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How can Gamification Improve MOOC Student Engagement?

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Abstract: Massive Open Online Courses (MOOCs) require students' motivation either intrinsically or extrinsically to complete any of its courses. Even though MOOCs enjoy great popularity and bring many benefits to the educational community, some concerns arise with MOOC advancement. In fact, MOOCs are affected by low completion rate and face issues with respect to interactivity and student engagement along MOOC duration, which may convert student excitement to boredom and then drop out at any stage. A key result of research in the past couple of years has proved that students' engagement in MOOCs is strongly related to their activities online. These activities are related to the interaction between student and logging in the MOOC, reading and writing in the MOOC discussion forum, watching videos and doing quizzes. In this research paper, we present our research in deploying a gamification mechanic in MOOCs to increase student engagement. The gamification approach relies on weekly feedback to drive student intrinsic and extrinsic motivation. Following learning analytics on students' data from a MOOC offered in 2014, 2015, and 2016, the outcome of this approach showed an obvious increase in students' activity and engagement in discussion forums, login frequency and quiz trials. The active students' cohort allotment has increased in comparison with previous versions of the same MOOC as well as the completion rate has incremented up to 26% of the total number of participants.

Keywords: gamification, massive open online courses (MOOCs), learning analytics, motivation, retention, dropout

1. Introduction

Massive Open Online Courses (MOOCs) have gained a lot of attention and impetus in the last five years. They are distinguished among other learning environments by being open for everyone, easy to enrol, and having a heterogeneous community. MOOCs were first coined by George Siemens and David Cormier in 2008 when they described a four-month course on connectivism theory (Cormier & Siemens, 2010). Years later, Sebastian Thrun, a Stanford University professor, offered an online course called "Introduction to Artificial Intelligence" that received a wide publicity of over 160,000 student registrations from all over the world (Yuan & Powell, 2013). Since then, MOOC becomes an environment that was bet on bringing revolution to higher education as well as to elementary education (Khalil & Ebner, 2015) based on factors of their popularity and massiveness of enrolments (Martin, 2012).

Given that MOOCs are online systems with minimal direct interaction between students and tutors, learners are required to self-regulate their learning. In Self-Regulated Learning (SRL) in classrooms, learners are asked to adjust their attitude based on the educational context where learning happens (Zimmerman, 2002). While in MOOCs, learners have to identify what type and how much of activities they need to engage with (Littlejohn et al., 2016).

In both traditional and online learning, student engagement is a crucial aspect for learning (Lam et al., 2012). Carini, Kuh, and Klein (2006) found that student engagement were linked positively with learning outcomes like quiz performance and critical thinking. On the other hand, Archambault et al (2009) identified that student engagement can be used as a forecast element for dropout in schools. Handelsman (2005) used engagement as a short-term indictor to distinguish between students in higher education settings to either performance-goal oriented or learning-goal oriented students. Hew (2016) mentioned that student engagement might be well suited for social cognitive behaviour and academic achievement prediction.

In respect to MOOCs, Milligan, Margaryan, and Littlejohn (2013) stated that motivation is an important benefactor to student engagement as well as an indicator of student engagement.

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Despite the fact that MOOCs are rapidly developing, they are affected by low completion rate and weak student-system and student-teacher interaction (Balakrishnan & Coetzee, 2013; Khalil & Ebner, 2016; Littlejohn et al., 2016). In one of the recent studies, this has been linked to the poor engaging design of MOOCs (Chang & Wei, 2016). Researchers have proposed different approaches to improve student engagement through concentrating at motivation from both sides of one coin, intrinsic and extrinsic motivations. For instance, one study linked the intrinsic motivation of MOOC learners to the inner intention to learn, compete and satisfy their curiosity (Wang & Baker, 2015). Other research studies tried to increase student engagement through drawing focus on the extrinsic side of motivation by introducing open badges and certificates to attract online learners (Wüster & Ebner, 2016). Although classical reward certificates were promising when they first were introduced, learners think that completing a MOOC to have completion certificates is not sufficient enough to finish a course (Hew, 2016). As a result, various new strategies that targeted to ignite the extrinsic motivation of learners were proposed; gamification as one of these strategies. The main aspect of using gamification in educational settings were mentioned in different studies as a tool, strategy, and methodology to entertain students (Gené, Núñez & Blanco , 2014; Chang & Wei, 2016; Wüster & Ebner, 2016).

