academic field.
- The paper must be exclusively related to the Requirements Engineering.

3.4. Exclusion Criteria

The following exclusion criteria were used:

- The paper deals with a game discussed in another already selected article.
- The paper addresses the comparison of other studies.
- The paper addresses gamification and not a game.

4. Results and Discussion

The snowballing process was completed in three iterations. In the first iteration, 223 articles were retrieved from Scopus, 124 from IEEE Xplore, and 42 from the CAPES portal. After applying the inclusion and exclusion criteria, 24 articles remained. The second and third iterations resulted in the identification of 5 and 1 additional articles, respectively, resulting in a total of 30 selected studies. It is important to note that the references identified in the articles from the second and third iterations that met the inclusion criteria had already been identified during the first iteration. The final set of selected studies is presented in Table 1. For each selected study, information relevant to each research question was manually extracted and synthesized.

4.1. RQ1 - Which RE topics were covered and practiced?

RE knowledge was addressed in 13 studies (43.3%). The knowledge covered includes RE in general (27 and 29), unambiguous requirements (3 and 4), structure of user stories (10 and 24), use case and class diagram (14), importance of RE (16 and 17), requirements classification (18, 19, 28, and 30), requirements activities (19), the responsibilities of the requirements analyst (19), and elicitation techniques (25).

The practical aspects mainly involved performing RE activities and applying requirements elicitation techniques. The activities addressed in the games are shown in Figure 1. As can be observed, requirements elicitation is the most frequently addressed activity, appearing in 18 studies (60%) (studies 1, 2, 5-9, 11-13, 15, 20-23, 26, 28, and 30). Requirements specification was present in studies 2, 6, 7, 8, 11, and 20 (20%). Requirements management was considered in 8, 9, 14, and 19 (13.3%). Verification and validation were considered in studies 7 and 19 (6.6%). It is worth noting that, in reality, only validation was considered. No verification tasks were identified. Negotiation was explicitly addressed only in study 7 (3.3%). Finally, although requirements analysis is an important activity for defining system requirements, this activity was considered only in study 2 (3.3%).

N.	Game	Paper
1	Wonderland of Mistery	[Pacheco et al. 2025]
2	Reqengin	[García et al. 2020]
3	Laura	[Parrales-Bravo et al. 2025]
4	DEAR	[Parrales-Bravo et al. 2024]
5	Game based on no Tic-Tac-Toe)	[Yasin et al. 2024]
6	Bara	[Liu et al. 2023]
7	Cubicle Conundrums	[Hainey et al. 2023]
8	Translation Loss	[Vilela and Lopes 2020]
9	No Name	[Ibrahim et al. 2019]
10	BakeRE	[Delen et al. 2019]
11	Biyubi	[Garcia et al. 2019]
12	UniRE	[Lima et al. 2012]
13	Earth Defense	[Rusu et al. 2011]
14	Communication and Traceability Game	[Zapata 2010]
15	TREG	[Vega et al. 2009]
16	Software Quantun	[Knauss et al. 2008]
17	Re-O-Poly	[Smith and Gotel 2008]
18	Classifiqui	[Monteiro et al. 2022]
19	The Requirements Island	[Thiry and Marcello 2010]
20	Sem nome	[Hainey et al. 2011]
21	EAReq	[Petri and C. Chiavegatti 2015]
22	LevReq3D	[Carvalho Rosa et al. 2021]
23	AD-RPG	[Lemos et al. 2020]
24	Mike, Help me	[Venâncio and Benitti 2023]
25	Element	[Vieira and Barbosa 2011]
26	Modelando	[Silva et al. 2012]
27	ERQuiz	[Sarinho et al. 2019]
28	EvacSIM	[Debacher et al. 2023]
29	Copilot doesn't know so much	[Ayora et al. 2025]
30	No name	[Ernst and Chapin 2005]

