MOTIVATING THE MASSES – GAMIFIED
MASSIVE OPEN ONLINE COURSES ON OPENHPI

**Christian Willems, Nicolas Fricke, Sebastian Meier, Richard Meissner,
Kai-Adrian Rollmann, Simon Voelcker, Sebastian Woinar, Christoph Meinel**

Hasso Plattner Institute, University of Potsdam (GERMANY)

Abstract

Gamification is a recently trending concept, which aims on raising the extrinsic motivation of users of a software (e.g. in business applications) by introducing game elements (including rewarding mechanisms) in a non-gaming context. Even though learning is known as a task that needs additional motivation from time to time, the concepts of gamification have not yet gained a foothold in the domain of learning platforms in general and massive open online courses in particular. The paper at hand gives an overview on suitable gamification building blocks that are applicable to MOOC platforms and explains, how these learning platforms can benefit from game elements in a number of ways. We do not only tackle the users' motivation but also try to influence students' behavior in order to soften demand for computing resource at peak usage times. We also focus on raising the importance of discussion forum components, which are crucial parts of most MOOCs and an important source of information for successful learners. Furthermore, we evaluate our concept at hands of four personae representing different player types with attention to the balance of our rewards.

Keywords: Massive Open Online Courses, Gamification, Motivation, Learning Platform, Performance.

1 INTRODUCTION

The term *gamification* means the application of game concepts in a non-gaming context. Today, it is commonly applied to make an activity more engaging and fun – or in other words to "amplify the intrinsic value" [2] of the respective activity by introducing extrinsic motivation. Well-known examples for highly gamified web platforms are e.g. the Q&A platforms from the StackExchange network[1], the location-based social network Foursquare[2], or the web-based CRM software Salesforce.com[3]. All these projects have in common that they incorporate game elements in order to reward users for activity on the platform. We use the means of gamification in the online learning context of the openHPI (accessible at *https://openhpi.de*) MOOC platform. Existing examples for gamification in online education can be found e.g. on educational web applications like the Khan Academy[4], DuoLingo[5], or Codeacademy[6]. Nevertheless, gamification has not yet entered the domain of MOOC-like courses, despite the fact that facilities that allow the learners to monitor their progress (*progress bars*, see chapter 3) exist in virtually every learning platform. With the introduction of game elements to our MOOC platform, we aim to

1. keep students in the course, who would drop out due to a lack of motivation,

2. draw attention on the platform's discussion forum, which is a crucial building block of the MOOC concept, and

3. tackle load peaks caused by the course participants' assignment submission behavior.

Recent studies of massive open online courses have shown that many users drop out of online courses very early – *"[...] most MOOCs have completion rates of less than 10%"*, according to [5].

Even though the openHPI courses show a completion rate that is significantly higher than the average MOOC completion rate (i.e. between 13% and 24%, averaging on 18.3%), there is still a high dropout rate, with a strong bias towards early dropouts [7].

Fig. 1 shows the average submission rates of the (obligatory) graded weekly assignments throughout the six weeks of a course on openHPI, normalizing the submissions count for the week 1 assignment as 100%. While the submission rate drops massively in week 2 (82%), and significantly in week 3 (73%), it stays quite steady over the rest of the course duration, especially from week 4 onwards.
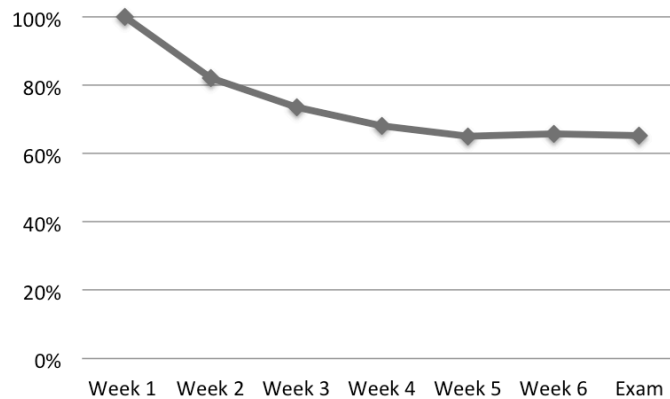

Fig. 1: Average submission rates for graded weekly assignments throughout the openHPI courses

The reason why people drop out is not always obvious. It can range from technical or content-wise shortcomings of the learning platform to personal reasons only known to the user that drops out. Since this pattern can be seen across several popular platforms and courses [11], the content of a course cannot be solely responsible for the dropouts. We therefore assume that at least a valuable part of the resignments are linked to a loss of interest or motivation to continue. With our approach we aim to address this issue and make users keep staying with the course, or, in terms of gamification: keep the players playing.

