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Engaging MOOC through gamification: Systematic mapping review

Elvira G. Rincón-Flores
School of Engineering
Tecnologico de Monterrey, Mexico/ GRIAL
research group, University of Salamanca,
Spain
elvira.rincon@tec.mx

María Soledad Ramírez-Montoya
School of Humanities and education
Tecnologico de Monterrey, Mexico/ GRIAL
research group, University of Salamanca,
Spain
solramirez@tec.mx

Juanjo Mena
Education Department
Salamanca University
Salamanca, Spain
Institute of Psychology and Education, Kazan
Federal University, Russia.
juanjo_mena@usal.es

ABSTRACT

While gamification has a strong position in business and marketing, it is just emerging in the education field. This is especially true in the environment of Massive Open Online Courses (MOOC). This paper describes the trend of gamification for education in MOOC within literature. For this purpose, a systematic mapping was conducted with thirty research studies about gamification in MOOC performed between 2013 and 2019. The mapping established three dimensions: discipline, research, and technology. Results show that gamification in MOOC progresses according to the resources offered by the technological platform. Even though results about learning and motivation are encouraging, there are still opportunities for producing scientific publications.

Keywords

Teaching/learning strategies; online learning; Gamification; MOOC.

1. INTRODUCTION

Although MOOCs have benefited many people around the world through open access to education [37], they have been subject to various criticisms. For example, that MOOCs are supported by the learning theory of behaviorism [16, 37], that the student does not have support from a tutor to point out their mistakes [24, 55], that they are boring or monotonous [6, 23], and their high dropout rate [7], among others.

However, MOOCs continue to grow in various universities around the world [56] and also in the field of business [33]. MOOCs are a source of opportunities. For example, MOOCs are suitable for the technological development of pedagogical models [22]. In the social context, MOOCs allow extensive access to educational resources, making education accessible to any internet user [1, 51] and, in the labor context, employees can follow the course from any place at any time.

At the same time, the growing use of the massive courses online is creating an integration of innovative strategies [15, 17, 37]. Some researchers such as Alraimi et al. [2], Borrás-Gené et al. [8], García-

Peñalvo et al. [19], González et al. [20], Hew [23], Kaplan and Haenlein [25], and Vaibhav and Gupta [50], among others, think that including didactic strategies such as gamification in MOOC could lead to increased motivation and course completion rate, as well as better academic performance or learning level.

The term gamification was coined by Nick Pelling in 2002, but it was until 2010 that became popular thanks to the digital reward systems offered in the commercial sector [42]. Some years later, gamification began to be incorporated into the educational environment around the world. The more generalized definition of gamification that is used as reference in several studies is: “using game design elements in non-gaming contexts” [12, p.13].

Its purpose is to engage and motivate students [49] placing them in scenarios or simulations that imply the achievement of attractive challenges in such a way that they increase their level of engagement and competitiveness [52]. In addition, skills and attitudes such as collaboration, self-regulation of learning, and creativity are developed by involving game elements in the design of learning activities [10, 52].

Therefore, gamification allows that cognitive, emotional, and social factors converge in the learning process by including game elements in it [32, 41]. Another interesting angle of gamification is that it offers participants the opportunity to learn from their mistakes thanks to the immediate feedback and the number of allowed attempts [29]. This is the case of a gamified system based on mechanics of opportunities (chances).

In summary, gamification is a system that consists of three interrelated elements [28]: (a) the dynamics (contexts in which gamification is developed), (b) the mechanics (activities within the dynamics), and (c) the components (objects and resources used within the mechanics) [9, 26, 53]. For example, social dynamics occur in an environment of interrelations, the mechanics element can be challenges to achieve, and the components may be the assignment of badges and position of the team in a leaderboard. Table 1 shows an example of a gamification design based on the model of Werbach and Hunter [54].

Table 1.

Example of a gamified environment design based on the model of Werbach and Hunter (2015).

