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The Gamification of a MOOC Platform

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***Abstract*—Massive Open Online Courses (MOOCs) have left their mark on the face of education during the recent couple of years. At the Hasso Plattner Institute (HPI) in Potsdam, Germany, we are actively developing a MOOC platform, which provides our research with a plethora of e-learning topics, such as learning analytics, automated assessment, peer assessment, team-work, online proctoring, and gamification. We run several instances of this platform. On openHPI, we provide our own courses from within the HPI context. Further instances are openSAP, openWHO, and mooc.HOUSE, which is the smallest of these platforms, targeting customers with a less extensive course portfolio. In 2013, we started to work on the gamification of our platform. By now, we have implemented about two thirds of the features that we initially have evaluated as useful for our purposes. About a year ago we activated the implemented gamification features on *mooc.HOUSE*. They have been employed actively in the course "Design for Non-Designers". We plan to activate the features on *openHPI* in the beginning of 2017. The paper at hand recaps, examines, and re-evaluates our initial recommendations.**

Keywords— Gamification, e-learning, MOOC, massive open online courses

I. INTRODUCTION

The term *gamification* is generally defined as the application of game elements in non-gaming contexts [1]. The concept remains a fluid term though, as there exists no broadly agreed on standard definition yet [2]. Driven by the successful implementation of gamification in other contexts such as the *StackExchange*[1] network, the location-based social network *Foursquare*[2], or the Customer Relation Management (CRM) software *Salesforce*[3], we started to examine if and how we could incorporate game elements in our MOOC platform. Right away we found promising gamification examples in the educational sector, e.g. *Khan Academy*[4], *DuoLingo*[5], or *Codeacademy*[6] to name just a few.

Other researchers have worked on this topic before. Hansch et al. [2] for example examined a couple of gamified learning platforms including *openHPI*. For all these platforms, the main motive to employ gamification was to increase the engagement of their learners. Progress tracking has been named by all platforms as the initial step. At least two of the examined platforms report that their users keep returning in rather high numbers to participate in further courses. Most platforms report that while some of their users are very active in the discussion forum, the clear majority keeps rather silent. Gamification is considered to be a tool to engage participants more intensely with the discussion forums in most cases [2]. MOOCs, even without gamification, show an inherent tendency to drift towards Edutainment [2]. While this is sometimes helpful and appreciated, we should be careful not to alienate the serious learners. Gamification has, therefore, to be employed very carefully.

We started to investigate the options of gamifying our platform back in 2013. In the following year, we worked on prototypes addressing several aspects of the gamification of the platform. Currently, about two thirds of the features that we had evaluated as useful for our purposes during the research phase, are implemented in our code base. About a year ago, these features went into production and have been activated on *mooc.HOUSE* to evaluate the outcomes. On the other platforms, they run in stealth mode, the data collection is activated, but there is no user interface that displays the results to the course participants. It is planned to reset the collected data and activate the features on openHPI in the beginning of 2017. The features have been actively promoted in the first iteration of the course *Design for Non-Designers* on mooc.HOUSE. The same course had been conducted previously on the same platform, before the gamification elements had been deployed. After the deployment of the gamification elements, other courses on mooc.HOUSE were offered in which they have not been actively promoted by the teaching teams. In total this situation provides us with the possibility to evaluate the effects of the platform's gamification from different perspectives. In Section II we present the initial motivation why to employ gamification and discuss how far these thoughts are still valid. Section III discusses some theoretical backgrounds. Sections IV to VI present the features we have deployed or planned in more detail. Finally, Sections VII and VIII present the evaluation of the features and our conclusions.

II. THE INITIAL PROBLEM SETTING

One of the criticisms towards MOOCs is that they suffer from high dropout rates. When we first started to think about the gamification of the platform in 2013, we had an average completion rate in our courses of 18.3% (#certificates / #participants-at-course-end). Back then this was a very good ratio compared to other platforms[7]. Figure 1 shows how the average submission rates of the graded weekly assignments

[1] http://stackexchange.com/
[2] https://foursquare.com
[3] https://www.salesforce.com /
[4] https://www.khanacademy.org/
[5] https://www.duolingo.com/
[6] https://www.codecademy.com/
[7] http://www.katyjordan.com/MOOCproject.html

declined throughout the six weeks' duration of the courses, which we offered on openHPI in 2012 and 2013. The submissions count for the week 1 assignment has been defined as 100%. The submission rate drops strongly in week 2 and 3 (82% respectively 73%), but from then on stays rather stable.

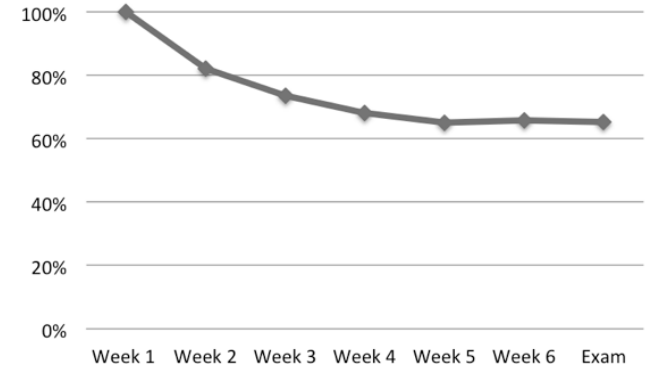

Figure 1: Average weekly assignment submission rates in the 2012-2013 courses [3].