Motivated by the increased impetus of gamification in education (Chang & Wei, 2016) and the youth generation of online learners (Hansen & Reich, 2015), in this publication we present our experiment on using an early-developed gamification framework (Khalil & Ebner, 2017) in a massive open online course. The goal of this research is to study the use of a gamified strategy that looks at increasing students' incentive to study MOOCs yet sparking their curiosity taking into account both intrinsic and extrinsic motivation factors. The intrinsic motivation will be driven by curiosity-guided strategy and the extrinsic motivation by a rewarding strategy influenced by the theory study of Ryan and Deci (2000). The study takes place in one of the offered MOOCs from the Austrian MOOC provider, iMooX (http://www.imoox.at). The main research question of this study is to examine *whether gamification can increase student engagement and activities and henceforth improve the retention rate of MOOC learners*. To carry out this research, we used a local developed learning analytics tool to support us in collecting and analysing the data from the MOOC.

The remainder of the paper is organized as follows: Section 2 is the related work of gamification use in MOOCs. Section 3 gives a short background of the tested MOOC and the iMooX platform. Section 4 lists the followed gamification approach and the deployment phase. Section 5 presents the results and discussion of this study. Finally, section 6 draws the conclusions.

2. Related work

This section enriches the paper by reviewing some of the related topics of gamification and engagement in the context of MOOCs. Through our examination in different academic libraries, the return results showed some relevant studies that surveyed gamification in MOOCs and others that aimed at improving students' engagement through the use of gamification mechanics. Gamification is defined as "the use of game design elements in non-game contexts" (Deterding et al., 2011). Given the issues of dropout and motivation in MOOCs, gamification mechanics were considered promising to alleviate such dilemmas. Practitioners linked gamification strategies in non-game settings to add fun and increase engagement and enjoyment of a service or a product (Hsu, Chang, & Lee, 2013). Gamification incorporates entertainment on its surface, but may function as playground for competition and collaboration. In respect to MOOCs, the popular MOOC providers like Coursera and edX became aware of the gamification impact on learners and introduced the use of rewards and badges as strategies to attract the students. The language-learning platform Duolingo has gone further with gamifying the platform. Duolingo uses skill points, badges, certificates, and a levelling system as incentive to encourage students to study and increase the competition level among them. Another popular MOOC platform, Khan Academy, employed gamification in various ways. Khan Academy has used Knowledge maps, badges and progress indicators in order to enhance students' motivation (Morrison & DiSalvo, 2014).

Through our search in the literature and to our knowledge, the biggest survey study on gamification in MOOCs, was done by Chang and Wei (2016). Their study scrutinized over 40 gamification techniques and their impact on student activities and motivation in MOOCs. Chang and Wei (2016) stated that not every gamification technique could enthral online learners. They found out that virtual goods, redeemable points, team leader boards, where's Wally game, and trophies are the top five most engaging gamification mechanics in MOOCs. The authors concluded the critical role of gamification in MOOCs as factors that push learners to spend a higher average time, enhance self and content interaction.

An empirical study by Vaibhav and Gupta (2014) examined the use of gamification in a MOOC through an A/B testing planned task. The researchers found out that the gamified quiz attracted a larger number of students than those without gamification in regards to the number of quizzes student submitted. Additionally, Vaibhav and Gupta (2014) realized that the success rate of the quizzes were higher for the cohort who were supported with gamification and therefore recorded a slight increased retention in comparison to the control group.

Gené, Núñez, and Blanco (2014) suggested applying gamification in MOOCs by replicating an experiment from Moodle learning system. The researchers looked at promoting cooperation and motivation in MOOCs and lowering dropout rate by using different gamification strategies such as ranking rating, voluntary activities, course progress and certificates. Two years later, the authors (Gené, Núñez, & Blanco, 2016) published a qualitative interview and survey study stating that gamification tools have deepen student learning and increased student motivation and engagement within the MOOC content.