MOOC system usually come with a discussion forum, where students get in contact with each other and ask or answer questions – this is the main facility, where *peer teaching* comes into play, a concept that is required to make learning at scale work. However, in a survey conducted among the participants of the second openHPI course on "Internetworking" with about 1,000 answer submissions, only little more than a 20% of the users state that they found the forum "helpful" or "very helpful" [4]. We believe this behavior does not mean that those students just do not like social interaction in an online learning context. Platform users have reported several shortcomings in the design and functionality of the discussion forum and its loose integration into the course content. Gamified Q&A platforms (i.e. StackExchange) have proven to be very successful. We want to show that this concept also applies for learning platforms for massive open online courses.

The third aspect where we will utilize gamification concerns an obvious technical challenge of MOOC platforms: since a majority of students tends to deliver their homework just in time before the deadline, there is a significant load peak on the respective day of the week. Figure 2 clearly shows the peaks in the page views over time, where the peaks appear in once per week. The first peak on Monday, Nov. 5th marks the start of the course, the other 7 peaks come in conjunction with the weekly homework assignment due date, which is on Mondays, 10 PM CET in a usual openHPI course.
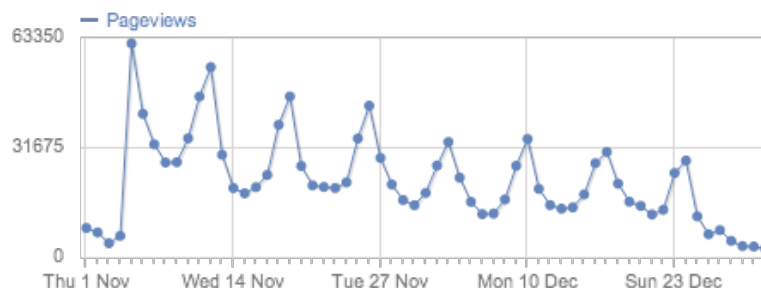
Fig. 2: Page views during the openHPI course "Internetworking with TCP/IP"

There was even a serious incident in another course, where the platforms database server broke down due to overload during the last hours of assignment submission. In that case, the courses' teaching team had to re-open the assignment for another week and granted all participants an extra attempt for the test. Besides the work on a solution of the technical problems, the openHPI staff had to deal with hundreds of support requests and calm down the Twitter and Facebook communities.

To avoid these performance problems in the future, we will use means of gamification to motivate at least a part of the users to submit their obligatory assignments earlier and thus balance the server load on several days.

The paper at hand is structured as follows: In the next section we introduce openHPI as a platform for online courses as well as our general course outline. Afterwards, we explain the elements of gamification, their possible application in massive online learning and introduces our gamification approach for openHPI. Subsequent to the introduction of our concept, we evaluate the approach at hands of example scenarios with different user profiles. We conclude the paper with a summary of our work and give an outlook on ideas for future enhancements of the concept.

2 OPENHPI – A LEARNING PLATFORM FOR MASSIVE OPEN ONLINE COURSES

openHPI is a platform for massive open online courses (actually xMOOCs), hosted at the Hasso Plattner Institute (HPI) in Potsdam, Germany. The courses offered on openHPI originate in the HPI IT Systems Engineering curriculum. The HPI professors and senior researchers address topics from the area of computer science, for example the in-memory database technology (see [9]. At the same time, broad basic knowledge is also conveyed, such as in the courses "Internetworking with TCP/IP" (first xMOOC in German language) or "Data Management with SQL". The subject matter taught in an online course cannot encompass an entire lecture program, based on time restrictions alone. Rather, online courses encapsulate the overall learning content in a more fine-grained manner, lowering the inhibition threshold of people to take part in a course. Furthermore, the courses are not intended to be lecture substitutes but rather aim to teach essential knowledge to a wide, general audience.