Table 1. Studies selected

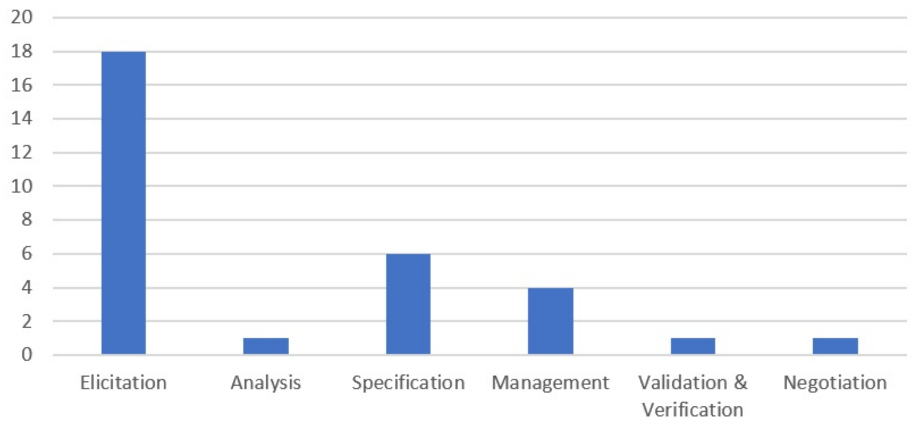

Figure 1. Requirements engineering activities

The frequency of each requirements elicitation technique is shown in Figure 2. The interview technique was addressed in 40% of the studies (1, 2, 6, 8, 11, 12, 13, 22, 23, 25, 28, and 30). The brainstorming technique was considered in studies 5, 7, and 25 (10%), observation in studies 5 and 7 (6.6%), the workshop in study 15 (3.3%), and document analysis in studies 2, 9, 11, and 23 (13.3%). These results indicate that other elicitation techniques besides interviews could be further explored in educational games. Furthermore, other techniques were not addressed, such as the use of questionnaires, performing users' tasks, prototyping, and having stakeholders make presentations about their needs. Therefore, opportunities remain to develop games that address these techniques.

It is worth noting that, despite the importance of use cases for representing system functional requirements, this topic was addressed only in study 2 (3.3%). Furthermore, use case diagrams can be used to represent the functionalities of a system, while class diagrams can be used to represent data requirements. However, use case diagrams were addressed in only three studies (2, 14, and 26) (10%), and class diagrams were addressed in only two studies (14 and 26) (6.6%).

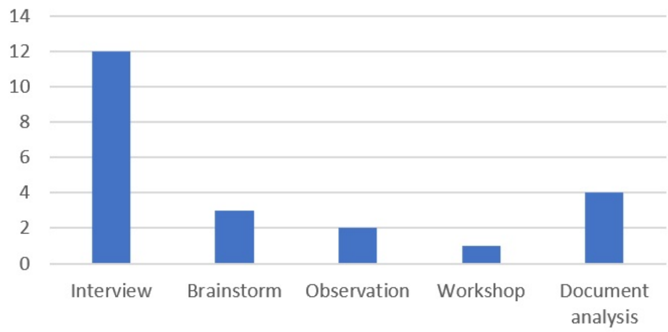

Figure 2. Requirements elicitation and analysis techniques

4.2. RQ2 - What was the scope of topics covered in the games?

An important aspect when using games for teaching RE is the scope of topics addressed. Games with a narrow focus require multiple games to cover the different RE topics. This situation increases the effort required for planning and preparation by instructors. Moreover, the use of different technologies may further complicate the preparation of the environment for students to play the games.

To answer RQ2, three aspects were considered: (1) the number of RE activities covered by the game, (2) the number of RE topic groups addressed, and (3) the flexibility of the game to broadly cover RE topics.

Based on these criteria, 24 studies (1, 3–5, 8–25, 28, and 30) (80%) were classified as specific, while 6 studies (2, 6, 7, 26, 27, and 29) (20%) were classified as comprehensive. Studies 26, 27, and 29 were classified as comprehensive because they are quiz-based games (i.e., question-and-answer games), which allow the creation of questions covering any RE subject. Studies 6 and 7 addressed at least three RE activities and their respective techniques. Study 2 was identified as the most comprehensive, enabling players to experience different RE activities and techniques.

