A Gamification Requirements Catalog for Educational Software: Results from a Systematic Literature Review and a Survey with Experts

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Abstract. Gamification is an emerging phenomenon for using in educational software in order to engage, motivate and improve the performance of students inside the learning context. However, despite its importance, the identification of significant gamification requirements for educational software is not trivial and a consensus of such requirements has not been reached. Motivated by this situation, the objective of this paper is to present a gamification requirements catalog for educational software. The requirements were identified from a systematic literature review, subsequently prioritized and validated through a survey conducted with 64 experts in the field. The results suggest that the requirements of the catalog are important to be applied in educational software.

1 Introduction

Requirements Engineering (RE) is the process of discovering the objective related to the development of software systems, by identifying the stakeholders and their needs, and documenting it in a form that is amenable to analysis, communication, and subsequent implementation [1]. The goal of RE is to produce a set of requirements that, as far as possible, is complete, consistent, relevant and reflects what the client wants [2].

A requirement can be defined as a characteristic of the system or a description of something that the system is able to performing to achieve their goals. In other words, a requirement indicates the purpose of the system, with no reference to how the system is to be implemented [3].

It is expected that the requirements consider the objectives of the stakeholders in order to result in the development of a software that satisfies these goals, contributing positively to the users perform their tasks effectively and efficiently. This preoccupation must be present also in the context of Educational Software (ES) development.

An ES is understood as the software developed to meet previously established educational goals, and in which technical quality is subordinated to pedagogical considerations that, in turn, guide its development [4].

In this scenario, it is observed an increasing use of gamification techniques to support learning [5]. Studies suggest that gamification can change the educational

scenario, transforming the emotional experience of the student, their sense of identity and their social positioning. Gamification projects offer the opportunity to experiment with rules, emotions, and social roles in a playful way [6].

The gamification is not about trivialize learning, it is a serious approach for accelerating the experience curve of learning. In addition, gamified learning can, and is, difficult, challenging and stressful, sometimes [7].

According to Deterding *et al.* [8], and Werbach and Hunter [9], gamification is the application of game elements in a non-game context. This is broad a definition and defines the term without objective explanations. For a greater understanding, it is necessary to answer three questions: (1) What are games? (2) What are game elements? And (3) What is a non-game context?

According to Crawford [10], a game is a closed formal system that subjectively represents a subset of reality. The game elements are the parts that are connected to represent the game in its totality. Werbach and Hunter [9] describes the game elements as the specific characteristics of this domain that can be applied in gamification. Besides, they can be classified into dynamics, mechanics, and components. Finally, a non-game context can be inferred as the context in which the game elements are applied to activities that are not games [11].

Many researchers have been working to understand how to apply gamification elements in education, in other words, which game elements should be applied in order to enhance learning. However, the definition of gamification does not provide practical clues with respect to this question [12].

The complication arises when one tries to go beyond the surface of definitions to identify the game elements which, in turn, would be the elements of gamification. The task of identifying the game elements that promotes engagement in learning tools is problematic and a consensus has not been reached [12].

In this sense, Borges et al. [13] conducted a systematic mapping to get an overview of gamification in education. It was asked about the educational context for the application of gamification and the types of study whose focus is on gamification. However, it was not asked about the gamification elements. The work of Dicheva et al. [14] also conducted a mapping of gamification in education. It was asked about the educational context for the application of gamification and about the gamification elements. However, the findings only cover elements concerning the mechanics of gamification.

Even if the elements are discovered, it is little known how students learn with gamification [13]. One way to know how students learn with gamification is to understand their personality types [15, 16].

Thus, a good start to make sure the gamified ES meets the desired needs of the educational environment in which it appears is through the introduction of appropriate RE techniques. Therefore, the establishment of a well-defined set of characteristics (requirements) specific to gamified ES can ensure the success of such systems inside the teaching and learning context.

Motivated by this scenario, this paper aims to present a gamification requirements catalog for ES, including the personality types of students. The catalog was created as a result of a systematic literature review (SLR) and it was evaluated using a survey with experts.