2.1 Current Online Course Setup

The online courses offered at openHPI are didactically prepared in accordance with specific guidelines. Courses have a fixed start date and offer a balanced schedule of six consecutive course weeks. At the beginning of each week, the course participants are offered a series of videos, further reading material, interactive self-tests and homework to complete during that particular week. The self-tests, which mostly alternate with the videos, help participants to check their learning progress. Learners are thus able to check whether they have understood the most important parts of the learning matter from the previous video. The homework exercises at the end of each course week are the building blocks for the performance evaluation of the participants. Here, grading points can be accumulated relevant to the successful completion of the course.

These offers are combined with a discussion forum where participants have the opportunity for exchange with course instructors and other participants. Here they can get answers to questions and discuss topics in depth. Fellow learners can comment on, discuss or expand on what has been said. Through the discussion of the subject matter, the participants become part of a virtual community with each other and with the instructors, much like a class in traditional schools or universities.

Upon successful completion of the course, participants qualify for a record of achievement. To do this they must have earned at least 50 percent of the possible points from the homework exercises as well as on the final exam. The distribution of points over the exercises and exam may vary from course to course, but is intelligible to the user on the openHPI web platform.

3 REWARDING MECHANISMS FOR MASSIVE OPEN ONLINE LEARNING PLATFORMS

There are a number of common game elements that can be rewarding, for example points, badges, leaderboards, acknowledgements, levels or content unlocking. In a gamified online learning environment, the challenge is to apply the right elements in a beneficial way. Consequently, we expect students to show an improved long-term motivation, potentially leading to a lower chance to drop out during the course. At the same time, however, any applied game elements must not harm the learning

experience or even demotivate students. Leaderboards, for instance, can have a demotivating effect on learners. This section gives an overview on general game elements and discusses whether they are suitable for online learning in the context of MOOCs.

Points

Points are the most generic reward, representing either progress or a virtual value in the sense of a currency. Points – next to levels – can also express the reputation of a user in the context of the actions the points were earned with. They can be issued for numerous actions and allow for easy balancing between the accomplishments that they relate to. There can be different types of points, they can either be spendable or not. The second type only increases and never decreases, making them an indicator of the general progress or the collected experience within a game. In online learning, the user interacts with a website, so there are plenty of activities that can be valued and then rewarded. Those activities range from watching lectures over forum participation to trivial usage activities like login behavior. Gaining points for activities a player preforms on the platform often immediately provides motivation. Therefore, points, without being combined with other game elements, would also be suitable in learning platforms for self-paced learners. Nevertheless, points are essential for many other game concepts, e.g. (social) leaderboards, levels, badges or content unlocking, which become effective in a large-scale community.

Leaderboards

A leaderboard is a list of students ordered by their scores. It is a good tool for motivating students to earn points regularly. As a drawback, this creates competition, which can lead to demotivation, for example when the distance to excellent students is getting too high. However, this depends on the actual implementation of the leaderboard. Still, leaderboards should be used with care. Especially in online learning environments demotivation has to be avoided. Therefore, the type of the leaderboard has to be chosen wisely. A balanced leaderboard only shows users that score about as high as the user himself. Social leaderboards only show scores within a group of friends. The most simple form is the global leaderboard, where all users are ranked globally only by their score. Leaderboards put points into a social context. Therefore, especially when choosing a more complex type of leaderboard, such as a balanced leaderboard, it is crucial that many players use the platform. Having enough users for balancing the leaderboard can prevent the demotivating effect of a global leaderboard.

Badges

Badges are small prizes that users earn for achieving certain goals. Any received badge is persistent, meaning that a user cannot lose a badge that he or she once earned. Applying this concept is especially useful when players can view other players' badges, because then badges indicate a status. In online learning, this makes sense when the platform is social enough to make badges matter. Showcasing badges loses motivational drive, if there is no one who watches the showcase.

Progress bars

A progress bar indicates partial or full completion of a task in a visually appealing way. If there is a defined set of simple steps users can perform to fill the progress bar, it is very likely that they will complete the tasks. In online learning, this is a helpful means for keeping every single student motivated to finish a course. In fact, the progress bar is a very basic game element that already finds wide application within a variety of learning platforms. The authors of [8] have shown that progress indicators *"enhance the attractiveness and effectiveness of programs that incorporate them"*, which particularly applies for learning platforms, where users can monitor their personal progress through the course material. The progress page, which contains week-wise progress indicators for content visits and course score is one of the most frequently visited page on the openHPI platform.

