

A Systematic Mapping on the use of Gamification in Virtual Learning Environments

Murilo Rocha Regalado – UFRN/PPGSC – murilorr90@gmail.com

Thiago Reis da Silva – UFRN/PPGSC – thiagoreis@ppgsc.ufrn.br

Eduardo Henrique da Silva Aranha – UFRN/PPGSC – eduardoaranha@dimap.ufrn.br

Abstract. Introduction: the gamification has emerged as a proposal for motivating students in recent years. Today are found studies which link the gamification within online learning environments. **Objective:** sort the previous studies around that area and analyze the results to identify patterns. **Method:** a systematic mapping was conducted to integrate the results coming from several studies published previously. **Results:** of the 149 primary studies found, 45 were included in this study, after this a filter by selecting 17 studies for final selection. **Conclusion:** was concluded by bigger impact on studies, information about gamification, the users and application details.

Keywords: systematic mapping; gamification; virtual learning environments.

Um Mapeamento Sistemático sobre o uso da Gamificação em Ambientes Virtuais de Aprendizagem

Resumo. Introdução: a gamificação surgiu como uma proposta de motivação aos alunos nos últimos anos. Hoje são encontrados estudos que atrelam a gamificação dentro de ambientes de ensino online. **Objetivo:** classificar os estudos já realizados em torno dessa área e analisar os resultados para identificar padrões. **Método:** foi realizado um mapeamento sistemático, para integrar os resultados oriundos de diversos estudos publicados anteriormente. **Resultados:** dos 149 estudos primários encontrados, 45 foram incluídos nesse estudo, após isso uma filtragem selecionando 17 estudos para seleção final. **Conclusão:** foi possível concluir através da maior incidência nos estudos, informações sobre a gamificação, os usuários e detalhamento da aplicação.

Palavras-chave: mapeamento sistemático; gamificação; ambientes virtuais de aprendizagem.

1. Introduction

The online learning systems have advanced in recent years, driven by developments in information and communication technologies, raising community interest with respect to various aspects related to education, especially regarding the distance education.

Despite all this progress, there are still problems in the educational context, both in person as the distance, which cover all areas of education. Teachers have difficulties in controlling the students, keep them aware of what is being taught and often deal with unruly students. Besides all this context, there is also a lot of entertainment available to students, which just further competing with students' interest in performing school activities. In addition to several other problems like socialization problems between students or motivation can also cited.

Despite the problems, interested researchers are discussing how to make teaching through online systems more attractive and motivating for students. These studies have focused

on new ways of teaching, based on advancement of communication technologies, social networks, games and gamification.

The gamification, identifies the elements that are fun and motivating from games and makes the application of these elements and mechanical game design in other contexts that are not games, in order to influence the behavior of students (HUOTARI, HAMARI 2012) (FALCÃO, LEITE, TENÓRIO 2014). This methodology comes with the proposal to assist in the problems mentioned above, using techniques that are already present for a long time in the games. The techniques of gamification try to increase interest in some human characteristics such as learning, socialization, field, competition, status, self-expression, altruism and others. In this study the most commonly used techniques and are classified into five categories were identified, as can be seen hereafter:

- **Badges or Achievements:** Medals or trophies that show the student status and their progress, are attractive and collectibles that make students become interested and feel important when the winning them;
- **Challenges, Quizzes or Puzzles:** A feature of gamification that makes learning more fun, with objectives that can be worked in a group with possibility of encouraging the socialization of students;
- **Gifts or Rewards:** Rewards are designed to show the student that he will be presented every positive action of their learning;
- **Levels or Progress:** In this technique the student can view the progress of your study, creating expectations to finish it first of their classmate, making it more focused on studies;
- **Leaderboard or Scoreboard:** Each student receives a score for his performance in the system, and thus is created a table to show each student scores, awakening a competition among students which requires a student dedication to achieve higher scores.

By applying these techniques is possible to see changes in student behavior, learning or even in socialization, arouses the interest of the student in class with a greater focus on learning. The strengths of gamification in online learning systems can be complementary. There are several significant ways to which the gamification and platforms can could work together as two large teaching methodologies (LEE, HAMMER 2011).