This paper is organized as follows. Section 2 describes the main guiding concepts of the proposal. In Section 3, the SLR is briefly presented. In Section 4, the survey results are presented. In Section 5, the gamification requirements catalog for ES is detailed. And finally, Section 6 shows the conclusions and directions for future work.

2 Background

Educational Software

The ES is defined as a didactic instrument to facilitate effective teaching-learning processes in traditional, classroom-based as well as in distance learning. This category includes both the instruments supporting the teaching-learning process and the instruments sustaining the management of educational or research processes [17].

An ES can be classified into educative or applications [18]. The applications are those that have not been developed with the purpose of education itself, but can be used for this purpose. The educative software was developed with the purpose of bringing the student to build a certain knowledge concerning an educational content [19].

Therefore, which confers educational characteristic for the software is its application in the teaching and learning process [19].

Gamification

There are three categories of game elements that are relevant to gamification: dynamics, mechanics, and components. They are organized in decreasing order of abstraction [9], as shown in Figure 1.

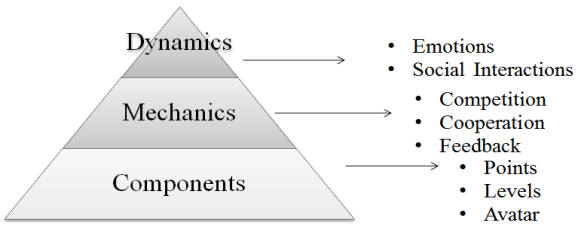

Figure 1. Elements of gamification [9].

Dynamics are the big-picture aspects of the gamified system that have to consider and manage but which can never directly enter into the game, in other words, dynamics are the experience of how the user interacts and creates expectations in the software. Mechanics are the basic processes that drive the action forward and generate player engagement. Components are more specific instantiations of mechanics and dynamics. Each mechanic is tied to one or more dynamics, and each component is tied to one or more higher-level elements.

Types of Personality

People differ from one another while think, perceive, understand, conceive, recognize and act in different ways. People act in different ways on the same events and some act in a similar way to other. Therefore, many types have been created to explain these differences and similarities, classifying them in certain types of behavior and attitudes in an attempt to simplify the observable variations [20].

In education, the understanding of the different personality types can support an educational planning that is better used by students of different psychological types and assist in the discovery of individual difficulties [20]. This situation is no different in the context of a gamified ES [21].

Just like people were grouped into personality types, some authors indicate that people can be classified into a players type.

In this context, Bartle [22] identified four types of players according to their characteristics and preferences: Achievers: regard points-gathering and rising in levels as their main goal, and all is ultimately subservient to this; Socializers: are interested in people, and what they have to say; Explorers: delight in having the game expose its internal machinations to them. Killers: get their stimulus from imposing themselves on others and become winners just to see others losing.

3 Systematic Literature Review

Protocol

The SLR followed the procedures indicated by Kitchenham and Charters [23]. According to the authors, specifying the research questions are the most important part of any systematic review [23]. Thus, this research answered the questions:

RQ1- What types of research published about gamified software focused on education?

RQ2: What types of software, educational context and educational goals are intended to use gamification?

RQ3- What are the main characteristics, in terms of requirements, for creating gamified software focused on education?

RQ4- Is there any approach that considers the personality types of students in gamified software focused on education?

Questions RQ1 and RQ2 were made to get an overview of gamification in education.

The identification of related research occurred in four different ways: manual search (events and journals about computing in education), automatic search, snowball method and papers derived from a pilot systematic review conducted previously by the authors [24]. Table 1 shows the sources of manual and automatic searches.

Table 1. Search Sources.

Source	Site
Revista Novas Tecnologias na Educação (Renote)	http://seer.ufrgs.br/RENOTE
Computers & Education	http://www.journals.elsevier.com/computers-and-education/
Simpósio Brasileiro de Informática na Educação (SBIE)	http://www.br-ie.org/pub/index.php/sbie/index
Conferência Latino-Americana de Objetos e Tecnologias de	http://www.laclo.org/papers/index.php/laclo/index