Levels

Levels divide a long progress into multiple smaller portions that users must complete to reach the next stage. Naturally, every level-up will give the user at least a psychological reward of accomplishment. So we may conclude that levels can be useful in an online learning environment, especially for a MOOC system, since courses require a number of weeks to be completed. If the only actual reward is the certificate of participation at the end of the course, that goal might be too far away in the beginning. Levels might help by providing intermediate goals. Like badges, levels can also be displayed on the player's profile. This way, on a highly social platform, levels offer a way for one student to compare his or her progress and reputation with friends who take the same course or other users they may be interacting with in the discussion forums.

Acknowledgements

Games often feature moments of surprise. Spontaneous turns of action or sudden gifts can be used to make the game experience more exciting. In a sense of online learning, this concept can be applied as well. Unexpected delight in the form of acknowledgements might encourage a student to keep learning. For example, motivational and appreciating text messages could easily be applied in an online learning environment, as long as they are not used too frequently. Unlike badges, acknowledgements are not persistent. They therefore are only targeted at each individual player and cannot be displayed on a users profile page.

We omit the closer revision of the game elements *Quests*, *Virtual Goods*, *Teams*, and *Boss Fights* in the context of this work.

4 APPLICATION OF REWARDING MECHANISMS ON THE OPENHPI PLATFORM

In this section we describe the game elements we implemented into the openHPI platform, discuss why we selected these elements and how we use them.

Fig. 3 shows the key entities of a rewarding mechanism suited for online learning. We identify two cycles therein: First, a user may get short-term rewards as feedback for his activities (say, he took a self-test, answered a question in the forum, etc). These short-term rewards should be given frequently and there will typically be no direct goal in sight. Secondly, there is a bigger feedback cycle, driven by long-term rewards. These represent goals in sight that users will actively pursuit. The students' motivation is kept at a higher level with the short-term rewards during the course progress making the learning activities more playful. The final goal – finishing a course successfully –, which is out of sight especially in the first course weeks and can only contribute to the long-term motivation will be accomplished rather incidentally.
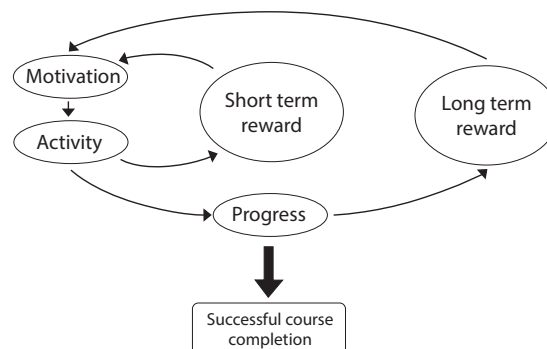

Fig. 3: Key entities of rewarding mechanisms in online learning

4.1 Points

The gamified openHPI platform will reward users by giving reputation points. These reputation points should not be confused with grading points: Grading points are given for assignments and the final exam, they are used to determine if a particular student has passed the course of not. Our reputation points, in contrast, are only intended to encourage the participants. We have decided to give them to users on several occasions, so referring to Fig. 3, our reputation points represent short-term rewards. In the following sections, we discuss some of the concrete rewarding decisions we have made.

Completed a lecture: 100 Points

Completing the lecture videos is an important task and should therefore be rewarded accordingly. Also, this is valued more than forum activity, since keeping the students progressing in the course is one of the primary goals of openHPI.

Voluntary self-test taken: 10 Points

Self-tests are normally not too difficult to do, but still, students might skip them. We want to encourage them taking the tests. After all, these tests are meant not only to check if a student has understood the preceding video lecture, but can also serve as feedback to the teaching assistants. If a significant fraction of the students fail in a self-test, it might be worth a deeper investigation.

An invited friend signed up: 50 Points

Students should get a bonus for inviting friends to the course. The reward should not be too large, since it might lead to exploitation using fake accounts. However, recruiting a new student is considered a decent accomplishment and must be rewarded accordingly. Not only does this encourage students to promote the openHPI platform, but it can also lead to a positive sort of peer pressure among groups of students.