Dynamics	Mechanics	Components
Emotions	Competitions Feedback Chances	Avatars, badges, combats, boards
Progressions	Challenges Competitions Rewards	Avatars, badges, boards, levels

2. METHOD

2.1 Data source and search strategy

The purpose of this investigation is to describe how the strategy called gamification has been implemented and evaluated in educational MOOC based on available literature, as well as showing the technological platforms that were used. We draw conclusions on how feasible it would be to replicate the gamification models in other MOOC courses. The idea is to set a theoretical precedent that presents the successes and failures of this strategy in the last six years from the literature to the researchers in the field of Gamification in MOOC. To achieve this, a Systematic Mapping Review (SMR) was conducted. To carry out the study, we followed recommendations proposed in previous works [27, 34, 35].

Three key dimensions were defined that served as a guide in the research: Discipline, Research, and Technology. The discipline dimension refers to the elements of the gamification used in each investigation and how they were used. For this dimension we used as a reference the model of Bunchball [9], Lee and Hammer [30], and Werbach and Hunter [53]. The research dimension shows how many works belong to conferences and how many to journals, what motivated the incorporation of the gamification strategy in MOOCs, and what were the results found [31, 39]. Finally, the technology dimension refers to how feasible it is to replicate the gamification model in other MOOCs. For this purpose, we noted what technological platforms were used, the type of MOOC, and whether the technological development of the MOOC is embedded in the platform or it is an external application.

The search was performed by consulting the databases: Springer open journals, Scopus, Web of science, IEEE, and Science Direct, which are characterized by being open and containing publications of high scientific rigor. Two descriptors were used: "Gamification" and "MOOC" and alternative words used for gamification were "game-based learning", "game" and "enhance". Alternative words for MOOC were "Open courses" and "Online courses". We followed the steps suggested by Pedreira et al. [34], in which the Boolean term "or" is used as a synonym or related terms, while the Boolean term "and" is used to link the main terms, which were applied to titles, abstracts, and keywords. The search was done with items published between 2013 and 2019.

The obtained results from the first search are summarized in Figure 1. A total of 495 research papers were found from which the duplicates and those that did not serve the purpose of this study were eliminated. Therefore, the preliminary sample was reduced to 40 items between journal and conference articles. Criteria for exclusion were: a) papers about serious games, b) no empirical research, c) papers before 2013, and, d) no arbitrated papers. Finally the sample was composed of 22 studies that includes publications about a MOOC that mention at least one gamification element, that were applied into practice or the result of a

documented proposal from theory, arbitrated, and published on 2013 or later. The sample is presented in Appendix 1.

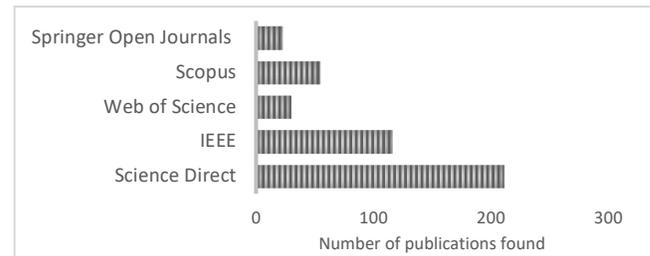


Figure 1. Summary of number of search results in several databases (data collected by the authors)

2.2 Research questions

The research is structured around three dimensions: discipline, research, and technology. From the dimensional analysis, six subordinate questions were established with the purpose of enhancing the research and discovering how the gamification is applied in the MOOCs. The research questions for this SMR are described in Table 2.

Table 2

Subordinate research questions

Dimension	Question number	Subordinate question
Discipline	RQ1	How gamification was applied to MOOCs?
	RQ2	What dynamics, mechanics, and components are used the most in MOOCs?
Research	RQ3	How the gamification effect in MOOCs was evaluated?
	RQ4	What are the most important results?
Technology	RQ5	What MOOC type was used?
	RQ6	Is gamification part of the MOOC's technological environment?

The defined dimensions allowed to conduct a wide scope research about the gamification strategy applied to MOOCs.