Another practical experience by Morales et al (2016) used three gamification strategies (leader boards, badges, and rewards) to increase student participation in their MOOC. The gamification approaches were deployed in discussion forum, assignments section and completed activities. Results of this study showed that the rewarding system was the most successful one based on a qualitative post survey while leader boards in the discussion forum were evaluated the lowest engaging strategy. Nevertheless, the authors reported that students faced challenges in regards to the dynamics of understanding each gamification strategy.

Although the previous studies shed light on gamification in MOOCs, the current literature involves little empirical validation. Our study seeks to bridge, to some extent, this gap with additional evidences on the significant use of gamification in MOOCs and its capabilities to improve student engagement.

3. The MOOC platform and the studied MOOC

3.1 The MOOC platform

As previously mentioned, this study is carried out cooperating with the Austrian MOOC platform (iMooX). iMooX is an online stage and the first Austrian MOOC platform founded in 2013 by Graz University of Technology and University of Graz. Since the first year launch of iMooX, over 5,000 registrations have been recorded in the database. Most of the courses are offered in German language and target not only academic holders but also elderly as well as school children. The pedagogical approaches of iMooX stand on the cognitive-behaviourist and social-constructive pedagogies through providing a rich interactive discussion forum, a convenient structure of information exchange, and a stimulus demonstration of active online learning videos. All the quizzes in iMooX follow the multiple-choice questions system by which every quiz is setup to give students the ability to try each weekly quiz more than once. The questions of each quiz trial are randomized for every attempt. The main reason behind this is to less stress students so that each student behaves in a more comfortable manner by picking the highest grade out of student tries, and to support the self-assessment learning guidance in MOOCs. When the students successfully finish the quizzes and fill out an final evaluation form at the end of a MOOC, they are rewarded with certificates completely for free.

3.2 MOOC studied

We implemented our research study on one iMooX MOOC called *Free Online Learning* course or as it is named originally in German language *Gratis Online Lernen* (Ebner, Schön & Käfmüller, 2015) that was offered in 2016. To ease denoting the course name in the context of the paper, we abbreviate the MOOC name to *GOL* in corresponds to the German name. The course was offered in 2014, 2015, and 2016 respectively and was instructed by Graz University of Technology. The structure of the MOOC was organized to be presented over a time-period of eight weeks with a set load of 2 hours/week. The *GOL* MOOC topic focused on the general topic of learning with the Internet (online learning) as well as on informing the public on the significant rising momentum of Open Educational Resources (OER), as well as the right to access, share, and adapt them. Following similar MOOCs, *GOL* course was supported with a set of affluent short videos, multiple-choice quizzes, a discussion forum, and recommended articles that are available to download. The MOOC was open to everyone without a need for any prerequisite knowledge. Furthermore the MOOC is following the didactical concept of Inverse Blended Learning, first introduced by Schön & Ebner in 2014[2]. The Inverse Blended Learning concept

[2] https://elearningblog.tugraz.at/archives/7412

focuses on meeting up the online learners on a round table, handing them additional printed materials as well as sharing thoughts and results in the online MOOC discussion forum. In comparison to other iMooX MOOCs, *GOL* attracted that largest number of participants in its first version with around 1,000 students.

4. The gamification approach

The research at hand followed our early-published concept *Activity-Motivation Framework* (see Figure 1; Khalil & Ebner, 2017). The main idea behind the conceptual framework was to increase retention rate through enhancing student engagement in MOOCs. To do so, the framework relied on a weekly-gamified feedback to drive student motivation. The scheme of the Activity-Motivation approach corresponds to the iMooX platform potential of offering various MOOC variable data: 1) quiz attempts, 2) watching learning videos, 3) reading in discussion forum, 4) posting in discussion forum, and 5) logging in MOOCs. In fact, the framework was set after testing the hypothesis that says students who complete MOOCs are more likely to perform extra activities (like watching videos, more involvement in forums..etc.) than those who do not (Khalil & Ebner, 2017), or in other way around, the more students participate and engage the more likely they finish a course. Based on that, the Activity-Motivation framework was developed in reliance on MOOC activities and the concept of motivating students to increase the general engagement hoping for an increased completion rate.