Continuous attendance: 20 Points

Like progressing with the lecture videos, we find that continuous attendance should receive special appreciation. A continuously active student will receive 20 points for every week in which he or she logs in at least on two different days.

4.1.1 Rewarding in the Discussion Forums

openHPI features a forum where users can ask questions and discuss lecture topics. While it is crucial for MOOCs to offer a place for users to discuss, the particular forum on openHPI is obviously not used by a notable share of the course participants. For the course "Internetworking with TCP/IP" only about 20% of the active participants posted at least one contribution to the forum. Nevertheless, there is a clear correlation between the forum activity and the overall result of the users [3].

User feedback showed us, that the loose integration of the discussion forum with the other content items of the courses is considered as an impediment for forum usage. Thus, in the course of the application of gamification concepts to the openHPI platform, the traditional forum will be replaced by pinboards. A pinboard differs from the traditional forum in the way threads are organized. In a pinboard, topics are mainly question- and answer-oriented, like on the StackExchange network, however still including the possibility to start a normal discussion. All posts can be up- or downvoted, best answers can be marked as the "solution" by the thread creator (see [10] for details on gamification in Q&A systems). Additionally, pinboards are tightly integrated into the learning platform: each lecture video is linked to a pinboard where questions arising from the video may be discussed. Questions from a video are linked to the timestamp of the video, where the question arose. Likewise, there are separate pinboards dedicated to each lecture week and also one global pinboard per course. In this manner, we aim to enable students to ask questions directly at the time, when they come up.

A positive side-effect of the gamification extensions for a pinboard, i.e. upvotes on questions and answers, help when using the forum as a passive participant: Questions (or discussions) with many upvotes indicate on the importance of a pinboard thread, the amount of upvotes on answers highlight those which are worth reading. In a forum that is used by thousands of contributors, important threads tend to disappear over time, since the threads are usually displayed in reverse chronological order. New discussions are shown at the top of the list while important threads are bubbled downwards over time end get out of the users range of vision.

From StackOverflow we can learn that reputation points are a well-suited means to gamify a Q&A platform. It has been very successful in balancing the point rewards in a way that denies exploitation and values true expertise over sheer time effort. That is why we took some inspiration from StackOverflow to decide on our point rewards for activities related to pinboards.

User answers a forum question: 10 Points

Since we want to encourage people to be active in the forum and answer questions, we want to reward the act of answering, regardless of the quality of the answer. However, in case of exploitation, this measure needs to be reconsidered.

User's answer is accepted by question author: 100 Points

Successfully helping someone who posted a question should be highly rewarded, because it shows active participation with good quality. Naturally, only one answer can be accepted per question.

User receives an upvote on a question: 5 Points

An upvote on a question can indicate either an interest in the question or an approval of the question quality or relevance. In both cases, we want to reward the question author. Since a good question is likely to be upvoted quite often, we give only few points per vote. It is also possible to decrease the points worth from a certain vote count on.

User receives an upvote on an answer: 10 Points

Again, an upvote is a quality indicator. But here, quality approval is the only motivation that leads to an upvote action, so we can promptly reward it higher than a question upvote.

4.1.2 Using Points to Control Platform Resource Utilization

Online course with a massive audience obviously pose challenges regarding the performance of the platform used for content delivery and quiz handling, especially when it comes to the processing of quiz submissions. The courses usually come with a fixed schedule, where obligatory assignments have a hard due date, e.g. students at openHPI have to submit their homework at 10pm CET. The quiz submission system works as follows: when a user starts working on a quiz, the system registers a new quiz submission object and stores timestamps for the start of the quiz attempt as well as for the actual deadline. The deadline is the minimum of the start timestamp plus the predetermined maximum handling time for the quiz attempt (e.g. 60 or 90 minutes) and the general quiz deadline. During quiz processing, the users web browser submits snapshots of the current solution to the server, whenever a value is changed. A quiz submission is closed either when the student finally submits her results or when the individual submission deadline is reached. In the latter case, the last submitted solution snapshot is applied as the actual graded solution.