4.3. RQ3 - Which interpersonal skills were addressed?

The execution of activities and the application of RE techniques require several interpersonal (*soft*) skills from requirements analysts, including empathy, communication, conflict resolution, moderation, self-confidence, and persuasion [Pohl and Rupp 2015].

To answer RQ3, the presence of these interpersonal skills in the analyzed studies was examined. Communication with stakeholders was considered in studies 8, 11, 14, 20, and 28 (16.6%). Conflict resolution was addressed only in study 7 (3.3%), while teamwork within the context of a project was considered in study 20 (3.3%). The interpersonal skills of empathy, moderation, self-confidence, and persuasion were not addressed in the analyzed studies.

These results indicate that interpersonal skills remain largely underexplored in games designed for RE learning. Most of the analyzed games focus primarily on technical aspects of RE, with limited support for the development of social and collaborative competencies that are essential for requirements analysts in real-world settings.

4.4. RQ4 - Was the game used for content transmission?

In the teaching–learning process, instructional activities aim to transmit knowledge and skills to students. Therefore, to answer RQ4, we examined whether the analyzed games included any mechanism for transmitting RE knowledge to students.

Content transmission was identified in only 33% of the games (2, 6, 10, 11, 15, 17, 23, 24, 28, and 30). This result is consistent with the instructional purpose of most of the analyzed games, which were primarily designed to reinforce knowledge previously taught, typically in classroom settings. In these cases, the games present limited instructional content and focus mainly on supporting practice and consolidation of knowledge rather than introducing new subjects. When present, the transmitted content is usually specific and directly related to the tasks that students must perform during the game.

4.5. RQ5 - Were Bloom's Taxonomy and learning objectives formally used?

Learning through games should be guided by clearly defined learning objectives and should consider different cognitive process domains to provide students with a comprehensive learning experience. In addition, considering these cognitive domains supports the selection of appropriate approaches for assessing learning outcomes.

To answer RQ5, explicit learning objectives were identified in studies 1, 9, 10, 11, 19, and 21 (20%). Bloom's Taxonomy was explicitly considered only in studies 10 and 19 (6.6%). These results suggest that the systematic definition of learning objectives and the use of educational frameworks such as Bloom's Taxonomy remain limited in the design of games for RE learning.

Explicitly defining the learning objectives of a game is essential, as it enables instructors to more easily select appropriate games when planning instructional activities and aligning them with the intended learning outcomes.

4.6. RQ6 - How were assessments applied to evaluate learning?

The terms diagnostic, formative, and summative assessment were rarely explicitly mentioned in the analyzed studies. Therefore, to answer RQ6, the articles were examined to identify actions or mechanisms consistent with these assessment types. Diagnostic assessment was considered when activities aimed to identify the player's prior knowledge before starting the game or a mission. Formative assessment was identified when evaluation activities occurred during gameplay to provide feedback and support the learning process. Summative assessment was considered when evaluation activities occurred at the end of a mission or game session to determine whether the intended learning objectives had been achieved.

Diagnostic assessment was identified in studies 10 and 26 (6.6%). Formative assessment was identified in 13 studies (2, 3, 4, 7, 14, 15, 17, 20, 21, 24, 26, 28, and 30) (43.3%). Summative assessment was found in 19 studies (1, 2, 3, 4, 8, 9, 10, 11, 12, 13, 14, 15, 16, 21, 25, 26, 27, 28, and 30) (63.3%).

These results indicate that the reviewed games still show a predominance of actions more aligned with summative assessment. In addition, the limited use of actions corresponding to diagnostic assessment suggests that they could be further explored, either to better prepare students for the game's learning activities or to adapt the game to students' knowledge and skills.

