Gamification for MOOC online courses

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ABSTRACT
One of the main problems of Massive Open Online Courses (MOOCs) is the low retention rate of students and a high no-show rate. Meanwhile gamification has been gaining notoriety in the last decade within the education field. This systematic literature review explores the impact gamification has had in MOOCs, how their success is being measured, what are the theories normally associated with these gamified learning environments, and what game design elements are used as well as their implementation and outcome. We've reviewed 22 papers dating from 2014 to July 2019. Our findings are positive in terms of the outcomes, with a general increase in participation and retention on gamified MOOCs.

KEYWORDS
MOOC; Gamification; Motivation; Student Retention.

1. Introduction

Gamification as the use of game design elements in non-game contexts (Deterding, Dixon, Khaled, & Nacke, 2011) has been researched in several domains such as Health/Exercise, Crowdsourcing and most notably Education/Learning. The latter corresponding to 46.7% and 35.4% of empirical and non-empirical papers, respectively, on gamification (Koivisto & Hamari, 2019). This rapid rise of academic literature on gamification started in 2011 (Koivisto & Hamari, 2019) and gamification is becoming more mainstream and could be a potential strategy to apply to MOOCs and raise retention.

MOOCs' low retention rates, percentage of users having completed the course, are a predominant problem with rates of less than 10% (Jordan, 2014). This further highlights the potential of gamification in MOOCs as a way to increase retention, such as the success of Vaibhav and Gupta (2014) when applying game design elements in their MOOC. This highlights our first motivator for this study, the impact that gamification has had on education already.

By their very nature MOOCs offer a distance learning for all sorts of individuals, being especially beneficial for those who do not have access to a traditional higher education setting. Butcher and Rose-Adams (2015) have found that in their study sample of part-time distance learners this type of distance education was at times their only option, making clear the need for further research in the area.

We've found one existing literature review (Khalil, Wong, de Koning, Ebner, & Paas, 2018) and one systematic literature review (Ortega-Arranz, Munoz-Cristóbal, Martínez-Monés, Bote-Lorenzo, & Asensio-Pérez, 2017), although neither were extensive and they analysed a low number of empirical studies. The limitation of existing literature is our second motivator to conduct this systematic literature review, in order

to provide a concise summary of the existing literature on this growing field and to examine how it's being studied.

With engagement in courses so low our goal is to see how gamification is implemented in MOOCs, and how its impact is being measured. We'll look into the motivational theory used to support the choice of game design elements, to the objective behind its implementation and later the effects it all had on users.

1.1. Research Goal and Questions

The main goals of this research is to identify the impact that gamification has in MOOCs, as well as the different success metrics being used. Our research questions are:

RQ1 What's the impact of gamification on MOOCs?

- What identifiers of performance are used to evaluate gamified MOOCs?
- Why does it have impact?
- What gamification elements are used?
- What effect does gamification have in MOOCs?

2. Background

2.1. Self-Determination Theory

Self-determination theory (SDT) was originally developed by Deci and Ryan, and is an empirically derived theory of human motivation and personality in social contexts (Deci & Ryan, 2012).

STD distinguishes between intrinsic and extrinsic motivation. An intrinsically motivated individual will do an activity because it is inherently interesting or enjoyable, not because of an external source. While an extrinsically motivated individual will perform a task for an external outcome different from the task itself.

For Niemiec and Ryan (2009) intrinsic motivation satisfies the need for competence, autonomy and relatedness. Students are *autonomous* when choosing to spend their time and energy on a class, and *competent* when they are able to do their work. However it is necessary to be both *autonomous* and *competent* to be intrinsically motivated, if students are competent but not autonomous the state of intrinsic motivation will not be maintained (Niemiec & Ryan, 2009).

Ryan and Deci showed also that the more students were externally regulated the less they showed interest, value, or effort. These findings agree with those of Landers, Bauer, Callan, and Armstrong who states that if users in areas like education only find external rewards to motivate them, their genuine interest in the activities may not be present. In fact an individual may shift intrinsic instincts to extrinsic ones if rewards are present (Landers et al., 2015). For students many tasks are inherently interesting or enjoyable, and knowing how to promote more active (self-determined) forms of extrinsic motivation becomes an essential strategy for successful teaching (Ryan & Deci, 2000).

3. Review Method

To perform a Systematic Literature Review (SLR) we followed the guidelines of Keele et al. (2007). There are three phases in this process: planning, conducting and reporting the review.