Despite the fact that users on openHPI have more than nine days to work through a course week's content and to submit the homework assignment, a majority of the student tends to start working on the homework assignment in the very last moment. This results in a very high server load in the hours when a deadline approaches which could so far only be reduced with more powerful hardware for the database tier of the openHPI platform. The downside is that there is a very bad overall server utilization on the database server because the performance peak only lasts for 3–4 hours per week. This effect even turns worse, if we offer multiple courses on our platform – currently, openHPI only runs one course at a time, while our partner platform openSAP[7] runs up to five courses in parallel. To balance the peak load over the days of week, the course schedule for different courses on openSAP courses have been shifted: the submission deadline for course A is on Mondays, for course B on Tuesdays, and so on.

We now aim to balance the homework submission within a single course over time by means of gamification.

User submits assignment before due date: X Points

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 $n^2 \times 5$ 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.

4.2 Other Game Elements

Next to points, we also use the concepts of badges and acknowledgements on openHPI. These techniques already allow applying our objectives on all targeted player types with both coarse-grained and fine-grained rewarding. Note that there are still points for grading and graded certificates of successful completion to be earned on openHPI. Addition- ally, we implement levels that represent a platform-wide reputation. For future work, we also see variants of *content unlocking* as promising ideas for the enhancement of a gamified MOOC.

4.2.1 Badges

Badges are typically used to reward unique accomplishments that a user pursues over a period of time (long term rewards). As such, badges have a remarkably high value, and should thus not be issued too often. Since the only kind of truly unique accomplishment on openHPI is the completion of a whole course, this is the only activity we reward with a badge automatically. Additionally, special badges can be issued by teaching staff of a course. They could reward users that have shown remarkable commitment to the community. E.g. in openHPI courses, we were able to observe users contributing translations, summaries, link lists or additional quiz questions just using the limited feature set of the discussion forum.

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[7] see *https://open.sap.com;* openHPI and openSAP share the same platform code and hosting resources

4.2.2 Acknowledgements

An acknowledgement as we implement it is a short text message shown to the user in a modal dialog, neither persistent nor relevant to any other part of the system, but only intended as a "'pat on the back" for any kind of minor accomplishment. For instance, watching three lecture videos in a row and taking the corresponding self-tests might be worth such a notification. Acknowledgements are intended to motivate especially those students who long for more confirmation, making them another example of short-term motivation.

As opposed to points and badges, acknowledgements can be shown at any time, even without a triggering accomplishment by the user. There is no need to tie acknowledgements to rules that users can intuitively understand. This may be desirable, since it allows us to flexibly fill the gaps between other rewards, which might be too long to overcome for some students. Think of a student that slowly loses interest or motivation, and scores lower than normal in a self-test. If the platform can recognize this impending user dropout, it can in return trigger an acknowledgement ("Congratulations! Only 15 percent of all users have made it this far – keep going!").

4.2.3 Levels and local vs. global reputation

When interpreting points in a learning platform as an expression of reputation, it is obvious to correlate this reputation with the users expertise in a course subject. This applies to the discussion forums in the first place: users of Q&A systems with points and levels tend to trust the answers of a user with a reputation value. However, there is no reason why a user, who finished a course on "Concepts of Parallel Computing" as best in class, should start a course on the "Basics of Marketing" with a high reputation – expressing expertise. This is why we decided that points would be on course level only in our concept.

Additionally to the course reputation points, we introduce a global *level*. The cumulated course points of all courses allow for leveling up a steep ladder of platform-wide levels, where the points needed for the next level grow exponentially. Levels on openHPI are represented with a color- and icon-coded decoration attached to the users avatar image. The first levels might be represented by a chalk board (white, bronze, silver, gold). Higher levels could be expressed as certificates, mortarboards, etc. These levels are to be understood as a measure for experience with platform and course concept as well as an indicator for broad knowledge.

4.2.4 Virtual goods

During the development of the next generation of the openHPI platform (see [6]), the developer team decided to come up with new and experimental features piece by piece over time. These features can also be introduced as *unlockable content*. Users, who cross a certain point threshold or achieve a special objective, could be rewarded with access to a special feature. However, unlockable content must not be restricted to additional features but can also be additional learning material or bonus exercises.

5   CONCEPT EVALUATION

Since our rewarding concept is implemented for the upcoming next major release of the openHPI platform, but not yet deployed to the production platform that is being used by students, we demonstrate the effects at the example of different user profiles. We discuss the implications of our rewarding decisions on typical users, selected from Bartle's player types [1], as well as the profile of an average user who does not provide any of the rather strong characteristics identified by Bartle.