In short, figure 1 displays a battery gamification element that is weekly charged based on four-dimensional MOOC variables (the number of logins, the number of videos watched and rewatched, the number of quizzed completed and the level of participation in the discussion forum). Our reason for choosing the battery icon returns to our thought of what happens to a battery is somehow similar to what a student does in MOOC platforms. We aimed at charging students with motivation and incentive by sparking their curiosity (Ryan & Deci, 2000). To attain the curiosity strategy, the algorithm was concealed on purpose and students never know how the battery symbol is charged/filled. The intention was to stimulate student intrinsic motivation to do more activities and actions in the MOOC by driving them to guess how the gamification approach works.

Each of the four dimensions contributes with a portion to fill the battery cumulatively. If a student logs in the course, watches a video, makes activities in the discussion forum and does a quiz, the battery will be fully charged. By the end of each week, the students are rewarded with the battery icon that only illustrates their prior activities and a motivational statement. Any shortage of one or a combination of these MOOC variables, the battery will be less charged based on student MOOC actions.

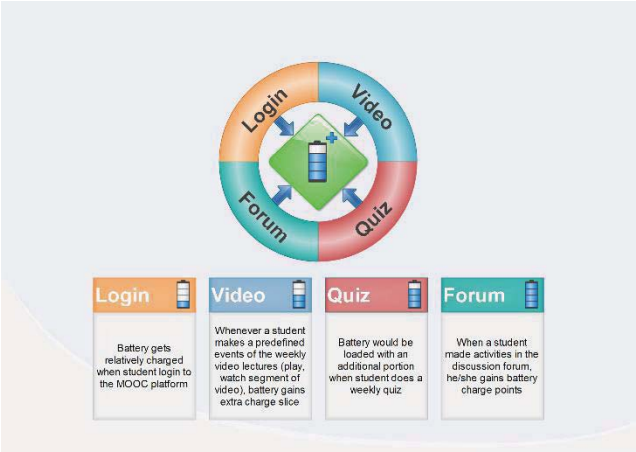


Figure 1: The MOOC activity-motivation framework employs MOOC variables in a gamification approach (Khalil & Ebner, 2017)

4.1 Deployment of the gamification approach

In this part, we show how the gamification approach was deployed in the *GOL* MOOC. The process of the gamification approach implementation was done manually since we were looking for evaluation results at the first stage. A second stage of automatic implementation can be systemized on upcoming MOOCs if the results are promising to the iMooX higher management. Our first step was to design the battery gamification element that should be attached to each profile. We chose an open source software called Inkscape (http://www.inkscape.org, last accessed: April 2017). Through our design, we aimed at having symbols that

supports the information-oriented aspect in which they reflect an easy understanding of visual elements. The design of the symbols followed the recommendation list for an effective visual communication of graphical user interface by Suzanne (1995). A key principle of Suzanne's (1995) list is to have a clear and strong visual identity of designed symbols. As a result, our design was simple and clear of a 2-D layout with a fine mix of light colours. Figure 2 shows five categories of the battery gamification symbol by which each of them represents a single status.

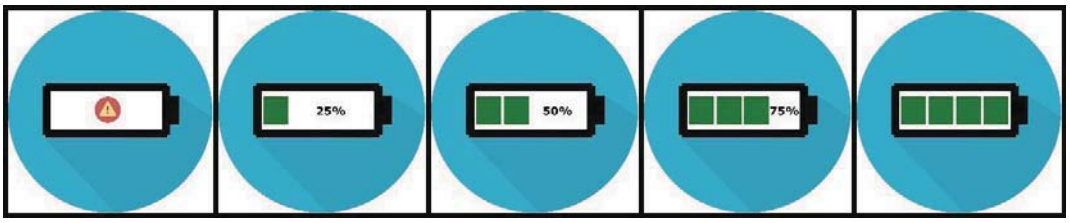


Figure 2: Five categories of the battery gamification element in iMooX MOOC platform

Each symbol in figure 2 was displayed on the top left side of each user homepage of the *GOL-2016* MOOC and a brief news feed was posted on the MOOC's homepage advertising about the gamification symbols.