Although our completion rates already were comparably high, we felt the urge to still increase them and advance our platform. The idea was to employ gamification to improve the completion rates of the courses. Our hope was to keep those interested who get bored or lose interest over time by injecting a little "extrinsic motivation intervention" here and there.

We ran the same statistic for the courses that we have conducted since then and have similar results. Figure 2 shows the submission rates for the courses that have been examined for the paper at hand. As in Figure 1, the submissions count for week 1 has been defined as 100%. Figure 3 shows the passive participation in comparison. Here the number of participants that have visited more than 10% of week 1's items have been defined as 100%. Both, Figure 2 and Figure 3, show that obviously, the gamification features did not have any influence on the results.

Meanwhile, three years and a couple of courses, surveys and user feedback later, our perception of drop-outs has somewhat changed. It became obvious that not every participant is interested in a certificate. At an extreme, some participants might even consider a course a success if they just find a particular piece of information in one of the videos.

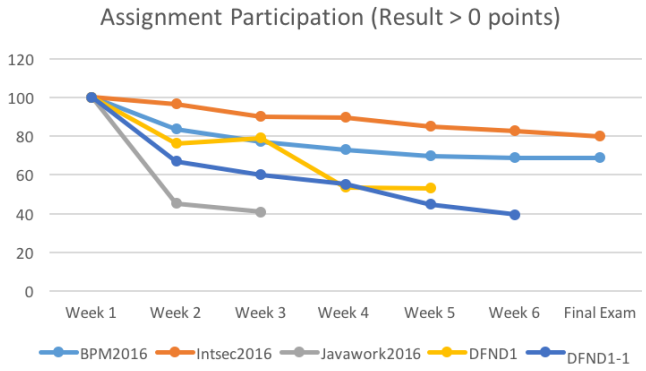

Figure 2: Weekly submission rates in the examined courses. See TABLE III. for additional course data. The absolute submissions in week 1 have been: 1344(BPM2016), 4803(Intsec2016), 705(Javawork2016), 769(DFND1), 375 (DFND1-1). The course Industrie4.0 did not have any exams. Gamification features have been activated and visible in the course DFND1-1 and Industrie4.0.

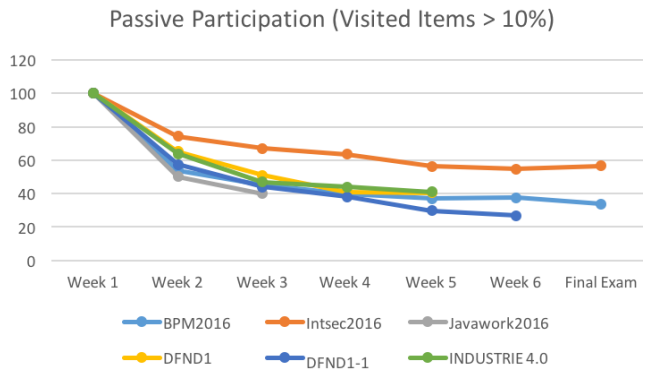

Figure 3: Participants that have accessed more than 10% of the week's items. The number of participants that have accessed more than 10% of week 1's course items have been defined as 100%. Participants that have visited more than 10% of the course items in absolute numbers: 3664(BPM2016), 8670(Intsec2016), 1802(Javawork2016), 1732(DFND1), 1176(DFND1-1), 5749(Industrie4.0). Gamification features have been activated and visible in the course DFND1-1 and Industrie4.0.

We have very early argued that the discussion on drop-out rates is flawed and have already published our findings towards these numbers back in 2014 [3]. Based on these thoughts and enabled by the more fine-grained data that we have collected by now, we changed the way how we calculate the completion rates. Currently, only the users that have enrolled before the course middle are considered, as they are the only ones who can complete the course with a sufficiently good grade. In these terms, we have completion rates ranging between 2.8% and 37.9% in the courses we offered since we moved to the new version of our platform in 2014 (see [4] for more detailed information on the development of our platform). The average completion rate in the examined courses is about 17.75%. In comparison, the average would be 16.01% if we use the original formula as mentioned on the previous page. The decline compared to the results from the 2012 and 2013 courses is caused by some outliers. E.g. the course with the lowest completion rate (Javaworkshop2015) is a good example why even the way we currently calculate the completion rate is still not quite correct. This course had a comparably high *no-show* rate (*no-shows* are people that enroll for a course but never even start it), as it had to be postponed for several months due to organizational reasons. Renz et al. have already proposed to re-calculate the drop-out rates by removing the no-shows from the calculation [5]. By following this approach, we achieve more accurate completion rates between 5.7% and 42%; 22.8% in average. We are dealing with a homemade issue of the MOOC community here, as every course provider is eager to show off with massive numbers of enrollments. Calculating completion rates this way, requires to be honest about the real number of participants as well.