In the initial phase, **planning the review** (section 3.1), we analysed the need for an SLR, formulated the research questions, develop and later evaluate a review protocol. In the second phase, **conducting the review** (section 3.2), we identified the research available, did a study selection and quality assessment, and conducted a data extraction and synthesis. The third and final phase consisted of **reporting of the review** (section 4).

3.1. Planning the Review

In the introduction we discussed the need for this SLR stemming from the lack of a concise yet thorough review of the literature. We formulated the research questions (section 1.1) and developed a review protocol.

To do this we set the search term to **((MOOC OR MOOCs) AND gamification)** and selected the search engines with which we would conduct the search: ACM Digital Library; IEEE Digital Library; dblp; Scopus; Google Schoolar.

Lastly we set our selection criteria.Inclusion criteria: empirical papers; related to the main question; languages spoken by us en/pt/es/fr. Exclusion criteria: languages all but en/pt/es/fr; conceptual papers; papers on *Serious Games*; papers on *Playful Design*; no access to full paper; low quality journal; unknown journal quality. Also a limited number (n=3) of conceptual papers were included.

3.2. Conducting the Review

The initial search returned 169 papers, excluding 209 duplicates. After that an initial selection took place, based on the title and abstract of each paper and its relatedness to our research questions and based on the quality of the journal. This first selection rejected 45 papers.

A final selection took place based on the introduction and conclusion of the papers resulting in 102 rejected papers. And so we were left with 22 papers to analyse.

4. Discussion

In this section we will present the data collected and summarised in order to answer our research questions.

4.1. What Identifiers of Performance are Used to Evaluate Gamified MOOCs?

In the following section we'll look into the different ways in which papers define success in MOOCs, meaning what identifiers of performance are used to evaluate gamified MOOCs and their overall performance.

4.1.1. Engagement

The most common goal of research into MOOCs is to increase engagement in users, however this is not reported as often as an effect of gamification in MOOCs (see figures 1 and 4).

Engagement is often used as a mean to increase other effects like *retention rates*, *participation* or *motivation*. It should be decided at the planing stage exactly how the level of engagement will be determined at the end of a study.

4.1.2. Retention Rate

The increment of retention rates, sometimes referred to as completion rate, is the second most reported goal. However its definition is not always the same with some authors calculating it with equation 1 and others with equation 2, giving vastly different results.

Retention rate is usually defined as the number of students who completed the course (n^{comp}) divided by the number of students who enrolled ($n^{enrolled}$).

$$Retention\ Rate\ (RR) = \ n^{comp}/n^{enrolled} \tag{1}$$

4.1.3. Net Retention Rate

However some papers define it not by the number of enrolled students, but by the number of students who never participated in any MOOC activity (n^{no_show}). This is because there can be a big discrepancy between the number of enrolled ($n^{enrolled}$) and the number of initially active people ($n^{enrolled} - n^{no\_show}$). To solve this problem some authors, like Bustamante and Jiménez (2019) calculate their retention rate like so:

$$Net\ Retention\ Rate\ (NRR) = \ n^{comp}/(n^{enrolled} - n^{no\_show}) \tag{2}$$

In table **??** we compared three of the papers which had enough information to

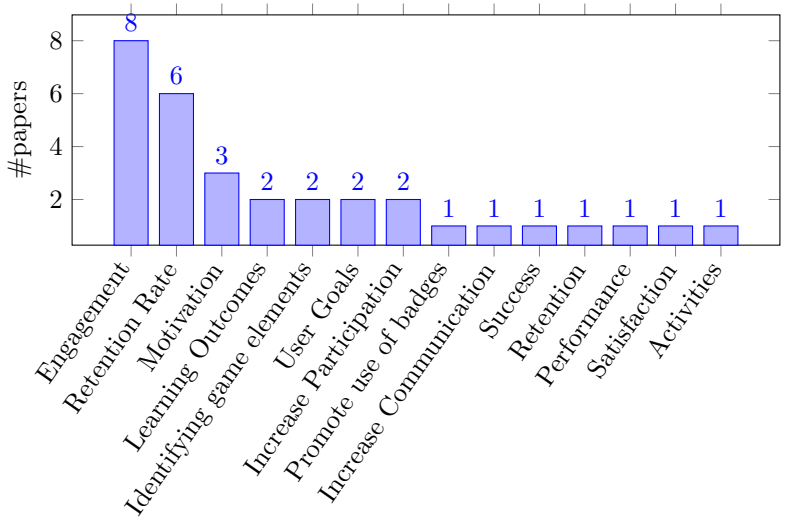

Figure 1.: Number of papers by goal

calculate Retention Rate (RR), Net Retention Rate (NRR) and the rate of enrolled users who never participated in any MOOC activity, *no-show* rate. The latter is defined as:

$$No\_Show\ Rate\ =\ n^{no\_show}/n^{enrolled} \tag{3}$$

The NRR is always higher than RR, and as we can deduce NRR will always be higher or equal to RR since the best possible outcome is to have a case with $n^{no\_show} = 0$, which would lead to $NRR = RR$.