Every battery symbol represents the recorded MOOC activity of the user based on the learner's previous week's interaction. For example, by the end of the first MOOC week, we show the student activity progress of that week on the first day of the second week and so forth except for the period of the first week where the system was automated to show 0% battery status since all students started with no activity.

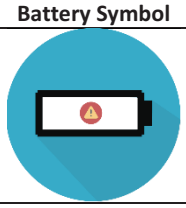
The MOOC activities that were planned to be logged in our implementation were: a) logging into the MOOC homepage, b) doing a quiz, c) posting/commenting at least once or reading two threads in the MOOC's discussion forum, and d) watching a video. Nevertheless, we faced a major technical problem with logging user video activities. The problem was detected just a couple of days before the MOOC launch date (10th.October.2016) when we discovered that the MOOC videos were embedded using *IFRAME* instead of *OBJECT* on the iMooX platform. Therefore, our simple and quick redress was that by assuming a user logs in, we show the "50%" battery symbol. Given this issue, we excluded the video activity and the quarterly-charged battery symbol.

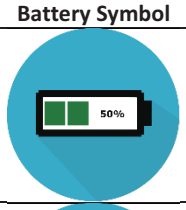
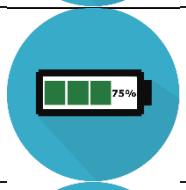
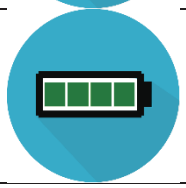
The final trailed approach for showing the battery symbols, thus, was established by the following guidelines based on every week activities:

- *Login activity*: When a student logs into the MOOC, the activity will reflect relatively on the gamification element (battery). The first segment of the battery will be 50% charged. Several logins will not increase the charged portion.
- *Quiz activity*: The battery symbol will be filled with one extra portion (25%) when a student takes a quiz. As described before, the iMooX MOOC-platform allows each student to try the weekly quiz up to five times. However, just one trial would be enough to indicate that the student is active not just as a lurker. Several attempts will not increase the battery's charged portion.
- *Discussion forum activity*: If a student is engaged in the forums either by writing at least one post or reading threads twice, then the battery-charging portion will add another 25%.

To support a multiple form of representation for gamification symbols, we took into consideration showing a percentage numeral that denotes progress and arranged a tooltip for each symbol so that students can recognize what these symbols imply (see table 1).

Table 1: The gamification battery symbols with their tooltips

Battery Symbol	Tooltip
	No activity last week – we are looking forward to seeing you again this week!

Battery Symbol	Tooltip
	Your activity last week was 50%. Good! Increase your activities to score better!
	Your activity last week was 75%. Great! Keep it up!
	Your activity in the previous week was 100%. Congratulations! Your commitment is excellent. Keep it up!

5. Results and discussion

The further step was to evaluate the efficacy of the gamification approach and to tackle our research question. The total number of enrolees of the *GOL*-2016 MOOC was not as much as the previous versions *GOL*-2014 and *GOL*-2015 (Table 2). A brief explanation for the lower involvement might belong to the iMooX huge advertisement back in 2014 when iMooX was first launched. That is, *Gratis Online Lernen* 2014 MOOC was one of the few offered courses at that time.

Table 2: Total number of enrolments of the *Gratis Online Lernen* MOOC

Course	# of Enrolees
GOL-2014	1,003
GOL-2015	476
GOL-2016	284

Next, we collected through our manual implementation the total number of students and their engagement level based on the gamification statuses as shown in figure 3.