In search about it on the internet you can identify online learning systems in various ways, with acronyms like LMS (Learning Management System), CMS (Content Management System) and MOOC (Massive Open Online Course). This study sought to delve into all these terms and see which would be relevant and would bring benefits to the results.

This article explores the gamification within the online learning platforms, in order to identify the technical and successfully used more practices. Therefore, this article goes organized into five sections, from this introduction. Section 2 presents the research method. Soon after, in Section 3, the overall results of the study. Section 4 presents related works, finally, Section 5, we draw some conclusions.

2. Research Method

The study of a systematic mapping provides an overview of an area of research, identifying the amount, types of research conducted, the results are available, in addition to frequency over time to identify trends publications (PETERSEN, VAKKALANKA e KUZNIARZ 2015). The systematic mapping proved to be the most appropriate research method because it allows a broader view of the primary studies. The mapping aims to identify the amount, research type and search results available in the area, and check the

progress of studies in the research area chosen (PETERSEN, VAKKALANKA e KUZNIARZ 2015). Therefore, the systematic mapping proved to be the best way to present the study objectives, intended to be a formal review, accurate, reliable and auditable.

The objective of this paper is to present the results of the systematic mapping designed to provide an overview of the use of gamification in online learning environments. Therefore, this study was based on the guidelines of systematic mapping by following these steps: *definition of research questions, identify relevant primary studies, screening documents, search keywords in abstracts and data extraction and mapping* (PETERSEN, VAKKALANKA e KUZNIARZ 2015).

2.1 Search string

To create the search string of this mapping, the keywords have been selected, which define the thematic focus: (1) Gamification, (2) E-learning and (3) LMS. We had to be careful to include in the search string terms variants (environments and education) and other grammatical.

The keywords that were used as search strings emerged after several search attempts in digital libraries to identify the behavior of the results found in each. The tests consisted of the combination of the word “gamification” with words that bind to education and online learning platforms such as LMS. Finally, the final search string was defined as follows:

gamification AND (lms OR ‘e-learning’)

This string presented the boolean OR operator connects the synonyms of the search string, while the AND operator connects the sections. No specific filter was used to limit the search, for example, date of publication.

To execute the search with the selected string were chosen the following search engines: ACM Digital Library, IEEEExplore and Science Direct, identified as potentially useful in previous studies. Although each mechanism present their particularities to compose the string, it was possible to set it according to your particularity.

2.2 Problem description

When distance learning platforms are used, often does not occur concern about the quality of education that is being passed. There is a suspicion in the labor market in relation to graduates of this modality, this, in part, for there are few graduates. After being implemented gamification within such a platform, there must be a concern if it is working positively to the students.

2.3 Objective

The focus of this mapping is to identify and classify gamified online learning environments, in order to contribute substantially an application of gamification in any other environment. We intend to conduct a survey on the platform operation after gamification, implementation details, gamification resources used and a conclusion on the results.

2.4 Research Questions

The research questions defined in this study are the following:

- **RQ1:** Which techniques of gamification are being used in the study?
- **RQ2:** What level of education is being worked in the study?

- **RQ3:** For which knowledge area the gamification learning systems are being developed?
- **RQ4:** What was the name of the application used to gamification?
- **RQ5:** Which is the programming language used for developing the gamification learning system?

2.5 Criteria for inclusion and exclusion

The selected studies were analyzed to be identified those relevant to the research context. This analysis consisted in Inclusion Criteria (IC) and Exclusion Criteria (EC) previously defined. The IC were prepared as Table 1.

Table 1: Criteria for inclusion and exclusion.

Inclusion Criteria	Exclusion Criteria
IC1: Articles that discuss the gamification of online learning platforms; IC2: In the case of newspapers or conferences reported the same study, only the most recent article was included.	EC1: Articles that discuss the gamification in classroom teaching; EC2: Articles that discuss the gamification out of online systems; EC3: Articles whose main theme was a online education game; EC4: Technical reports, documents that are available in the form of abstracts or presentations and also secondary education (i.e., systematic reviews and systematic mappings) are deleted; EC5: Publications were excluded if they are not written in English language; EC6: Duplicated articles.