III. Educational Background, Motivation, and Learner Types

A. A Word of Warning

Gamification is rooted in the behaviorist education model as proposed by B.F. Skinner in the 1950-60s [6] [7]. His educational model was built on the theories of J.B. Watson, who himself was influenced by Pavlov's work on conditioned reflexes [8]. Skinner proposed that children learn to speak in their mother tongue based on a given set of words and sentences, positively reinforced by receiving little rewards when they do it right [9]. The behaviorist learning theory assumes that all behavior are mere reflexes on consequences that result from previous behavior. The teacher is assumed to be a benevolent dictator rewarding or punishing the learner for right or wrong behavior, whereas rewarding correct behavior is rated to be superior to punishment [9]. The behaviorist model was very dominant in early forms of e-learning. Skinner himself developed a teaching machine to be employed in "*programmed learning*." Questions were shown to students and in the case of a correct answer, the student received a reward [10]. E-learning often tends to fall back to these primitive mechanisms as they are the easiest to implement. Gamification elements, such as game points or badges, are a means of positive reinforcement. Similar mechanisms are still used in "analogue" learning environments, such as "praise cards", etc.

Noam Chomsky back in 1959 already doubted that—if Skinner was right—humans would be able to learn to use their language in its infinite variety of combinations [11] , one of the abilities that define the distinction between human and animal. We, therefore, should be very thoughtful when we employ gamification in a learning context if we do not want to end up with a system that favors learning by rote instead of real understanding.

B. MOOCs, MOOC Platforms, and Educational Theory

The first cMOOCs, provided by George Siemens and Stephen Downes, originated from the connectivist theory and did not make use of a dedicated MOOC platform at all. The following, and in terms of enrollment numbers much larger, xMOOCs fell back to a rather classic instructional approach where knowledge is imparted by a teacher via the use of video. In those days, an ecosystem of MOOC platforms, such as Coursera[8], Udacity[9], edX[10], openHPI[11] etc., MOOC search engines such as Class Central[12], MOOC list[13], Open Education Europa[14] and other peripheral resources, such as blogs about MOOCs evolved. When edX open sourced their code base many other course providers were enabled to run courses on their own platforms, based on the edX code, France Université Numerique[15] or XuetangX[16] in China to name just a few.

Some MOOC platforms claim to implement more modern educational paradigms. The British platform FutureLearn[17] claims to implement a social constructivist model. NovoEd[18] and openHPI/openSAP/mooc.HOUSE provide increasing support for teamwork, etc. The order in which we implemented features shows our priorities. *CollabSpaces* enabling teamwork [12] [13], support for practical programming exercises [14] [15] [16] or a peer assessment system [17] [13] have had a higher priority than the gamification of the platform. That said, we still are convinced that, in a few well-defined areas, it will have positive effects for our learners in the long run.

C. Motivation Theory

In the following, we will briefly present three theories that try to answer the question about the motivation of our participants to finish a course. For more details see also Staubitz et al. [19].

In their *Self Determination Theory (SDT)* [20] Deci and Ryan state that people are innately curious and interested creatures who possess a natural love of learning and desire to internalize knowledge, customs and values. Their term for this is *intrinsic motivation*. They identified three major intrinsic motivators:

- Competence—humans attempt to be efficient and good in what they are doing
- Autonomy—humans attempt to be in command of their life
- Relatedness—humans have a universal desire to interact and be connected with others

Daniel Pink's *Drive Theory* [21] differentiates between intrinsic and extrinsic motivation. According to him, particularly monetary bonuses can be negative and prevent creativity [21]. He also identifies three major intrinsic motivators:

- Autonomy—humans want to make their own choices
- Mastery—humans attempt to improve what they are doing
- Purpose—humans attempt to make meaningful contributions

Andrzej Marczewski combines the insights of the *SDT* and *Drive Theory* in his *RAMP* (Relatedness, Autonomy, Mastery, Purpose) framework [22].

D. User Types

Marczewski also introduced *user types* to get rid of the overused metaphor of Richard Bartle's *player types* in the context of gamification [24]. In the 1990s Richard Bartle analyzed players of Multi-User Dungeons (MUDs) and categorized them into four types—achievers, explorers, socializers, and killers—to better understand their behaviors

[8] https://www.coursera.org/
[9] https://www.udacity.com/
[10] https://www.edx.org/
[11] https://open.hpi.de/
[12] https://www.class-central.com/
[13] https://www.mooc-list.com/
[14] http://openeducationeuropa.eu/
[15] https://www.fun-mooc.fr/
[16] http://www.xuetangx.com/
[17] https://www.futurelearn.com/
[18] https://novoed.com/

[25]. Marczewski transferred these player types into user types for applications in a non-game context. He differentiates four intrinsically motivated types—socializers, free spirits, achievers, and philanthropists—plus four extrinsically motivated types—networkers, exploiters, consumers, and self-seekers [22] [24]. Marczewski states that different user types afford different intrinsic motivation factors. *Socializers* are driven by relatedness, *free spirits* are driven by autonomy, *achievers* are driven by mastery and *philantropists* are driven by purpose [24]. In Section VII we will examine if we can detect any of these user types in the participants' interaction data in our courses.

Educators often undermine the inherent human tendencies to learn and develop by introducing external controls into learning climates. Those external controls tend to replace a human's inherent *intrinsic motivation* with *extrinsic motivation*. The activity is no more performed for its own sake but to obtain some separate outcome, usually caused by a third party. This often comes in forms of reward or punishment (positive or negative reinforcements in behaviorist lingo). Through both, the students' cognition of tasks can change, so tasks which were intrinsically fun before are no longer experienced in this way. For example supervision, monitoring, and performance evaluation are common means in schools which can reduce the original motivation of students [26].