The example scenario for each persona illustrates the collection of points over the typical term of a six-week course. All personas are fictional characters to illustrate our concepts. We use a persona's name to describe their actions more easily. In this example, the course contains an average of seven video lectures each week and exactly one self-test per video.

Jakob, the achiever. The achiever is willing to do anything that promises a reward on the openHPI platform. Jakob will try to collect as many points as possible, see all of the acknowledgements and miss no badge. Our challenge is to always provide enough exciting tasks for this person to accomplish and reward him or her accordingly. In the example scenario, Jakob would earn 5775 points in total, distributed as follows:

- 4200 points = 700 points × 6, for seeing all of the video lectures there are.

- 420 points = 70 points × 6, for taking all the voluntary self-tests.

- 815 points for early-submitted homework assignments. Jakob submits the first week's assignment directly after watching all videos on his first visit of the platform, on Thursday. He earns 80 points for the first week ($4^2 \times 5$). Triggered by the points, he realizes that he can earn more points, when he finishes the assignments earlier. From the second week on he tries to watch the videos shortly after their release. Three times, he is able to submit the assignments 5 days before and two times 6 days before the deadline ($3 \times 5^2 \times 5 + 2 \times 6^2 \times 5 = 735 \ points$).

- 120 points (20×5), for continuous attendance. Jakob misses the first week's 20 points, since he completed everything there on a single day. In the second week, he discovers this reward by accident and from this point onwards, he continues to be active on two days each to earn this reward every week.

- 220 points from forum activity: 100 (accepted answer) + 40 (four answers given) + 60 (six upvotes on those answers) + 20 (four upvotes from questions asked). Jakob will try out the forum up to the point when he realizes it takes too much effort for him to gather points there. Further, as an achiever, his characteristics do not particularly include social behavior. So we assume, that he will post two questions of high quality there, producing five upvotes in total, and answer four questions with six upvotes in total. One answer of him will be selected as the accepted answer by the question author.

Belinda, the socializer. Socializers will read the forum a lot, and won't be shy to ask questions, whenever they don't understand something. They will also try to answer questions and help others as good as possible, if that means communicating. Our challenge is to provide enough possibility for social interaction to keep this person engaged. In the example scenario, Belinda would earn 4455 points in total (see Table 1 for details).

Mathilda, the explorer. An explorer wants to discover any kind of bonus material that we have, unlock the content to the last lecture, even if this means not watching or learning everything in detail. They will try out the forum to the fullest, clicking every possible button and linking on the site. An explorer interacts with the system and finds all features, details and - even - loopholes. Our challenge is to engage this user in a positive way, providing optional quests, easter eggs and maybe some secret acknowledgements to encourage explorational behavior. In the example scenario, Matilda would earn 5830 points in total (see Table 1).

Frank, the average student Since all of the previously described user profiles favor one strong characteristic, we find it useful to illustrate the developed reward system at the example of a rather average student. After all, real world people are always a mix of Bartle's player types. Frank is simply curious what the course is about, since the topic sounds exciting. As soon as the tasks start looking too exertive, he is likely to quit and not return. Our challenge is to bind him to the course from the beginning by making the experience as interesting and engaging as possible. So for the following example scenario, we lay out the events of a course in chronological order and describe how they might affect Frank's behavior. Starting with the course, Frank is curious to watch the first few of the seven videos of the first week. After seeing the first three videos and taking one or two self-tests, he realizes that he has already gained over 300 points in about 45 minutes. This will encourage him to find out other actions that are rewarded with points. But he already feels satisfied with his daily effort and decides to take a break instead.

Two days later, he logs in again and is greeted with 20 extra points for continuous attendance. Encouraged by that, he continues to watch the four remaining videos of the first week. Since the self-tests promise extra points and do not take him more than five minutes each, he also finishes those. For the first time, he does not understand a particular part of the content and uses the possibility to ask a question on the pinboard. A few minutes later, he receives an answer but is too lazy to mark it as accepted. He also earns two upvotes on his question during the day. Frank does not want to defer the first homework assignment and starts it right away. When he submits the assignment he receives positive feedback about submitting early and earns 80 points ($4^2 \times 5$). From now on, he knows that submitting the homework early is appreciated and rewarded. For a short amount of time, he browses the pinboard and reads some popular questions. Soon, however, he leaves the website without further action, but with the positive feeling of having accomplished the week's tasks in the course. His total points now add up to 860 (700 for watching the videos, 70 for taking self-tests, 80 for submitting the assignment early, 10 for two upvotes on his question).