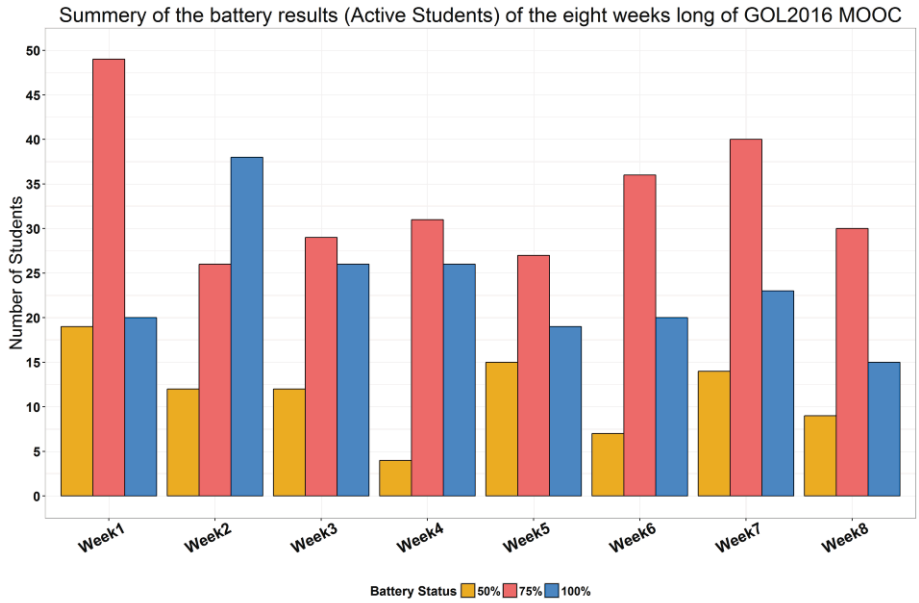


Figure 3: Summary of the battery results (left to right 50%, 75%, 100%) of active students in *GOL*-2016 MOOC. non-active students or the 0% battery are excluded

The figure shows an elevation of the 75% battery status in the number of students across all the MOOC weeks. By investigating student behaviour in the discussion forums and the submitted quizzes, students who are

committed to complete the MOOC have intended to log in at least once a week and do the weekly quiz. That is, students were more involved in doing quizzes than being involved in the discussion forums which is an expected behaviour in order to have a certificate.

Also, the figure shows that there is a slight decrement of the 50% battery status from week1 to week8 wavering from (*N*=19) in the first week to (*N*=7) in the eighth week. This was interesting since active students tried to push more efforts to score higher than the 50% or the 0% battery status. For instance, the number of students who were active has increased by 15.5% than the status of week1. Week4 showed the minimum score of 50% status. On the other hand, the full activity status 100% was at its highest in the second week with around (*N*=38) students. Our explanation of this behaviour can be interpreted by the fact that students were pushing more efforts to improve their battery status influenced by the motivational triggers. Likewise, the stability of participation in quizzes is clear across all the weeks. It is worth pointing out that some students might do quizzes in different weeks. This can be complicated to track. Nevertheless, our tracking records were based on every week's quizzes, logins and forum activities.

To check the validity of how active the students were within the MOOC variables, we inspected the quiz activities across every week of *GOL*-2014, *GOL*-2015 and *GOL*-2016 using the iMooX learning analytics tool. Figure 4 depicts bar plots for the number of students who did at least a one quiz in every MOOC week. The x-axis represents the MOOC weeks; the y-axis represents the number of students (*identical students not repetitive*). We preferred to show a plot for each MOOC since there is a substantial difference of enrolments among every MOOC.