Aprendizagem (LACLO)	
Workshop sobre Educação em Computação (WEI)	http://csbc2014.cic.unb.br/index.php/wei
Congresso Internacional de Informática Educativa(Tise)	http://www.tise.cl/2014BETA/index.html
Symposium of Special Interest Group on Computer Science Education (SIGCSE)	http://www.sigcse.org/events/symposia
IEEExplore	ieeexplore.ieee.org/
ACM Digital library	dl.acm.org/
Science Direct	http://www.scopus.com/
Scopus	www.sciencedirect.com/
Ei COMPENDEX	http://www.engineeringvillage2.org/

For the identification of related research through automatic search, a search string, with relevant synonyms, was developed:

Search String:
("Gamification" OR "Gamifies" OR "Gamifying" OR "Gamified") AND ("Educational" OR "Learning" OR "Educative") AND ("Requirements" OR "Characteristics" OR "Technique" OR "Method" OR "Methodology" OR "Process" OR "Strategy" OR "Software Engineering" OR "Theory" OR "Personality" OR "Style" OR "Software")

To obtain consistent results, inclusion and exclusion criteria were defined (Table 2).

Table 2. Inclusion and exclusion criteria.

Inclusion Criteria		**Exclusion Criteria**	
I1	Primary and peer reviewed studies	E1	Studies that not discuss education as a focus of gamified software
I2	Studies that analyze characteristics of gamified ES	E2	Duplicated studies (only one copy is included)
I3	Accessible studies	E3	Incomplete, secondary and tertiary studies
I4	Original studies in the languages: English, Portuguese and Spanish	E4	Studies dealing with gamification in education as future work

First, the studies have been checked using the exclusion criteria. If a paper could meet any of the exclusion criteria, in turn, if E1 OR E2 OR E3 OR E4 is true, then the paper must be removed. Subsequently, the inclusion criteria were observed, thus, it was verified if I1 AND I2 AND I3 AND I4 could meet. If so, papers must be selected.

Selection Process

The selection process occurred in three different steps. Step1: reading titles and keywords; considering the inclusion and exclusion criteria. Step 2: reading abstract and conclusion; considering the inclusion and exclusion criteria. Step 3: the studies included are fully read; excluding irrelevant papers for the research questions.

Results

Initially, 912 papers were found. After performing the three stages, 127 papers remained (Figure 2).

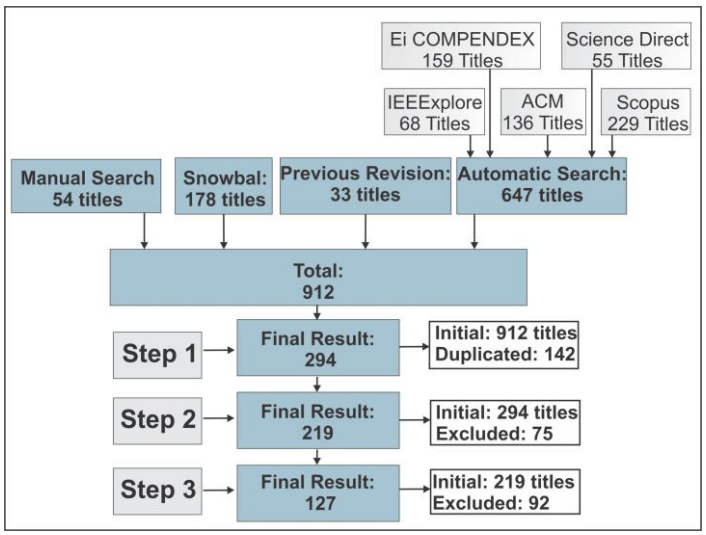

Figure 2. Results of searches.

The first research question suggests: the main year of publication was 2014 with a total of 61 papers (48.03%), followed by 2013 with 42 (33.07%), 2012 with 11 (8.66%), 2015 with 10 (7.87%) and the year with less publications was 2011 with 3 papers (2.36%). It is important to note that this research does not show the full effect of all the papers published in 2015, because the search and selection occurred between May and August of 2015. Authors from the selected papers were from 34 nationalities. In this case, it was considered only the nationality of the first author of each paper. The United States of America had the highest number of authors 23 (18.1%), followed by Brazil 21 (16.5%) and Spain 8 (6.3%). Eight nationalities contributed with just one paper. Brazil had the second highest number of publications because several manual searches were conducted in Brazilian sources (as displayed in Table 1).