3. RESULTS OF THE LITERATURE REVIEW

This section presents the research results based on the dimensions previously established. The items were arranged in a matrix, where each column contains the answers of each subordinate question, as well as the year of publication, country, educational level, and purpose of the gamification. From the information organized in the matrix, the results were obtained. First these results will be presented to have a general outline of the demographic characteristics of the items, then the results will be given by dimensions.

Descriptively, Germany is the country that stands out in number of publications from 2013 to 2019 with 6 items, followed by India

with 2 items. The educational level in which gamification was more prevalent in MOOC was higher education and the purpose of including gamification was mainly to increase engagement and motivation with the final goal of either improving learning or increasing the completion rate or both.

3.1 Discipline dimension

This dimension consists of two subordinate questions: 1) how gamification was applied to MOOCs? And 2) what dynamics, mechanics, and components are used the most in MOOCs? From the studies revised, we found that only three of them declared a gamified system in their research. Studies [A1, A2, A3, A4, A5, A6, A10, A13, A16], and [A22] designed a system with social or emotive dynamics, or both. The mechanics within that dynamic were competitions, challenges, and rewards. The components used within those mechanics were points, badges, and leaderboards. The rest of the items applied gamification mechanics or components without structuring it as a gamified system formed by dynamics, mechanics, and components. There were even some items that refer to components as mechanics.

Table 3 shows the distribution of the dynamics, mechanics, and components, based on the models of Werbach and Hunter [54] and Bunchball [9]. Table 3 shows that emotional is the most frequent dynamic followed by the social dynamic. This can be explained with the idea that the mechanics of challenges and rewards usually cause emotions in the participants, generated by the intrinsic desire to solve the challenge and to gain recognition of the applied effort. It is surprising that the second most frequent dynamic was social, given how complex it can be to work with massive groups. However, 41.2% of the items apply this dynamic, either by forming teams to complete a challenge, or awarding points or badges for the quantity and quality of the contributions in the discussion forums. Within the mechanics, challenge was the most frequent mechanic followed by rewards. Most courses offer challenges for participants to be solved individually or collaboratively.

Table 3
Dynamics, mechanics and components employed in the analyzed studies (see Appendix 1)

DYNAMICS	Studies
Emotions	A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A17, A21, A22 (44.1%)
Narrative	A14, A19 (5.9%)
Progression	A13, A15, A18 (8.8%)
Relationship	A2, A3, A4, A5, A9, A10, A11, A12, A14, A16, A17, A19, A20, A22 (41.2%)
MECHANICS	
Battles	A3 (4%)
Challenge	A1, A2, A5, A6, A7, A14, A21, A22 (32%)
Chances	A8, A18, A22 (12%)
Competition	A4, A9, A17 (12%)
Cooperation	A14, A19 (8%)
Rewards	A10, A11, A12, A13, A15, A16, A20, A22 (32%)

COMPONENTS	
Achievements	A11 (2.9%)
Avatar	A11, A19 (5.7%)
Badges	A2, A3, A4, A5, A6, A9, A10, A13, A15, A17, A20, A22 (31.4%)
Leaderboard	A5, A9, A12, A14, A16, A20, A21 (20%)
Medals	A4 (2.9%)
Points	A5, A7, A10, A13, A14, A16, A17, A18, A20 (25.7%)
Scores	A1, A22 (5.7%)
Virtual Goods	A5, A20 (5.7%)

The mechanics of rewards is very convenient in a gamified system within a MOOC environment, since it can be a factor that enhances extrinsic motivation, because it gives recognition to the participant for the achievement of something, for example, a challenge, an activity, an exam, or a contribution in a forum, among others. On the other hand, the most used components are the badges, points, and leaderboards, perhaps because this type of components pairs well with the mechanics of challenges and rewards as well as with the emotional dynamics.