2.6 Search Results

The research of primary studies were conducted in the second half of 2014. First, were returned 149 primary studies of digital libraries shown in Table 2.

Table 2: Number of studies returned from each digital library database, candidate studies and final selection.

	Databases					
	ACM	IEEE	ScienceDirect	Total	Candidate studies	Final studies
Articles	101	13	35	149	45	17

A three-step approach was used in the search process. In the first stage, all primary studies retrieved were evaluated in order to identify those relevant to answer the research questions, a total of 149 studies were analyzed. After reading the titles, abstracts and keywords, this initial set was reduced to 45. During this screening, were applied IC and EC.

In a second step, we proceeded to read the abstracts and conclusion, then again the application of IC and EC of 45 candidate articles and the result was a subset of 17 primary studies as stated in Appendix A. Note that in some cases the reading of other parts of the articles was performed to make the selection. In the third stage, the 17 studies selected to the final selection were read in full. Although most of the studies analyzed were available in digital libraries ACM and Science Direct, the IEEE database had the highest rate of studies included in the final selection for the quantity of candidate articles in the second stage, as shown in Table 3.

Table 3: Number of studies returned from each digital library database, candidate studies and final selection.

	ACM	IEEE	ScienceDirect	Total
Articles	6	9	2	17
Acceptance Level	52.95%	35.30%	11.76%	100%

3. Study Results

In this section, we discuss the research questions answers, presenting the details of each study and relevant information obtained during the process. A summary of the information that has been extracted from each included study is presented in Table 4.

Table 4: Summary of included studies.

Study	Gamification Element	Level of Education	Knowledge Area	Application	Programming Language
E1	Badges, Progress, Scoreboard	High School	IT	Moodle	PHP
E2	Badges, Scoreboard	Higher Education	IT	Self-Developed	-
E3	Challenges, Progress, Scoreboard	Higher Education	IT	Self-Developed	Java
E4	Badges	Higher Education	IT	Trakla2	-
E5	Challenges, Progress, Reward, Scoreboard	Higher Education	IT	Moodle	PHP
E6	Challenges, Progress	Elementary School	-	Self-Developed	-
E7	Scoreboard	Higher Education	Math	Self-Developed	-
E8	Badges, Reward, Progress, Scoreboard	Elementary School	-	Schoooooools	-
E9	Badges, Challenges	Higher Education	Others	Schoooooools	-
E10	Badges, Scoreboard	Higher Education	IT	Schoooooools	-
E11	Challenges, Scoreboard	Higher Education	-	Drupal	PHP
E12	Badges, Scoreboard	Higher Education	Others	Khan Academy	Java Script
E13	Badges	-	-	Self-Developed	-
E14	Challenges	Másters School	Others	ERPSim	-

E15	Scoreboard; Progress, Reward	-	-	Moodle	PHP
E16	Badges, Progress, Reward, Scoreboard	Elementary School	Math	Self- Developed	Python
E17	Scoreboard	Higher Education	Others	Moodle	PHP

As a new area, studies were analyzed by publication year, returning three years (2012, 2013 and 2014) and with a higher rate in 2013, as seen in Figure 1. This confirms that these studies about gamification in online learning systems are not yet fully elaborated on, having a lot of elements to be studied.

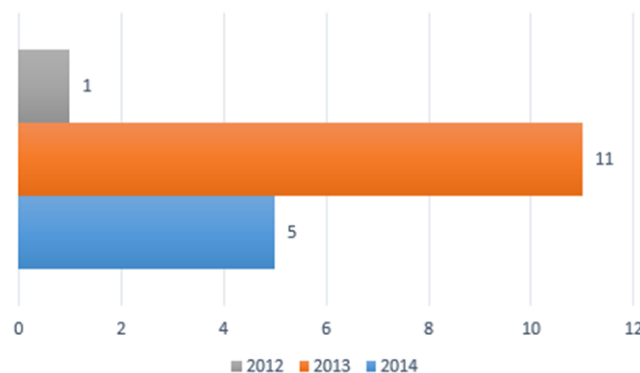


Figure 1: Classification of studies by year of publication.