The first research question refers to the types of studies found. The variable type of study was based on Petersen et al. [25] and Borges *et al.* [13].

Evaluation Research: Techniques are implemented in practice and an evaluation of the technique is conducted. That means, it is shown how the technique is implemented in practice (solution implementation).

Experience Papers: Experience papers explain on what and how something has been done in practice. It has to be the personal experience of the author.

Opinion Papers: These papers express the personal opinion of somebody whether a certain technique is good or bad, or how things should have been done.

Philosophical Papers: These papers sketch a new way of looking at existing things by structuring the field in form of a taxonomy or conceptual framework.

Solution Proposal: A solution for a problem is proposed, the solution can be either novel or a significant extension of an existing technique. The potential

benefits and the applicability of the solution is shown by a small example or a good line of argumentation (But no empirical data).

Validation Research: Techniques investigated are novel and have not yet been implemented in practice. Techniques used are for example experiments.

The types of studies, presented the proportions: Evaluation Research with 50 papers (39.4%), Solution Proposal with 21 papers (16. 5%), Experience Papers with 18 papers (14.2 %), Validation Research with 14 papers (11. 0%), Opinion Papers with 12 papers (9. 4%) and Philosophical Papers, with 12 papers (9. 4%). These findings are similar to Borges et al. [13] findings.

The second research question refers to types of software, educational context and educational objectives proposed with gamification. Among the 127 selected papers, only 74 (58.3%) propose some kind of new software, 24 used some existing software and 29 were not specific regarding the software type used. The types of software found were: Learning environment, distance learning environment, virtual learning environment, app, learning tool, management tool, game, learning object, learning platform, plug-in, educational resource, simulator, collaboration system, teaching system, learning management system, support system, educational system, tutorial and website.

It was noticed that the papers indicated the requirements they judge important, however none of them indicate possible differences in the application of requirements for different software. In other words, the requirements indicated by the papers could be used in the development of any software that is inserted in educational context.

For the educational context, the numbers of reported papers were: adult literacy (1), childhood education (2), informal education (6), college education (56), college education and graduate (6), elementary school (13), elementary and secondary education (2), secondary education (4) and graduate (4). A total of 33 papers did not inform the educational context. These findings are similar to Borges et al. [13] findings.

The objectives for using gamification were: graduate, education support, generate proactive attitude, promote the interaction, increase satisfaction, involve, engage, motivate, behavior changing, promote mechanisms against retention of students, promote learning, promote participation, promote collaboration, stimulate, incentive, influence behavior and attitudes, promote ludic thinking and training skills. The most used objectives to justify the use of gamification in education were engage, motivate and involve.

The third research question refers to the gamification requirements for ES. A total of 725 requirements were reported. Certain characteristics/requirements were cited in several studies, such as points (134 citations), reward systems (90 citations), levels (92 citations) and feedback system (88 citations). However, other characteristics, such as star, zeal and tips were present in only one paper. Many requirements present different names, but with the same meaning, such as points and experience points. In this case, they were grouped and resulted in the total of 232 requirements. Section 5 presents a gamification requirements catalog for ES.

The fourth question regards the types of student's personality related to the gamification. Fifteen works address some aspects related to different personality types. For example, Barata *et al.* [14] developed their studies based on personality classification of player types defined by Bartle [22].

4 Survey

The purpose of the survey was to evaluate the gamification requirements catalog and to establish priority levels for the requirements regarding ES. The type of study used is called cross sectional because participants are asked for information at one fixed point in time. The survey was applied through a self-administered questionnaire via Internet.

The instrument used consists of quantitative questions, in order to collect personal data (step A), and investigate priorities and evaluate the requirements (step B). Step B utilized, in all 232 items (requirements), a 10 points Likert scale, ranging from 1 "not entirely true for me" to 10 "totally true for me". The requirements were organized on the pyramid of Werbach and Hunter [9], which corresponds to different types of gamification elements.