The concept of gamification mostly increases extrinsic motivation by externally creating goals and rewarding participants for achieving them. Though rewards are a proven way to spur students to put forth effort, this behavior control often does not increase the motivation of learning itself but rather increases the motivation to achieve the external goal. Some educators have refused extrinsic motivational methods from the beginning. It can be seen as bribing the students to do something they should do anyway because it is in their own or in society's interest. Then again, extrinsic methods can develop a minimax mentality, so students do what will bring them the most rewards with the least effort [27]. When students become aware of being bribed, they start to consider the bribing necessary for the activity, as they are not expected to overcome it without rewards. The students adopt the view that the activity itself is not worth performing in the absence of extrinsic rewards. That way, the initially present intrinsic motivation is undermined [28].

A very powerful yet problematic extrinsic incentive is the competition between students. Competitions can be for tangible prices or just for the satisfaction of winning (being better than the others), between individuals or between groups. They are usually structured around test scores or other performance measures, to be able to announce a winner. However, although it is powerful, Brophy states a number of arguments against the application in regular classrooms. To name just a few, students tend to focus on the competition rather than on the given task and they often do not have the choice if they want to participate or not (a lack of autonomy). Furthermore, competition requires teams that are balanced by ability profiles, and most of all competitions only have one winner but many losers [28].

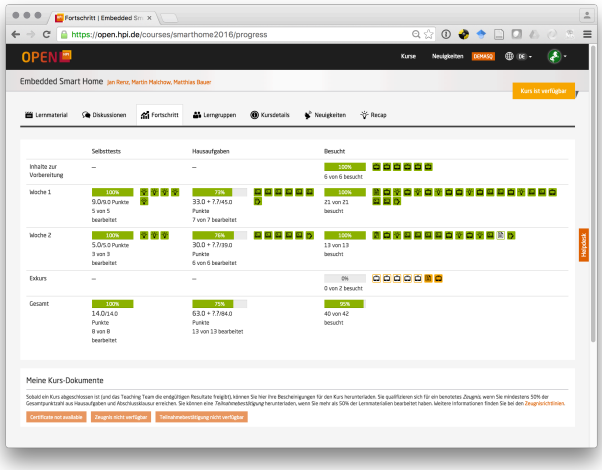

Figure 4: The new progress page

IV. Gamification Round One

In 2013 we started to re-model and re-implement our platform from scratch (see also [4]). Already in version 1 of the platform, we featured a simple gamification element: progress bars. Back then, they have been very simple, only showing the percentage of the achieved from the overall available points per course section. Typically, our major courses are delivered within a timeframe of about six weeks where in general each week forms a section. Additional sections are the final exam as well as some excursions and additional or related topics. Progress bars help users to position themselves within the current course by showing what they already have done and what they still need to work on. When we moved from version 1 of our platform to version 2 (the current one), the options for the gamification of the platform were investigated in detail. A group of students defined and prototyped different gamification features. Not all their suggestions directly made their way to the new platform, often due to restraints in terms of time and resources. An improved progress overview, however, was directly introduced with the launch of the new platform. Instead of just showing the mere percentage of achieved points, the user can now see exactly how many activities she already has visited and how many points she received for this activity (Figure 4). Additionally, we animated all the progress bars on this page to fill up from zero to the current progress percentage. This emphasizes the "game-ish" look-and-feel of the progress page. Unfortunately, we did not take any measurements how often the participants visited the old progress page, but we do know that the new progress page is one of the most viewed pages on the platform. As a future improvement, we are working on an even more detailed and fine-grained way of displaying the participant's progress, e.g. by showing how many minutes of a video a user has seen.

At this stage, we also set the foundations for what will become the main benefiter of the platform's gamification in the future. The forum plays a very important role on our platform. Early on, strengthening the forum discussions and rewarding the active participants in the forum was one of the major goals of our gamification plans. Figure 5 shows the importance of the forum discussions. We can state with great confidence that there is a strong correlation between the activity in the forum and the

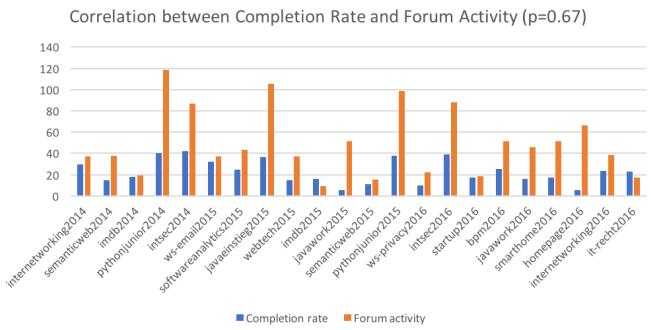

Figure 4: Correlation between completion rate and forum activity

completion rate of a course (Pearson correlation coefficient: 0.67). We have presented similar results in previous work [28]. Furthermore, the forums play an important role in those courses that attempt to take a more social-constructivist approach. In our Java courses, we have employed the discussion forum as a "soft" exercise type; instead of questions about the content of the most recent video, the self-tests in these courses often encourage learners to do some research of their own and discuss their results in a pre-arranged discussion thread. Also, the hands-on exercises often force the participants to go to the forums and ask for help or check existing discussions. We will discuss this in more detail in a future paper.