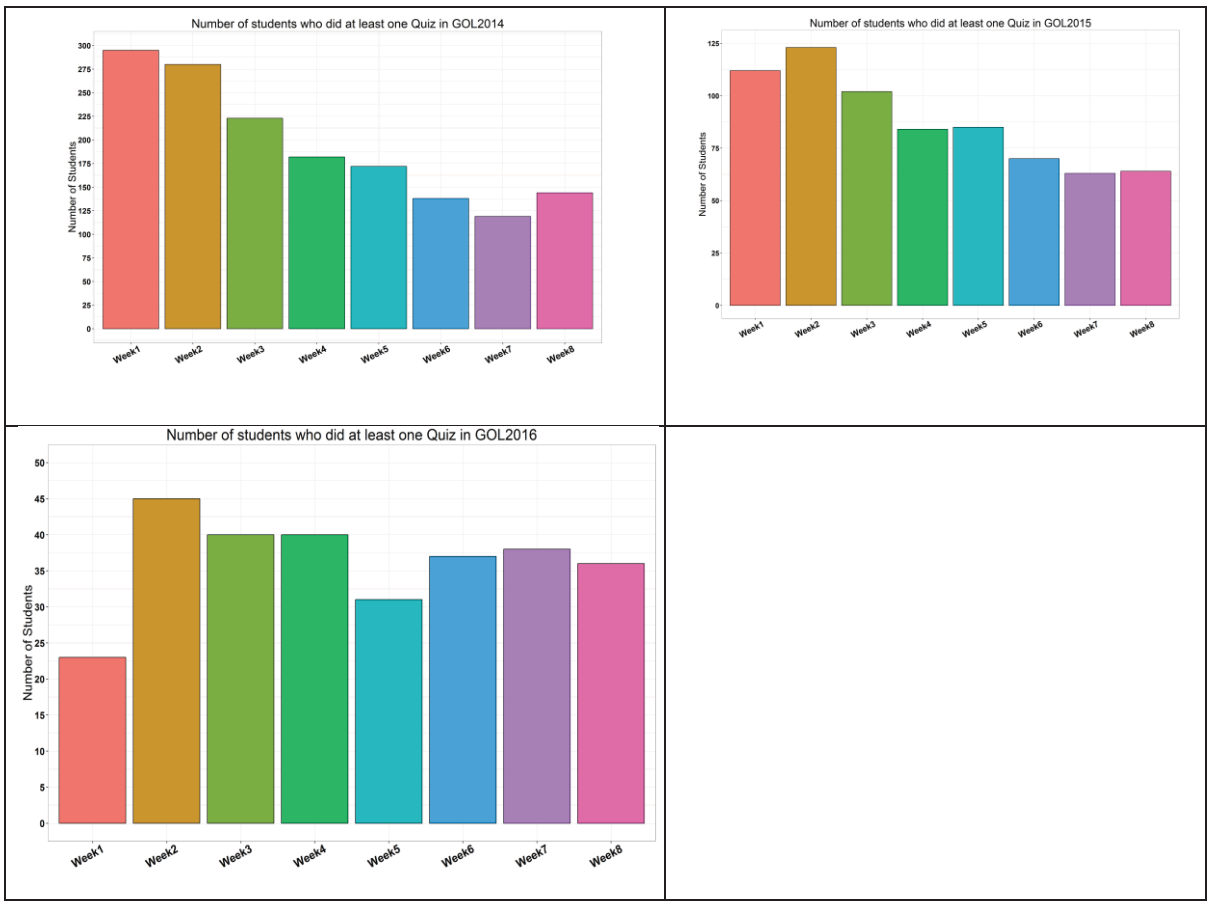


Figure 4: The number of students who did one quiz of each described week (a) Top-left: *Gratis Online Lernen* 2014 MOOC (b) Top-right: *Gratis Online Lernen* 2015 MOOC (c) Bottom: *Gratis Online Lernen* 2016 MOOC

In figure 4a, we can see that the number of students who did the *GOL*-2014 quizzes dropped across the weeks except for a slight increase in the last week. Student engagement usually reveals a high attrition scale in activities in the first two weeks (Balakrishnan & Coetzee, 2013). Likewise in figure 4b, the plot shows nearly the same direction of *GOL*-2014 behaviour by which students were doing quizzes of *GOL*-2015 actively in the first two

weeks and then dropped till the last week of the MOOC. On the contrary, figure 4c shows a very interesting student engagement behaviour in the *GOL*-2016 MOOC where the gamification approach was applied. The number of students who did the second week quiz nearly doubled when compared with the first week. We believe the reason behind is because every student was given a 0% battery status when the MOOC started. Given that the gamification element mechanism was hidden as a type of curiosity-driven behaviour, i.e. intrinsic motivation, students tried to figure out how to progress better the week after. An alternative explanation can be related to the extrinsic triggers as well in which students pushed efforts in order to gain the highest status of the battery gamification element.