RQ1: Which techniques of gamification are being used in the study?

The concept of implementing the techniques of gamification in online learning systems rely on game design elements. These elements have an important role in the creation of learning effectiveness, improving student motivation during the course. Therefore, as presented in the introduction, studies were classified into five gamification techniques: Badges or Achievements [E1, E2, E4, E8, E9, E10, E12, E13, E16], Challenges, Quizzes or Puzzles [E3, E5, E6, E11], Gifts or Reward [E5, E8, E15, E16], Levels or Progress [E1, E3, E5, E6, E8, E15, E16] and Leaderboard or Scoreboard [E1, E2, E3, E5, E7, E8, E10, E11, E12, E15, E16, E17].

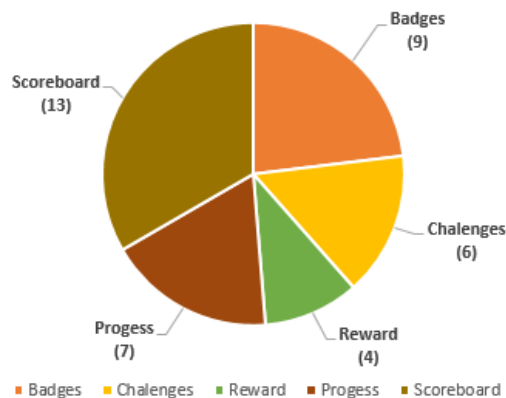


Figure 2: Use of gamification in selected studies.

Figure 2 illustrates the amount of each technique found in the studies. Even though some elements are linked to others, it was possible to see greater use of Scoreboards and Badges within the platforms.

RQ2: What level of education is being worked in the study?

The articles were classified according to the level of education for which the research were intended. Looking at Figure 3 it is apparent that most application studies of gamification in educational environments are facing Graduation [E2, E3, E4, E5, E7, E9, E10, E11, E12 and E17]. You can also see that Elementary School level [E6, E8, and E16], which covers children up to twelve years of age, was the second school level in greater focus of gamification. The High School and Master School levels were identified in only one study each respectively [E1] and [E14]. In two studies [E13 and E15] have not defined the schooling levels.

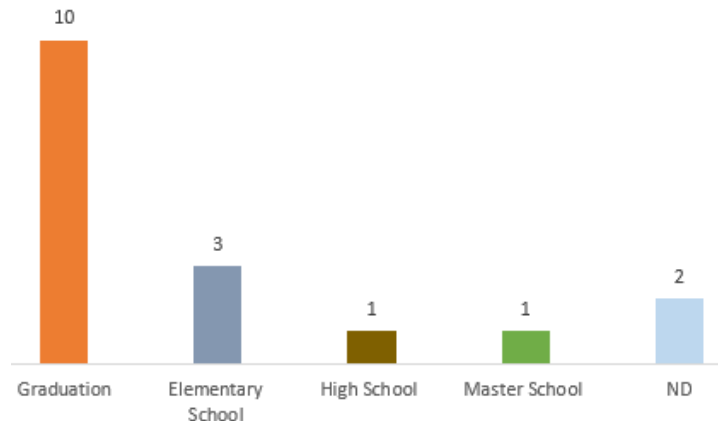


Figure 3: Classification studies by level of education.

RQ3: For which knowledge area the gamification learning systems are being developed?

Another point to be noted in the studies is the knowledge area that is being worked on. Through this information we can analyze which areas had greater success with the insertion of gamification.

From Figure 4 you can see that most of the studies focus to the teaching in the IT area [E1, E2, E3, E4, E5 and E10], which addresses research question 3. The study of Mathematics [E7 and E16] comes second in the results, as well as other areas such as Enterprise Resource Planning, Physics and Surgery which were classified into Others [E9, E12, E14 and E17] they did not have a quantity greater than one. The remaining articles generally describe the gamified platform without determining the area of knowledge worked, so it was classified as Non-defined (ND) [E6, E8, E11, E13, and E15].