When we developed version 2 of the platform, we added a few features to the forums that had been missing in the version 1. Particularly, the possibility to vote for posts—questions, answers, and comments—and the possibility to mark questions as answered. These features are prerequisites for some of the elements that have been implemented in round two, which will be discussed in the following Section.

V. GAMIFICATION ROUND TWO

Due to a variety of reasons it took us quite some time to include at least the core set of features in a productive version of the platform. We already introduced the intended set of features in 2014 [29], it took another year until we started the first gamified course on *mooc.HOUSE*. As this is our smallest platform, it was the best choice to verify and evaluate the functionality of our newly developed features. Estimated in the beginning of 2017, *openHPI* will follow.

In detail, the features that we have introduced are badges and eXperience Points (XP). Badges are trophies, represented by small graphics. They are displayed on the participants' private profile pages. It is planned to show these badges on the participants' public profile pages as well; for those who opt-in for that option. The decision-making-process on which interactions will be rewarded in which way on the platform was extensive and included the consultation of an external game design expert. The result of this process is shown and explained in Tables TABLE I. and TABLE II.

Figure 5: Badges are available in three variations: yellow, orange, red. These colors correspond to gold, silver, and bronze.

TABLE I. EXPERIENCE POINTS (XP) FOR COMMUNICATION.

Activity	Explanation	XP
Answering a forum question	Encourage participants to be active in the forum and answer questions, regardless of the quality of the answer.	1
Answer is accepted by question author (or teaching team)	Additional points for high quality answers. Only one answer can be accepted per question.	30
Question is up-voted	An up-vote on a question indicates either an interest in the question or an approval of the question quality or relevance. In both cases, we reward the author. Each participant can up-vote a question once. Since good questions are likely to be up-voted quite often, we give only few points per vote.	5
User receives an up-vote on an answer	Up-votes are quality indicators. In contrast to questions, quality approval is the only motivation that leads to an up-vote action for answers. Thus, we can reward it higher than an up-vote for a question.	10

In addition to the experience points, we added a couple of badges, each of them available in three versions: bronze, silver and gold as shown in Figure 6. The *Communicator* badge (Figure 6 middle) is available for students that have posted 3 (bronze), 8 (silver), or 13 (gold) questions, answers or comments in the discussion forums. The *Knowledgeable* badge (Figure 6 left) will be rewarded to participants, whose answers have been accepted by their peers. Furthermore, we have a *Self-Tested* badge (Figure 6 right) for participants that have taken a certain number of self-tests. The requirements for the latter badges are similar to the ones for the Communicator badge.

VI. GAMIFICATION ROUND THREE?

Some of the gamification elements that had been recommended in the original paper [29] have still not made their way into the platform or will be removed or altered due to our findings so far. In this section, we will comment on these features, more detailed motivation why we decided to remove or alter existing features will follow in Section VII.

TABLE II. OTHER EXPERIENCE POINTS (XP).

Activity	Explanation	XP
Voluntary self-test taken	We want to encourage the participants to take the self-tests so they receive as much as possible in-time feedback. On the other hand, many taken self-tests provide fast user feedback to the teaching team: If a significant fraction of the participants fails in a self-test, it might be worth a deeper investigation.	10
Continuous attendance	A participant has seen more than 70% of the weeks available videos and started a self-test or assignment for more than one week in a row. *X = #continous_week * 10* (*#continous_week* starts with 0, the attendance of the first course week is not rewarded with any points. Attending the first week in a row is rewarded with 10, then 20, 30, etc. *eXperience Points*)	X (variable value)
User submits assignment before due date	Since homework submissions are obligatory, they were not chosen for point rewards. However, by offering extra points for early assignment submissions, decreasing every day ahead of the deadline, we can motivate certain player types not to wait until the very last second for their submission. We offer a reward of n^2 × 5 points for an early submission, when a user submits an obligatory assignment n days prior to the due date, i.e. 180 points for a submission 6 days earlier, 125 points for 5 days earlier, 80 points for 4 days earlier, etc. The maximum of points is capped to 180 (relevant for excursions etc. that run longer than one week).	X (variable value)

The most prominent example is the leaderboard. Already in the original recommendation, we have been rather critical towards this feature. While it might be encouraging for the few participants that range at the top of the results, it will demotivate the majority of the participants: Having several thousands of enrolled participants, most of them are listed with a bad ranking, even if they perform well within the course. For this reason, it was suggested to integrate a social graph into the platform [19]. The social graph allows to create connections between participants, which in turn allow to implement social leaderboards. Social leaderboards only show comparisons between friends. Even if a participant is the last in line, this will be way less frustrating, as she will at least always be visible on this board on the first page. Even more important in this context is that the participants are comparing themselves only to participants that they know, so this provides *relatedness* [19].

Before deploying the gamification features to openHPI, we will remove the suggested experience points and badges for participants that hand-in assignments early. The reason for implementing this feature has become technically obsolete. When the original paper was written, we still had an issue with load peeks right before exam deadlines. Rewarding participants with experience points then seemed to be a promising solution to flatten the load curve at least a little. By now we have solved the problem by means of a better scalable quiz system. We still think that encouraging users to hand-in exercises earlier might have its benefits. However, we consider this now in the context of a personal learning schedule. In future, the user can create her own schedule with a new planning tool we are currently developing. Encouraging the user to learn according to her plan therefore seems desirable, so this can be rewarded as well.