The figure further shows that the number of students in week3 till week8 represents a stable participation rate in weekly quizzes in comparison to *GOL*-2014 and *GOL*-2015 participation.

Before moving to the completion ratio of *GOL* MOOCs, we wanted to examine the first part of the research question that hypothesise if our gamification approach has increased student engagement. With this in mind, we categorized students to a) registrants and those who register in the MOOC; b) active students and those are the students who make at least one quiz or post in the discussion forums; and c) certified who successfully complete a MOOC and are granted a certificate.

With the available filtered data from the learning analytics tool, we categorized the students of *GOL*-2014 and *GOL*-2016. The cohort distribution for these two MOOCs is shown in table 3. The offered MOOC in 2014 recorded (N=1,003) registrations, *GOL*-2015 (N=476), while *GOL*-2016 had a total number of (N=284) registered participants. Given the active student definition, the grouping of participants resulted in having (N=475, P=47.3%) in *GOL*-2014, (N=188, P=39.49%) in *GOL*-2105, and (N=209, P=73.5%) in *GOL*-2016 of active students. Surprisingly, the ratio of active student in *GOL*-2016 has increased (P=55.3%), by which denotes a significant difference in comparison to *GOL*-2016 MOOC. This demonstrates that students were more digitally engaged and did additional activities to have a higher score with the gamification symbol.

On the other side, the certification ratio results were also promising for the gamification deployed MOOC. *GOL*-2016 had a (N=74, P=26.05%) of certified students which is relatively higher than the previous offered MOOCs. *GOL*-2014 and *GOL*-2015 MOOCs have lower certification ratio equalled to (P=17.54% and P=19.74%) respectively. Although the certification rate of the *GOL*-2016 MOOC was not of that big difference with the other MOOCs, the students in *GOL*-2016 were more digitally engaged in comparison. Besides the quiz activity in the *GOL*-2016 MOOC, student other actions were actively present in discussion forums and login frequency.

Table 3: Overview of *Gratis Online Lernen* MOOCs cohort distribution

Course	Registrants	Active students	Certified
GOL-2014	1,003	475 (47.35%)	176 (17.54%)
GOL-2015	476	188 (39.49%)	94 (19.74%)
GOL-2016	284	209 (73.59%)	74 (26.05%)

6. Conclusion

The use of gamified mechanics in non-game contexts has become popular recently (Deterding et al., 2011; Hsu et al., 2013). Gamification is looked at with potential to leverage student engagement and motivation in educational contexts. Thereupon the gamification capabilities and the given MOOC dilemmas, this paper presented our experiment and the results of gamification deployment in a massive open online course that focused on two main issues of MOOCs: participation and engagement.

We used a simple gamified approach that supported a weekly feedback. The deployment results show that the MOOC by which gamification was applied to, has gained an increased level of students attention and engagement. The gamification approach of this experiment was instrumental in increasing the student interactions with MOOC variables on one side and increasing the student motivation to complete quizzes on the other side, which leads to students wanting to complete the rest of the quizzes. In addition, the analysis identified a stable participation rate in weekly quizzes in comparison to previous tested MOOCs. The outcome of this research study also confirmed a slight increase in the certification ratio in MOOC when gamification was deployed.

We believe our approach was distinct than previous research studies through targeting intrinsic motivation and extrinsic motivation factors together. The intrinsic motivation was driven by obtaining student curiosity while the extrinsic motivation was driven by the battery gamification symbols progress. However, the explanation of this research study and how students react to both motivation triggers are only based on numeric and learning analytics. A future direction by doing a post survey can further explain how student perceived our gamification approach.

Finally, gamification may carry tremendous potential behind. That is, it ties strongly with student motivation and therefore increases the general completion rate. The big MOOC players like edX, Khan Academy, and Coursera have become aware of the importance of gamification designs and the future will carry new techniques that will verify their impact on the success of MOOCs.

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