Statistical analysis was performed through a descriptive analysis of frequencies and percentages (step A), and averages and standard deviations (step B), by calculating the difference between averages that used nonparametric test, after normal distributions of frequencies have been found (Kolmogorov-Smirnov test). The significance level of 5% was adopted. For performing statistical analysis, it was used the statistical software SPSS® (Statistical Package for Social Sciences), version 20.0.

Items with an average ranging from 1 to 3 were classified with low evaluation, therefore they were discarded in the Gamification Catalog. Scores 4 and 5 average were considered as little relevant. Scores 6 and 7 were considered relevant. Scores ranging from 8 to 10 averages were considered as very relevant. Items presenting statistical differences ($p < 0.05$) between the nonparametric average were classified with the lower priority that the average obtained.

The time to answer the survey was 30 minutes. The study involved answers of 64 people: 4 researchers with knowledge about gamification in education are acknowledged from the authors, 3 members of gamified ES companies and 57 expert researchers identified in the SLR, with an average age of 36.85 years. Regarding the educational level, 6 are graduated, 23 have master's degree and 35 have doctoral degree. In relation to the experience with gamification, it was perceived that 25 participants have theoretical experience, 28 have practical experience and 11 have both theoretical and practical experience. Regarding the time of experience, 46.9% declared to have more than 3 years' experience with gamification, 43,8 % have between 1 and 3 years and 9,4 % have less than 1 year.

Results from step B revealed the following proportions to 232 items: Averages lesser than 4 was identified in 1 item when considering the entire sample, and in 4 items when considering the categories of experience. Averages higher than 4 and lesser than 6 were identified in 14 items when considering the entire sample, and in 48 items when considering the categories of experience. Averages higher than 6 and lesser than 8 were identified in 174 items, when considering the entire sample, and in 205 items when considering the categories of experience. Average higher than 8 were identified in 43 items when considering the entire sample, and in 86 items when considering the categories of experience.

In 215 items, no significant differences were observed ($p < 0.05$) between nonparametric averages according to the the type of experience.

It was concluded that 3 items received low score and, therefore, they were not considered. 26 items were considered little relevant, 161 relevant and 42 very relevant.

In the next section we present the gamification requirements obtained from the SLR and evaluated through a survey.

5 A Gamification Requirements Catalog

A catalog of requirements is a set of patterns of requirements that occur repeatedly, to be used as a reference [26]. This approach is usually used as a kind of organized requirements list, in which each software requirement is individually described and is classified according to its functionality and importance. In this sense, the requirements must be prioritized in order to facilitate their choice within the catalog [27].

The 725 requirements listed in the catalog arise from the SLR, who had clear description of their meaning were analyzed and grouped to compose the gamification requirements catalog for ES. The catalog has 232 items and it is represented in 3 levels. The first one concerns to the specific criteria of gamification elements suggested in the Werbach and Hunter's [9] pyramid, composed by dynamics mechanics and components. The second level is composed of the requirement itself. And, the third level classifies the requirements according to the personality types of Bartle's [23] types of players: socializers (S), explorers (E), killers (K) and achievers (A). The requirements are presented in order of prioritization: (+) little relevant; (++) relevant; (+++) very relevant. Table 3 shows the gamification requirements catalog for ES.

Tabela 3. Gamification Requirements Catalog for Educational Software.

Dynamics			
Sense of Competence (A) +++	Recognition (A) +++	Reputation (A) +++	Relationships (S/A) +++
Success (A) +++	Satisfaction (A/S/E/K) +++	Mastery (A/E) +++	Commitment (E/S) +++
Responsibility (E) +++	Curiosity (E) +++	Relevance (E) +++	Joy (E/A) +++
Feeling Valuable (A) +++	Context (E/A) +++	Progress (A/E/K) +++	Interaction (S/A/E/K) +++
Rule (E) +++	Conscience (E/K/A/S) ++	Fixed Structures (E) ++	Integration (S) ++
Respect (S) ++	Social Rank (A/S/K) ++	Gaining Visibility (A) ++	Prestige (A/S) ++
Charity (S) ++	Community (S) ++	Common good (S) ++	Conflict (K) ++
Connection (S/E) ++	Frustration (E) ++	Empathy (S) ++	Love (E/S) ++
Pride (A/S/E/K) ++	Solidarity (S) ++	Altruism (S) ++	Step By Step (A/E) ++