Finally, we altered the amount of points that are awarded for completing voluntary self-tests. More details on this will follow in Section VII.

Our current implementation of the gamification feature also still misses the recommended *User States* from the initial proposal. *User States* are additions to a participant's display name in the discussion forum. The participant will enter a new state each time she has passed a certain level of points. The idea here is to give other participants a feel for the credibility of the peers they are discussing with. This technique is well known from diverse expert forums. It took us some time to decide on an appropriate scheme. As each instance of the platform has a diverse user group and also the different platforms approach their users in a different way, it was not easy to find a scheme that fits and appeals to all participants. Finally, the decision was made to use the *kyū* ranking system with different "belt" colors as used for martial arts. This feature is currently being implemented.

VII. EVALUATION

A. Point distribution

We will now make a first attempt to make sense of the data we have collected on our platforms. As already mentioned in Section I, the preconditions and contexts in which we have been collecting the data differ quite a lot between the platforms and also between individual courses. While on *openHPI* the gamification feature runs in stealth mode—the users are collecting points but the points are not displayed anywhere, the gamification feature has been completely activated on mooc.HOUSE starting with the course *Software Design for Non-Designers*. While in this course, the participants have been made aware of the possibilities to earn experience points and badges, in the following course *Industrie4.0*, the users have not been actively informed about these possibilities. We selected a representative sample of courses on both platforms, which are listed in Table III. For the listed courses, we evaluated the amount of XP and badges that the participants have gained (Figure 7). The data already shows that, in comparison, self-tests and early submissions are rewarded extraordinarily high. Therefore, we should decrease the amount of points that can be gained for these activities while forum activity needs to be rewarded more. As the participants, obviously, are already intrinsically motivated to solve those kind of tasks, awarding them with XPs might be even harmful as we discussed in Section III. Motivated by these results we decided to change the rule for receiving XPs for submitting self-tests. While the rule that had been implemented in round two awards 10 XP for every self-test that is submitted by a participant, the updated rule only awards 2 XP and only for the first 90% (or more) correct submission to a self-test.

TABLE III. STATISTICS OF SELECTED COURSES. *PARTICIPANTS*, *NO SHOWS* AND *RECORD OF ACHIEVEMENTS* ARE LISTED. *GAMIFICATION* POINTS WERE COLLECTED IN ALL COURSES. HOWEVER, THEY WERE SHOWN ONLY IN TWO OF THE COURSES. THE AVERAGE FORUM ACTIVITIY *(POSTS* AND *THREADS)* PER PARTICIPANT WAS CALCULATED USING THE NUMBER OF PARTICIPANTS AT COURSE MIDDLE, NOT INCLUDING *NO SHOWS*.

Platform	Course	Duration in weeks	Participants	No Shows	RoA	Gamification visible	Forum Posts Total (Avg. Per User/Week)	Forum Threads Total (Avg. Per User/Week)
mooc.house	Design for Non-Designers (Pilot) (DFND1)	5	2187	n.a.	472	No	350 (0.03)	97 (0.01)
mooc.house	Software Design for Non-Designers (DFND 1-1)	6	1305	n.a.	167	Yes	530 (0.07)	254 (0.03)
mooc.house	Industrie 4.0 (Industrie40-2016)	4	6443	n.a.	n.a.	Yes	658 (0.03)	212 (0.01)
openHPI	Einführung in die Testgetriebene Entwicklung mit JUnit (Javawork2016)	2	2800	938	284	No	814 (0.15)	143 (0.04)
openHPI	Business Process and Decision Modeling (BPM2016)	6	5197	1724	851	No	1717 (0.06)	403 (0.05)
openHPI	Sicherheit im Internet (Intsec2016)	6	10688	1850	3482	No	7788 (0.12)	1120 (0.01)

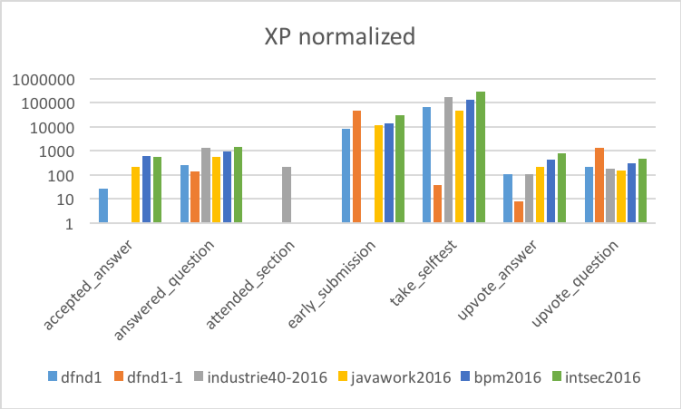

Figure 6: Gamification points received by participants. The absolute sum of points per gamification rule has been divided by the number of points per rule item and the number of course participants. Example: We measured a total of 1770 XP in Javawork2016 for the rule *accepted_answer*. This rule *accepted_answer* values for 30 points each. We had a total of 2800 participants in this course. So we normalized the XPs by applying the following formula: measured XP / rule value / # participants (1770 / 30 / 2800). We finally multiplied this value by 10.000 so that we can display it in a diagram with logarithmic scale as otherwise some of the results would not be visible at all due to the differences. Where the rule value is calculated dynamically, as e.g. for *early_submission*, we took the average between the possible minimal and maximal values.