3.2 Research dimension

Results from this dimension followed the direction of our two alternative questions: 1) how the gamification effect in MOOCs was evaluated? And 2) what are the most important results? Out of the 22 items, 4.5% corresponds to the year 2013, 22.7% to 2014, 18.2% to 2015, 45.5% to 2016, 4.5% to 2018 and 4.5% to 2019. During the years 2014 and 2016 the production of research on gamification in MOOC increased considerably. However, most of them are publications in conference proceedings and gray literature rather than publications in Journals (59% and 41% respectively). This may prove that the area of research on gamification in MOOC is at an emergent stage (see Appendix 1). On the other hand, to determine how the gamification effect was evaluated, we classified the items as shown in Table 4. Four categories were identified: Questionnaires, Analytics, Control vs experimental groups and Course completion rate.

Table 4
Evaluation of the effect of gamification in MOOCs, according to the study sample.

Categories	Studies	F	%
<i>Not describe</i>	A1, A6, A13	3	10.3
<i>Questionnaires and/or interviews</i>	A2, A5, A9, A10, A14, A15, A16, A21	8	27.6
<i>Analytics</i>	A3, A4, A7, A8, A9, A11, A17, A19, A20, A21, A22	11	37.9
<i>Control vs experimental groups</i>	A18	1	3.4

Course	A2, A4, A8, A12,	6	20.7
completion rate	A15, A22		

There exists a tendency for data analysis to lean to positivism, since more than 60% of the items show a quantitative methodological approach, in which quantitative instruments were applied or the numerical analysis of the MOOCs was processed.

The most relevant results are:

- 1) Items A2, A8, A11, A12 and A15 found course completion rates above 18%, which is encouraging considering that the overall average completion rate is around 5% [5]. Even more, the MOOC of item A12 obtained a 91% completion rate. On the other hand, even though the MOOC of item A4 had a completion rate of 8.5% in one group and 3.44% in the other, the final scores were 88.6 and 81 respectively in the scale of 100. At the same time, the MOOC of the item A22 had a completion rate of 13.5%, which is an interesting percentage among the xMOOC type.
- 2) Items A5, A6, A7, A9, A10, A14, A18, A20 and A22 found that participants were more active, satisfied, and motivated with gamification.
- 3) Also, item A6 revealed that virtual goods, points, and team leaderboard are the components that enhances engagement the most. Item A3 states that the badges and the battles motivated the participants to take more steps each week to take care of their health. Item A22 found that the mechanics of chances helped the cognitive element, since it gives the opportunity for the student to learn from their mistakes and try again.
- 4) Item A16 found that psychological connection in gamification is a strong motivator, since relationship with others help the participants to not give up. Finally, items A19 and A22 found that gender and previous experience do not make any difference regarding the use of gamification.

3.3 Technology dimension

To study this dimension, the information was analyzed regarding the questions: 1) what type of MOOC was used? 2) Is gamification part of the MOOC's technological environment? The most used platforms are Moodle [A3, A4, A12, A15], HPI [A10, A16], and Coursera [A5, A8]. The countries that have designed their own platforms are Brazil (Brasil Educa), Germany (HPI), Mexico (Mexico X), Spain (Miriada X) and France (mobil mooc). With respect to the type of MOOC, 14 items are about the xMOOC type [A1, A4, A5, A6, A8, A10, A12, A14, A15, A16, A18, A20, A21 and A22], one item studied the fMOOC or fitness MOOC [A3], one item is about gcMOOC [A2] that takes the best of connectivity [45,46] and self-management, and one item studied SPOOC [A11] with the objective to encourage interaction among students.

When analyzing whether the gamification is part of the MOOCs' environment, we found that, out of the 22 items, 18 used gamification resource embedded in the platform, while others used external resources, such as Facebook, YouTube [A2], or Quizlet [A28]. In this regard we can say that these platforms allow access to resources to apply gamification in MOOC as long as these technological resources meet the didactic expectations of each pedagogical architecture. It is worth noting the design of the MOOC in item [A11] in which users can choose avatars and develop battles with others to take quizzes. This resource may be

novel and appealing, however, the development of these resources could be expensive for platforms that serve a large number of users.