Captivating (S/K) ++	Pleasure (A/S/E/K) ++	Zeal (E/A) ++	Loyalty (A) ++
Faithfulness (E/A) ++	Companionship (S) ++	Social Environment (S)	Camaraderie (S) ++
Optimism (E/A) ++	Stress (E/A) ++	Sensation (E/A) ++	Loss Aversion (A) ++
Imagination (E) ++	Fascination (E) ++	Conviction (A/E) ++	Excitation (E) ++
Emotion (E/S) ++	Confidence (A/E) ++	Narrative (E/S) ++	Plot (E/S) ++
Story (E/S) ++	Novelty (E) ++	Fantasy (E) ++	Influence (S/K) ++
Metaphor (E/K/A/S) ++	Concentration (E/K/A/S) ++	Abstraction (E/K/A/S) ++	Socialization (E/K/A/S) ++
Rivalry (K/A) ++	Expression (E/K/A/S) ++	Predictable Consequences (A/E) ++	Linearity (A) +
Anxiety (E/A) +	Pretense (K/E) +	Envy (K) +	Aggression (K) +
Distress (E) +	Subversion (K/E) +	Flirting (K) +	
Mechanics			
Challenges (E/K) +++	Discovery (E/A) +++	Meaning (E) +++	Autonomy (E/K/A) +++
Objectives (A) +++	Achievements (A) +++	Control (A/K) +++	Fun (E/K/A/S) +++
Different Experimentations (E/A) +++	Experience (E) +++	Adaptation (E) +++	Effort (A) +++
Overcoming (A/E) +++	Self-efficacy (A) +++	Preference (E/K/A/S) +++	Participation (S) +++
Feedback System (A/K/E) +++	Rewards System (A/E) +++	Prize (A) +++	Routes (E/A) +++
Strategies (E/K/A) +++	Increasing Difficulty (A/E) +++	Low Risk (A) ++	Tournament (S/K/A) ++
Complexity (E) ++	Power (A/E/K) ++	Rivalry (K/A) ++	Creativity (E/A) ++
Attention (E/K/A/S) ++	Praise (E/A/S) ++	Beauty (E) ++	Serendipity (E) ++
Realization (A) ++	Ability (E) ++	Immersion (E/K/A/S) ++	Opportunity (A/E) ++
Obstacle (A/E) ++	Acceptable Failure (E) ++	Precision (A) ++	Productivity (A) ++
Assistance (S) ++	Stimulus (E) ++	Creation (E) ++	Triumph (A) ++
Encourage (E/K/A/S) ++	Independence (E/A) ++	Surprise (E) ++	Persistence (A) ++

Transparency (A/E) ++	Competition (K/A) ++	Contest (K/A) ++	Cooperation (S/K/A) ++
Collaboration (S) ++	Sharing (S) ++	Failure (E/A) ++	Missions (E) ++
Transition System (A) ++	New Features (E/A) ++	Freedom (E) ++	Logical Conclusion (A) ++
Behavior (A) ++	Time Counting (E) ++	Paths (E) ++	Periodic Verification (A) ++
Differentiated Solution (A/E) ++	Compensating (A) ++	Correcting Misconceptions (E) ++	Simulation (E) ++
Incentive (S) ++	Action (E/K/A/S) ++	Betting (K/A) +	Exchanges (S/A) +
Comedy (E/S) +	Focus (E/A) +	Scenarios (E) +	Danger (E) +
Judgment (A) +			
Components			
Results (A) +++	Performance (A) +++	Evolution (A/E) +++	Free Lunch (A/E) ++
Investment (A) ++	Attempt (A/E) ++	Tasks (E) ++	Cycles (E) ++
Social Group (S) ++	Reinforcement (E/A) ++	Tips (E) ++	Classification (A) ++
Trigger Event (E/S/A) ++	Communications (S) ++	Trophies (A) ++	Points (A/K) ++
Medals (A/K/E) ++	Leaderboards (A/K/E) ++	Virtual Identity (S/E) ++	Avatar (S) ++
Profile (S/A) ++	Character (S/K) ++	Energy Pills (A) ++	Stamps (A) ++
Symbol (A) ++	Levels (A) ++	Score (A/E) ++	Star (A) ++
Users Table (A/S) ++	Virtual Goods (A) ++	Certification (A) ++	Rounds (E) ++
Episodes (E) ++	Assignments (E) ++	Volunteering (S) ++	Error (A/E) ++
States (E) ++	Phase (E) ++	Tutorial (E) ++	Rankings (A) ++
Unlockable Content (A/E) ++	Notification (A) ++	Comparison (K/A) ++	Ghosts Images (E) ++
Bonus (A) ++	Time Pressure (E) ++	Flow (E) ++	Lives (A/E) ++
Activity (E/K/A/S) ++	Specialization (E/K/A/S) ++	Populational Graphic (A/E) ++	Consulting Statistics (A/E) ++
Record (A) ++	Evaluation (A) ++	Comments (S) ++	Views (A/E) ++
New Roles (E) ++	Tracking (A/E) ++	Report (A/S) ++	Category (A/E) ++
Return (A/E) ++	Repetition (A/E) ++	Global Knowledge Map (A) ++	Customization (S/E) ++