4.2. Why Does It Have Impact?

In this section we will look into the theories used when developing a gamified MOOC. Many papers did not mention motivational nor education theoretical references as a stepping stone for their work. As a result the most mentioned theories (see figure 2), Self-Determination Theory and Flow Theory, are two decades old and don't reflect the current boom that has appeared in the last few years around gamification.

4.2.1. Intrinsic and Extrinsic Motivation

To prevent gamification from lowering intrinsic motivation some authors gamified only optional parts of the course (Ortega-Arranz, Bote-Lorenzo, et al., 2019; Ortega-Arranz et al., 2017). Some used curiosity and novelty to try and increase intrinsic motivation (Khalil, Ebner, Admiraal, et al., 2017).

Staubitz, Willems, Hagedorn, and Meinel (2017) used intrinsic and extrinsic motivation to review user types, based on the user types defined by Marczewski (2015), and which game design element could have the effect they wanted on each type. They tried to define three user types (*socializers, achievers, explorers*) with each type being intrinsically motivated by a slightly different thing. For example the *socializers* being motivated by *relatedness*.

4.2.2. Self-Determination Theory

Self-Determination theory (SDT), as explained in section 2.1, has been at least partly mentioned by four papers out of the 22 analysed (see figure 2).

Understanding what motivates a person is an important part of knowing how to best design a MOOC that meets the goal of engaging users. Out of the 6 papers mentioning STD, 5 showed increasing retention as one of their goals.

4.3. What Gamification Elements Are Used?

In figure 3 we present the 23 game design elements from the 22 papers analysed. In the rest of this section we will present a brief summary of the information collected.

Chang and Wei (2016) studied 40 gamification mechanics chosen by a focus group with 25 MOOC frequent users and later reviewed by 5,020 MOOC learners. They reported that the top 10, with 50% of of the engagingness, most engaging gamification mechanics in MOOCs are:

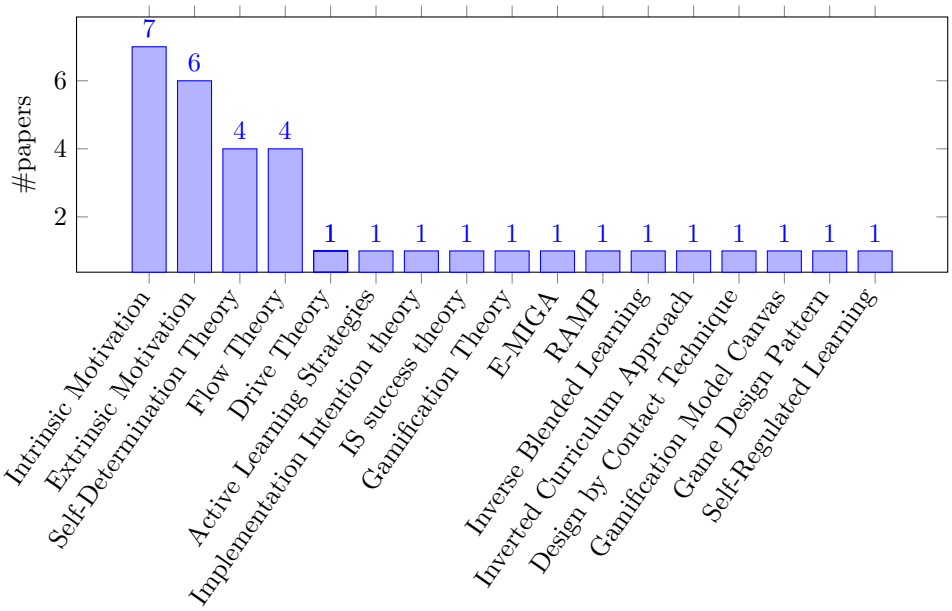

Figure 2.: Number of papers by theory

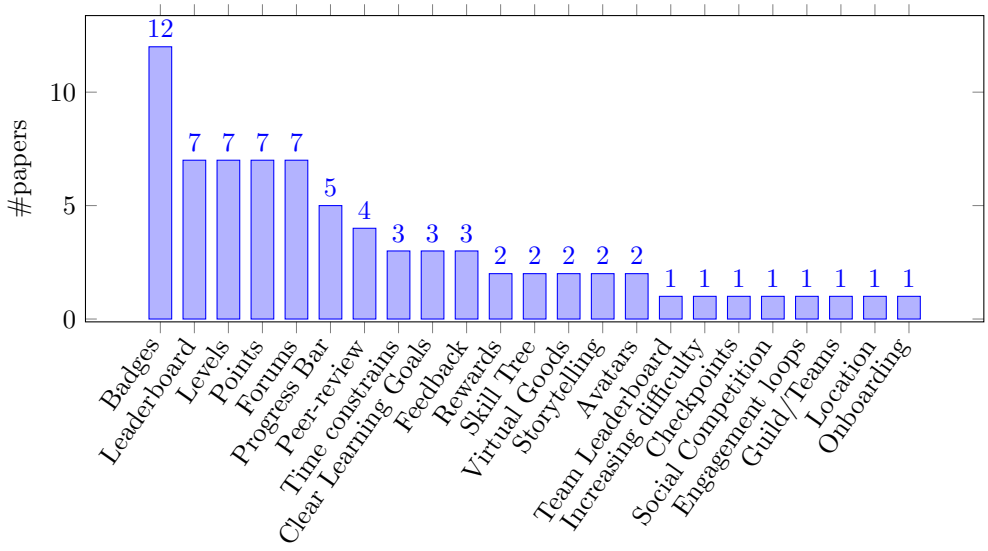

Figure 3.: Number of papers by gamification element

1. *Virtual goods*
2. *Redeemable points*
3. *Team leaderboards*
4. *Where's Wally game*
5. *Trophies and badges*
6. *Peer grading*
7. *Peer emoticon feedback*
8. *Memory-game interactions*
9. *Check points*
10. *Skill points*

On the other hand Antonaci, Klemke, Stracke, and Specht (2017) looked into the top game design patterns (GDPs) for 3 different goals: *Enhancing learning performance; Enhancing goal achievement; Enhancing engagement.* 21 GDPs were reviewed by 42 experts in three fields: game design; learning science and technology-enhanced learning.

The result of the top ranked 9 GDPs were by goal:

- Enhancing learning performance: *Empowerment, Smooth Learning Curves and Communication Channels;*
- Enhancing goal achievement: *Levels, Clues, Communication Channels, Smooth Learning Curves, Goal Indicators and Skills tree;*
- Enhancing engagement: *Guild, Skills tree, Storytelling.*

However the gamification mechanics lists studied by each paper are not exhaustive, and not all items in them match. The fact that neither list is exhaustive could explain some of the mismatch between the combined results.

4.4. What Effect Does Gamification Have in MOOCs?

In the following section we will look into the effects reported by the gamified MOOCs analysed (see table 4).

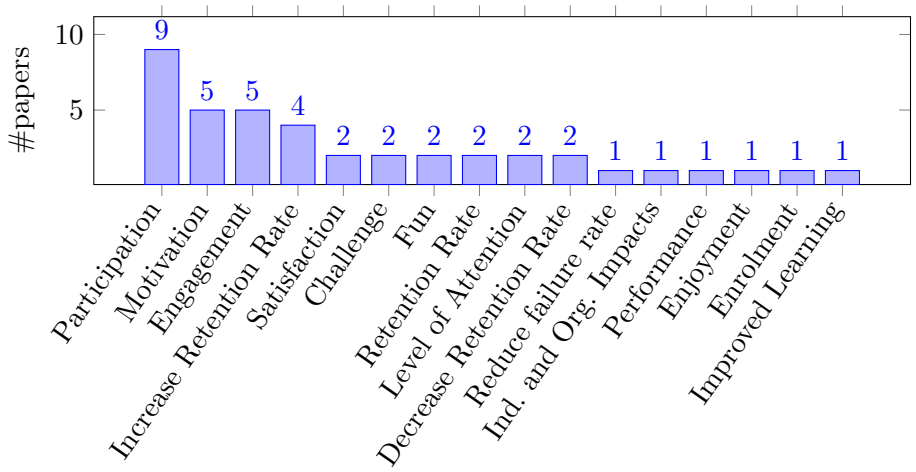

Figure 4.: Number of papers by gamification effect

4.4.1. Participation

The most common effect amongst all papers was an increase in user participation. This was reported in many ways such as:

- Increase of the number of tasks done (Butgereit, 2015; Lehtonen, Aho, Isohanni, & Mikkonen, 2015; Ortega-Arranz, Er, et al., 2019; Piccioni, Estler, & Meyer, 2014);
- More time spent on the platform (Lehtonen et al., 2015; Ortega-Arranz, Er, et al., 2019);
- MOOC use (Aparicio, Oliveira, Bacao, & Painho, 2019);
- Forum activity (Staubitz et al., 2017);
- More students attending the evaluation (Khalil et al., 2017; Vaibhav & Gupta, 2014);
- Number of lessons done (Krause, Mogalle, Pohl, & Williams, 2015).

For Ortega-Arranz, Bote-Lorenzo, et al. (2019), even though their gamified MOOC

did not help the retention rate nor engagement compared to their non-gamified MOOC, it did help already motivated learners to perform optional tasks (i.e. participation). This shows the importance of measuring *engagement* with metrics like participation.

4.4.2. Increased Retention Rate

Six MOOCs compared a plain version without game design elements, to a gamified version of the same MOOC. Of the six, four found an increase in retention rate, and two found a decrease.

For further reading on *Increased Retention Rate* see: Khalil et al. (2017); Krause et al. (2015); Romero-Rodríguez, Ramírez-Montoya, and González (2019); Vaibhav and Gupta (2014)

4.4.3. Motivation

Motivation was a performance identifier (see figure 1) on three papers (Martínez-Núñez, Fidalgo-Blanco, & Borrás-Gené, 2015; Ortega-Arranz, Er, et al., 2019; Staubitz et al., 2017), being positively reported on all three.

Meanwhile Saraguro-Bravo, Jara-Roa, and Agila-Palacios (2016) did not set motivation as a main goal, instead they studied the level *satisfaction* and *participation*. They gave an online survey in order to determine the *level of satisfaction* where they measured four main criteria (content, activities, experience, motivation). All were favorable, with *quality of content* and *motivation* in the participants being tied for highest.

4.4.4. Engagement

Although engagement was the most common goal (see figure 1), with eight papers reporting it, it only appeared in five papers as an effect of gamification in MOOCs. This could be because engagement itself is unmeasurable, showing up as *participation* or *motivation*.

Khalil et al. (2017) focused on increasing engagement and concluded that the gamified MOOC increased the level of students' attention and engagement. This was because there was a stable weekly retention in quizzes, not present in the non-gamified versions. If engagement is so highly used as a goal, for the sake of consistency, it should be better reported as an effect of gamification.

5. Conclusion

In this systematic literature review we analysed the impact of gamification in MOOCs, reviewing 22 papers and their contributions to the study matter.

As far as goals identified the two most frequent were *engagement* and *retention rate*. The first presents difficulties in measurement. The latter has different definitions, none more correct than the others. This shows the difficulty of defining a clear goal and determining a MOOC's success.

Participation was the most reported effect, with slightly different meanings, such as participation in tasks or simply time spent on the platform (see section 4.4.1). However all these different definitions point to a higher interaction with the system and to a potential increase in intrinsic motivation.

In terms of limitations we have 4 things to note. The first limitation is the lack of studies on specific game design elements. The number of empirical studies analysing only one element or comparing elements is limited, with 3 studying *badges* (Araújo, Santos, et al., 2017; Ortega-Arranz, Bote-Lorenzo, et al., 2019; Saraguro-Bravo et al., 2016) and 1 study specifically on *claimable rewards* (Ortega-Arranz, Bote-Lorenzo, et al., 2019). It then becomes hard to distinguish and separate the effects that different elements have on users.

Secondly the way effects are measured is not systematic. The choice of analysed effects, the way they are measured and the timing of the assessment can influence study results (Cook & Artino Jr, 2016; Khalil et al., 2018). Cook and Artino Jr go on to say effects depend deeply on the theory and the research question, however a great deal of the papers analysed in our review did not have a good theoretical foundation.

Thirdly, the limited number of empirical studies found made the sample of selected studies smaller than desired. Given the vast number of game design elements, outcomes reported and all the different types of evaluation, it became hard to reach some conclusions.

The fourth limitation was the search term used as it may have not caught some terms, for example a paper may have used the term *gMOOC* and so not have shown up in our search. The same goes for terms like *gamified*. As such a better search term would have been *((*MOOC*) AND (gamif*))* instead of *((MOOC OR MOOCs) AND gamification)*.

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