4.7. RQ7. What actions were applied to improve learning during gameplay?

In a teaching and learning process, it is essential to use mechanisms that allow students to learn from their mistakes. To answer RQ7, the studies were analyzed to identify actions implemented to support students' learning improvement. Two types of actions were identified: formative feedback, which explains the errors made by the students, and task repetition. Formative feedback was found in 23.3% of the studies (2, 4, 5, 10, 15, 23, and 24), while task repetition was identified in 23.3% of the studies (2, 3, 7, 14, 20, 21, and 26).

These results indicate that mechanisms aimed at improving students' learning still need to receive greater attention in the design of educational games.

4.8. RQ8 - Which approaches to educational game development were used?

To answer RQ8, we investigated whether the analyzed games were developed using a specific framework or methodology for educational game design. Games developed following such approaches were identified in studies 1, 3, and 23 (10%). In study 1, the authors used the LM-GM (*Learning Mechanics–Game Mechanics*) framework [Arnab et al. 2014] to guide the development of the game. The game presented in study 3 was developed using the EMERGO approach [Nadolski et al. 2007]. Finally, the game described in study 23 was created using the ENgAGED (*Educational Games Development*) methodology [Eduardo Battistella and Gresse von Wangenheim 2015].

The lack of the use of frameworks for developing educational games for RE learning indicates that it is still necessary to adopt approaches that address important aspects of student learning.

5. Threats to Validity

The search was limited to studies that explicitly mentioned Requirements Engineering, which resulted in a more restrictive search string. However, educational games have also been used to teach different Software Engineering topics, such as software design.

Only three digital libraries were used. Although these libraries cover a large portion of the literature in computing and education, relevant studies published elsewhere may have been missed.

The classification of educational aspects in the analyzed studies required interpretation by the researchers. Although the analysis followed predefined criteria, some degree of subjectivity may be present.

As this study employed a Rapid Review methodology rather than a full systematic literature review, some simplifications were made in the search and selection procedures. No formal quality assessment or inter-rater agreement analysis was performed, which represents a limitation of this Rapid Review.

6. Conclusion

The analysis of the reviewed studies reveals several trends and research opportunities in educational games for RE.

Most reviewed games focus on requirements elicitation, indicating opportunities to develop games that address other RE activities, particularly requirements analysis. Among elicitation techniques, interviews are the most frequently used, followed by document analysis, while techniques such as questionnaires and performing the user's task remain unexplored. These results suggest opportunities for future research to design games that incorporate a broader range of elicitation techniques and support additional RE activities.

Most reviewed games address specific RE topics, which may require instructors to combine multiple games to cover different concepts. Developing more comprehensive games could reduce both pedagogical planning effort and the technical complexity of integrating several tools. Therefore, future research could explore the design of games that integrate multiple RE topics within a single learning environment.

Interpersonal skills are rarely addressed. While a few studies consider communication with stakeholders, conflict resolution, and teamwork, essential competencies such as empathy and moderation are absent. This reveals opportunities for future research to investigate game mechanics and interaction models that foster the development of these interpersonal skills.

Only a small portion of studies explicitly define learning objectives. Clearly specifying these objectives—especially using Bloom's Taxonomy—helps instructors align games with intended learning outcomes and assessment strategies. Future work could explore the systematic integration of learning objectives into the design of RE educational games.

Most games reinforce knowledge learned outside the game, and only 33% support knowledge acquisition during gameplay. This indicates opportunities to design games that not only reinforce previously learned concepts but also support the acquisition of new conceptual knowledge during gameplay.

Assessment mechanisms are predominantly summative (63.3%), while formative (43.3%) and diagnostic (6.6%) approaches are less common. Mechanisms supporting feedback, error reflection, and iterative practice also remain limited. Future research could explore the integration of diagnostic and formative assessment strategies that adapt gameplay to students' prior knowledge and support continuous learning.

Finally, most games were developed without following a specific educational game design approach. This suggests opportunities for future work to investigate how established educational game design frameworks can be applied to the development of games for RE education.

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