4. DISCUSSION

This section presents the discussion about the results. As with the previous section, discussion is presented organized by the three defined dimensions.

4.1 Discipline dimension

The mechanics of challenges, reward, and chances, accompanied by components such as points, leaderboards, and badges, enhance the engagement, motivation, and metacognition of the participants in a MOOC. Table 3 shows that these were the most popular mechanics and components, 5 items had a completion rate higher than 18% while 9 items stated that the students were motivated and engaged. These results match with what was found by [32, 40, 41 y 43], who found that gamification enhances cognitive and emotional aspects. Likewise, [4, 44] claim in their research that gamification is a key factor in engaging participants. That is, the mechanics of rewards combined with components such as points or badges or leaderboards, generate emotions through recognition. The mechanics of chances favor the cognitive element through self-reflection that invite to try again after missing the correct answer. And finally, the challenges boosts intrinsic motivation thanks to the participants' desire of solving them.

4.2 Research dimension

Research on gamification in MOOC is growing. However, there is a tendency towards a more positivist approach in the type of instruments used and data analysis. This can be seen in Table 4. Clearly, technological advances will make MOOC gamification possible [3, 48]. Also, it is necessary to generate research about the impact of these innovations on different educational aspects [47] in such a way that gamification research can reach a maturity level. At the same time, results mostly revealed that gamification in MOOCs increased the completion rate and that users were more active, satisfied, and motivated compared with courses that do not offer gamification. This may encourage educators and researchers to continue developing creative resources that improve gamification in MOOC and its research.

4.3 Technology dimension

The massive nature of MOOCs can be an obstacle to include more sophisticated gamification in MOOCs. In this regard, the creativity of pedagogical architects and instructional designers plays an important role. We observed that almost all platforms offer resources for gamification in MOOC, however, they may not match the expectations or needs of the instructor, especially if it is a massive course [19, 20, 40]. Although there are resources external to the platforms that could be used to apply gamification, there would be no information to process for research because these resources are not embedded in the MOOC platform. In this direction, MOOCs still have areas of opportunity to incorporate gamification for masses in a creative way that also includes social dynamics.

5. CONCLUSIONS AND FUTURE WORK

The purpose of this study was to make a literature review of publications about gamification in MOOC worldwide. To meet that purpose we used a sample of studies from high impact indexed

databases such as Scopus, WOS, and JCR. Also, we focused exclusively on gamification and discarded those studies that talked about serious games. Online courses that were not massive or open were discarded as well.

The methodology employed for the search and subsequent analysis was based on work performed by Dicheva et al. [13], and Faiella and Ricciardi [34]. Three research dimensions were defined: educational gamification in international literature about MOOC, gamification elements utilized in MOOCs, and type of investigation about gamification in MOOC. These dimensions were guided by a set of subordinate questions with the objective of narrow the search and the data analysis.

Main results indicate that there is a research trend to improve the didactic design of the MOOCs. Evidence highlights the practice of innovative didactic strategies such as gamification. Besides, it is interesting to note that the audience addressed by MOOCs is heterogeneous and the topics discussed exhibit a great variety. This confirms the idea that MOOCs democratize education.

Then, it was found that the area of research about gamification in MOOCs is emerging and that there is a need to strengthen scientific research, because, out of the sample used, 67% of studies were published in conferences, 17% of empirical studies obtained their results from analytics or control-experimental groups, and it was possible to obtain a sample of 30 items only with some difficulty out of the 450 studies found in the first search.

There is little doubt that technological advances will make gamification grow in complexity and this will allow gamification become part of MOOC infrastructure. This will enable researchers to access data and perform more rigorous scientific research. Gamification in MOOCs should be evaluated objectively and not only under the participant perception. Gamification, as any other teaching innovation strategy, should be assessed without personal bias because we will not be able to declare whether gamification is an effective educational innovation resource or only a trendy methodology until its impact is evidenced objectively.

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8. APPENDIX 1

Complete list of all primary studies included in the study.

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