Troubleshooting (A/E) ++	Exploration (E/K/A/S) ++	Collectible Cards (A) +	Marathon (K) +
Penalty (A) +	Money (A) +	Gifts (A) +	Badge (A) +
Label (S) +	Nickname (S) +	News (E/S) +	Combos (A/K) +
Interest Curve (A/E) +			

Landers [28], states that gamification can be used in education in many ways, for example, points are used to track the number of correct answers obtained by each learner as each learner completes an activity. Conflict and challenge could be used in a small group discussion activity when that each small group competes for the "best" answer/ position. The control requirement may happen in a small group discussion activity when each decision made by each small group influences the next topic the group will discuss. Rules and goals may occur in the educational context when next activities appear to be performed and when they were completed.

According to Li *et al.* [29] fantasy evokes images of objects or situations that aren't actually present. This can make the experience more emotionally appealing to the students. Providing feedback can increase users' engagement levels. In addition, if a user makes a mistake, they can become lost and disoriented. As such, the system should help users to recover from error states.

Using unlock content can help students to continually increase their abilities, ensuring that the challenges coincide with their skill levels. For example, the system could provide more strict guidance to a novice user or more freedom to proficient learners [29].

Time pressure can be commonly considered a critical aspect. However, adding time pressure is effective as it establishes clear and challenging goals [29]. The social position is a mechanism to promote competition and cooperation among users [30].

All requirements present in Table 3, in some way, were cited as important to the educational context and can be used in ES.

The catalog must be used together for requirements engineers and people from the educational field. The use of the catalog should follow four steps: 1- specify the types of personality of students; 2- choose the dynamics; 3- choose the mechanics; 4- choose the components. However, each mechanics must be associated with one or more dynamics, and each component must be associated with one or more higher-level elements (dynamic and mechanics).

6 Final Considerations and Future Works

This paper presented a gamification requirements catalog for developing ES as a result of a SLR and a survey.

The SLR has generated enough information for the development of the requirements catalog. And, the survey findings were used to evaluate and to prioritize the requirements catalog.

Some steps were followed to assure that research is the most correct and objective as possible. However, potential limitations were identified in a few moments: the

search string used in SLR cannot cover all the area papers; the sample of subjects participants in the survey was the type for convenience, ie nonprobabilistic; the association between mechanics, dynamics and components is performed subjectively.

It contributes to present the bases to standardize specific requirements for gamified ES, while gamification requirements that make these significant learning systems have been identified.

As future work, we intend to extend the review to: Identify other requirements that may be indicated by some recent research; Perform meta-analysis of the results to speculate about the general reasons for success and failure; Mapping, in an efficient way, possible connections between the requirements of dynamics which are related to the requirements of mechanics and components.

In addition to extending the review, it is intended to make relationships and correlations between the theories of personality types, present in the third level of the catalog, with some theory of learning styles of students. Finally, developing a tool to be used in a collaboration between developers and people from educational context, which facilitates the identification of the requirements present in the catalog for a specific ES.

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