B. *Detecting User types*

A new feature of our learning analytics engine enabled us to cluster participants by their interaction with the platform. We attempted to determine if we can separate our participants into *socializers*, *achievers*, and *explorers*—three of the user types defined by Marczewski. While the clustering itself is not really helpful here, the statistical and graphical output of this feature provides several interesting insights. We're capturing our analytics data similar to the TinCanAPI[19] format in the form of "Noun, verb, object". Some of the verbs are then combined, according to rules that we have defined, to metrics (see also [30]). In the following, we will examine some of these verbs and metrics:

- *course_performance(CP)*: a value between 0 and 1. Shows the percentage of points a participant has received in a course. Includes all main and bonus assignments[20].
- *item_discovery(ID)*: the amount of items that a participant has seen in a course. The amount of available items differs from course to course.
- *forum_activity(FA)*: a metric calculated as a weighted sum of *textual_forum_contribution* and *forum_observation*, whereas *textual_forum_contribution* has a 5-times higher weight than *forum_observation.*
- *forum_observation(FO):* the amount of question visits and subscriptions of a participant in a forum

[19] http://tincanapi.com/overview/

[20] In terms of the way how achieved points are included into the course result, our courses feature three types of assignments. Self-tests, main assignments, and bonus assignments. Self-tests are not included at all in the course result, main assignments define the amount of possible points in a course, and bonus assignments allow to fill gaps in the main assignments.

- *textual_forum_contribution(TFC)*: the amount of questions, discussions, answers, or comments that a participant has contributed.

We ran the clustering on the three *openHPI* courses that are listed in TABLE III. We could not run the same analysis on *mooc.HOUSE* as the clustering feature is not yet activated there. Figures 8, 9, and 10 show these clustering attempts in the the three listed courses. The colors in the scatterplots represent the clusters that have been formed by our clustering mechanism and does not contain relevant information in our context. Next to the scatterplots, the clusterer also generates a correlation matrix, which is shown in TABLE IV. From the correlation matrix and the scatterplots we derive the following statements:

There is only a very weak correlation between a participant's forum activity (FA) and her performance (CP). This, combined with our finding that there is a strong correlation between the total forum activity in a course and the course completion rate, indicates that there might exist a group of participants that fits the *socializer* definition.

We will now compare the correlations between forum contribution (TFC), forum observation (FO), and forum activity (FA) in the three evaluated courses. In *Javawork2016* all three metrics are strongly correlated. In *BPM2016*, only the forum observation has a strong correlation to the forum activity. In *Intsec2016*, particularly the very weak correlation between forum contribution and forum observation is interesting. In other words: in *Javawork2016*, the participants were **communicating** with each other and the teaching team, while in *BPM2016* the participants mostly read the forum. In the *Intsec2016*, the participants posted a lot (see also TABLE III.), but hardly any of the posters also read the forum.

TABLE IV. CORRELATTIONS MATRIX FOR FORUM_ACTIVITY (FA), TEXTUAL_FORUM_CONTRIBUTION (TFC), FORUM_OBSERVATION (FO), COURSE PERFORMANCE (CP), AND ITEM DISCOVERY (ID). COLOUR CODE -- DARK RED: VERY STRONG CORRELATION, RED: STRONG CORRELATION, ORANGE: MODERATE CORRELATION, YELLOW: WEAK CORRELATION, GREY: VERY WEAK CORRELATION.

Course		FA	TFC	FO	CP	ID
Javawork	FA	1	0.722	0.991	0.303	
2016	TFC		1	0.621	0.134	
	FO			1	0.316	
	CP				1	0.293
	ID					1
BPM	FA	1	0.059	0.965	0.196	
2016	TFC		1	0.551	0.059	
	FO			1	0.224	
	CP				1	0.369
	ID					1
Intsec	FA	1	0.943	0.501	0.04	
2016	TFC		1	0.183	0.049	
	FO			1	-0.011	
	CP				1	-0.055
	ID					1

We can also see that the Java workshop—even if the correlation is still weak—shows a significantly higher correlation than the other courses between forum activity and course performance.

If we have a closer look at the scatterplots in Figure 8-10, we can find a group of participants, in each of the examined courses, that has visited many of the course items, but did not perform well enough to be eligible for a certificate (Figure 8 – 10, top – 1). In other words: they are exploring the platform. Close enough to Bartle's definition of *explorers* or Marczewski's definition of *free spirits*. Then there is a group of participants that does not seem to consume more items than absolutely necessary to get a good result: *achievers* (see Figure 8 – 10, top – 2). Another interesting observation is shown in Figure 8 – 10, bottom – 3. These are participants, that performed well in all the exams they took, but in total they were not eligible for a certificate. These are what we might call the *drop-outs* (maybe a couple of *drop-ins* as well). In all three cases, it does not matter where exactly we draw the borders as they only determine the size of the group but not its existence.