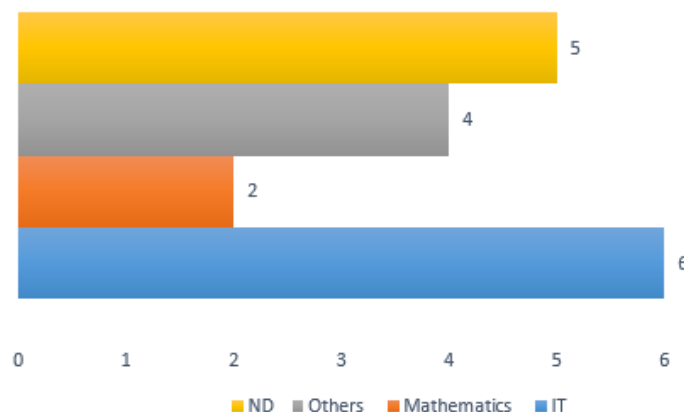


Figure 4: Classification studies by knowledge area.

RQ4: What was the name of the application used to gamification?

To answer this question, it was necessary to conduct a research on the platform used for gamification. Figure 5 shows the results of the articles, it is possible to realize a large number of studies have used a system Self-develop [E2, E3, E6, E7, E13 and E16], i.e. own development. Moodle [E1, E5, E15 and E17], Schoooooools [E8, E9 and E10], Khan Academy [E12], ERPSim [E14], Drupal [E11] and Trakla2 [E4].

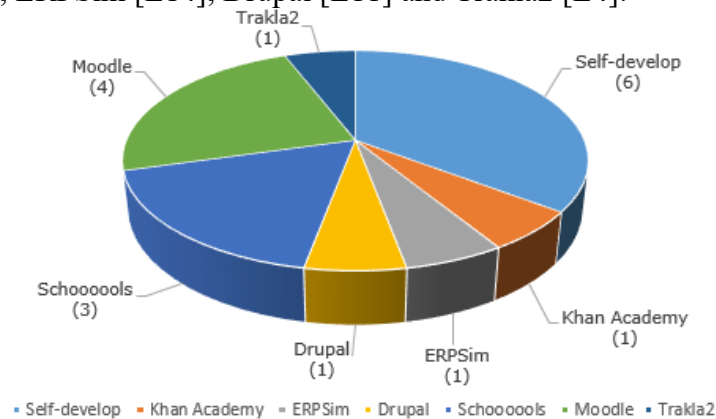


Figure 5: Classification studies by system used.

RQ5: Which is the programming language used for developing the gamification learning system?

After analyzing all studies included in the mapping, you can submit a rating on the programming languages included in the study.

As shown in Figure 6, it is possible to realize that a large part of the results was not detected the programming language that was used [E2, E4, E6, E7, E8, E9, E10, E13 and E14]. However, we found that the PHP language was the most found in studies [E1, E5, E11, E15 and E17]. Making a connection with the RQ4, this results probably because most environments are using Moodle, developed using PHP language.

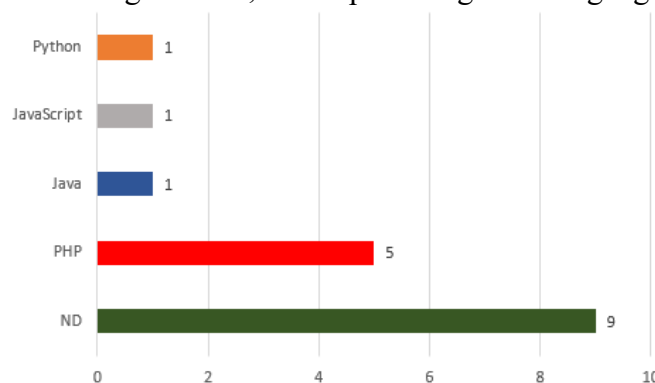


Figure 6: Classification of online learning systems by programming language.