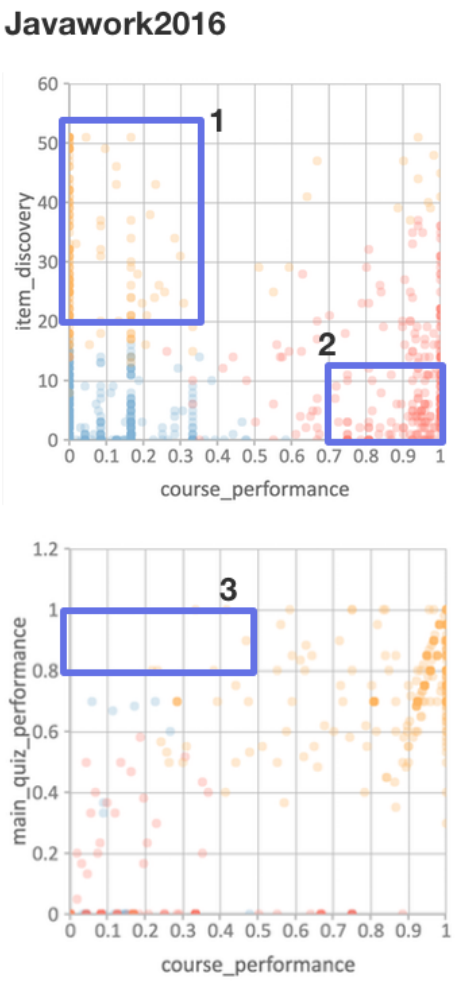

Figure 7: An attempt to cluster separate user types in the course *Einführung in die Testgetriebene Entwicklung mit JUnit (Javawork2016)*. In this and the following figures, the left and the right image display two different dimensions of the clustering.

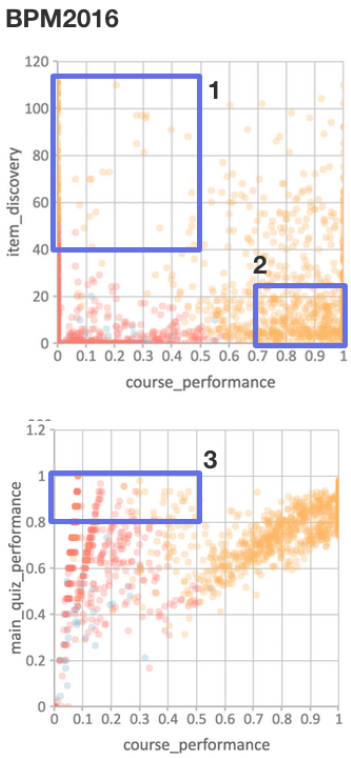

Figure 8: An attempt to cluster separate user types in the course *Business Process and Decision Modeling (BPM2016)*.

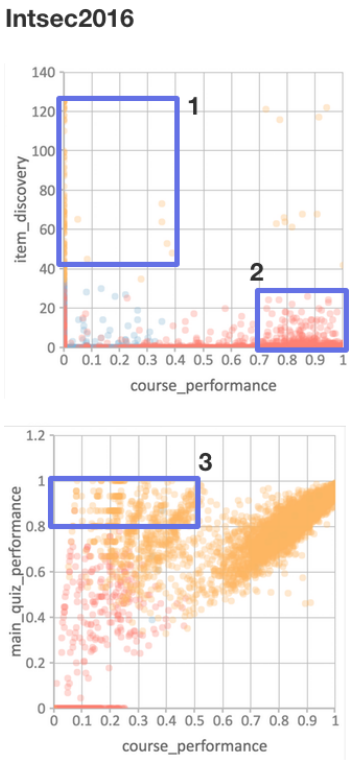

Figure 9: An attempt to cluster separate user types in the course *Sicherheit im Internet (Intsec2016)*.

VIII. Future Work

As already mentioned, the implemented gamification features will be deployed to the *openHPI* platform where they also will be promoted more prominently. As our intention is to reduce the behavioristic character of gamification and rather push it into a more social constructivist direction, we will avoid to put too much stress on the competitive character of the feature and strengthen the collaborative part. Particularly, our long planned social graph feature will play a major role here. We already have experimented with mentioning the most supportive participants in a few courses. We plan to do this on a more regular basis to value the contribution of these participants and motivate more people to actively participate. In addition, we think about offering those people to become kind of a moderator for future courses to help the teaching team with supporting the forums as well as to positively influence the atmosphere within the course.

IX. Conclusion

Employing gamification on an e-learning platform must be handled very carefully. A thoughtless implementation will let the platform fall back to the *simple positive reinforcement* mechanisms of behaviorism and programmed learning which are not what we desire. Our decision was, therefore, to strengthen the collaborative and communicative aspects of gamification by subtly gamifying our main communication channel: the discussion forum. This enables us not only to award the efforts of our learners that are active in the forum, but also to employ the discussion forum as a sort of "soft" exercise type. Although the active participants are not honored with a better course grade, gamifying the forum offers at least a lightweight appreciation for their work. We have shown that our interaction data supports the hypothesis that a user group that fits Marczewski's definition of *socializers* exists. We have also shown that this group benefits the success rate of the course in total and thus play an important role in the courses. These very important activities within the courses are currently not duly rewarded, which is one of the reasons why we decided to focus our gamification efforts on this particular area of the platform. With our approach of rewarding high quality discussions in the forums, we attempt to bend gamification from its rooting in behaviorism into a more social constructivist direction. It is in the nature of the question that it is harder to separate *explorers* from *achievers*. We were able to show, however, that at least a group is existing that is exploring the platform features without being high performers. The question that is still to be answered is how far this group can (or should) be motivated to perform better. Or how far it makes sense to provide this group of participants with a better usage experience of our platform where our main goal still should be to enable those participants who want to learn to learn what they want.

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