3.1. Study limitations

The main limitation of this study is the most common limitations in systematic mappings. This limitation concerns about the process of implementation, with the inclusion of errors and bias in any of the steps, first in the pre-selection of items then the inclusion and exclusion and, finally, the extraction of data. As there was a large number of articles analyzed during the pre-selection, there is a good chance that some important items go unnoticed in the analysis of titles, abstracts and keywords. This situation is even worse when the titles, abstracts and keywords are confused and do not adequately reflect the

objectives, scope of work and main findings or research contributions. Another limitation is the application of inclusion and exclusion criteria. These threats were controlled by making use of researchers with experience in the area and time available to carefully make the selection.

4. Related Works

The analyzed studies in this work have focused on the use of gamification in education inside online learning platforms. Among these related works, we could identify items with the use of gamification in many fields, we choose some the articles who conducted a systematic mapping with the theme of gamification in education. This systematic mapping differs from the studies found (BORGES *et. al.* 2014), (SURENDELEG *et. al.* 2014) and (DICHEVA *et. al.* 2015) as it restricts the studies for those using gamification to online learning platforms and focuses on different questions to get unique results and conclusions.

5. Conclusion

As a main goal, this study showed an overview of previous studies on gamification context linked to online learning environments. The systematic mapping was conducted by specifying the methods used during the conduct of work. The criteria defined were sufficient to obtain satisfactory and conclusive results around the subject. The systematic mapping also proved to be an effective methodology, involving a reading and analysis of the studies found, which gave answers to the research questions raised. From the results, it was possible to answer the research questions and make some conclusions: In the first question, it can be seen that most used gamification technique is the Scoreboard. Despite the Badge technique had fewer results, can also be considered of great use in online learning systems for its proximity to the first place. Regarding the second question, the classification made it clear the answer to the question. The predominant educational level among the studies was the Graduation. The third question refers to the knowledge area that is being worked on and we concluded that the IT area was the most prominent. The identification of the online learning system is the fourth question, so we do not consider the Self-developed systems, we had the highest incidence on Moodle system. The system information in the fifth question, is a detailed complement to the previous question and serves to support the same, but it was concluded that most of studies have not declared the programming language used, but if you take into consideration the valid conclusions, then PHP is the most programming language used among the online learning systems.

With the result of this study, was created a systematic mapping, seeking help all future work related to teaching or gamification. Considering that the results did not find many works, it is concluded that a mapping like this, of a new area, it is of paramount importance for the understanding of previous studies. The list of articles of this mapping can be seen in Table 5.

Table 5: Included articles in the systematic mapping.

Study	Digital Library	Year	Title
E1	IEEE	2013	An empirical study of gamification impact on e-Learning environment
E2	IEEE	2013	The gamification of the study of electronics in dedicated e-learning platforms
E3	IEEE	2013	Gamification of a Software Engineering course and a detailed analysis of the factors that lead to it's failure
E4	IEEE	2013	Empirical Study on the Effect of Achievement Badges in TRAKLA2 Online Learning Environment

E5	IEEE	2013	Redesign of a gamified Software Engineering course
E6	IEEE	2012	A Study on the Relationship between Educational Achievement and Emotional Engagement in a Gameful Interface for Video Lecture Systems
E7	Science Direct	2014	Leaderboards in a virtual classroom: A test of stereotype threat and social comparison explanations for women's math performance
E8	Science Direct	2013	A social gamification framework for a K-6 learning platform
E9	ACM	2013	Gamifying learning experiences: Practical implications and outcomes
E10	ACM	2013	GradeCraft: what can we learn from a game-inspired learning management system?
E11	ACM	2013	METAVERSIA: a proposal for a Drupal based MOOC Publisher
E12	ACM	2013	An architecture for extending the learning analytics support in the Khan Academy framework
E13	ACM	2014	Engaging with massive online courses
E14	ACM	2013	Competition as an element of gamification for learning: an exploratory longitudinal investigation
E15	ACM	2014	Gamification in MOOC: challenges, opportunities and proposals for advancing MOOC model
E16	ACM	2014	Gamification in intelligent tutoring systems
E17	ACM	2014	Playing with SHULE: surgical haptic learning environment

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