In the next week, he manages to find enough time to watch five video lectures and take three self-tests. This leaves him with a total score of 1390 by Thursday. Again, he has trouble understanding one particular detail from one of the videos, browses the pinboard and finds his question already answered. Spending some time with the pinboard, he compares other students' score with his own and realizes, that he is actually doing quite well. He decides to come back later to watch the rest of the videos. Saturday, Frank realizes he runs out of time and will not be able to watch more videos this week. Still having in mind that he has to complete the homework assignment and that early submissions are appreciated, he logs in and answers the questions. The platform grants 5 points to him for the early completion.

On Monday Frank continues his learning in week three by catching up on the two videos of the second week and the remaining self-tests, increasing his points to 1635. After that, he is curious for the topic of week three, which he enjoys so much, that he continues to watch all of the seven videos and take six of the seven self-tests. After that, his score equals 2315. Proud of his current score, he stops for this day. The next day he logs in to attend the homework assignment and to get the bonus points for continuous attendance. He earns 125 points ($5^2 \times 5$) for the early submission. Besides that, he checks the pinboard and encounters a question he feels capable of answering, does so and receives two upvotes for his answer. This day he leaves the website with a total of 2580 points.

In week four on Monday, Frank encounters a topic he is not interested in, watches the first video, happy about 100 extra points, but cannot convince himself to continue. So for the next five days he stays absent, but then on Sunday, he opens up the openHPI website by accident again. Instantly greeted by the 20 bonus points for continuous attendance, he continues by watching two more lecture videos, but then resigns. Hence the homework assignment is due to Sunday as well, he tries to solve the questions passionless. His score after week four is 2900.

The last two weeks, Frank is mainly driven by the motivation to still get the certificate, since an acknowledgement appeared at the beginning of week five, saying "Keep going, you have enough lecture points to finish the course, you only need to pass the exam". So he watches six more lecture videos, and receives three more upvotes on his previously asked question during exam preparation time. He submits his last homework assignment two days before deadline, solves the final test one day before the deadline and earns another 25 points ($2^2 \times 5 + 1^2 \times 5$). He eventually passes the exam with 70% correct answers and finishes the course with a score of 3540. Looking back at his experiences with the platform and the course, he is surprised that he stayed up to the fourth week and scored comparatively high.

Table 1: Points distribution for all personae

	Jakob	*Belinda*	*Mathilda*	*Frank*
Videos watched	4,200	3,400	4,200	3,000
Self-tests taken	420	180	300	210
Early submission	815	55	140	235
Forum activity	120	140	430	55
Cont. attendance	220	530	600	40
Friends invited	0	150	50	0
Total	**5,775**	**4,455**	**5,830**	**3,540**

5.1 Summary

Our first three personas exhibit quite different behaviors in their usage of openHPI, yet their point scores spread by less than 25%. Granted, the point scores are only estimates and we expect to see outliers and possibly a wider average spread when testing our concept with real users. But still our evaluation allows concluding that the point scores will not vary in orders of magnitude between participants of different kind with equal motivation (see Table 1).

Frank, our last persona, differs from the former three in terms of general motivation. Though his activities and will for participation do not quite qualify for many points, he still earns more than half of the points of the others. In a way, one could say that the system over-rewards him. But that is not true: A baseline point score can be interpreted as the reward for staying on the platform – which was our primary intention to employ techniques of gamification in the first place.

6 CONCLUSION AND FUTURE WORK

The paper at hand presents a concept for the introduction of gamification to a MOOC platform. We have listed numerous common techniques of gamification and discussed their effectiveness in context of online learning. Furthermore, we have designed several game elements to tackle three related problems from the introduction: a) the generation of additional extrinsic motivation for users in order to reduce the dropout rate, b) a boost for the importance (and user acceptance) of the course forums, and c) the reduction of performance peaks on days with due dates by creating an incentive for students to submit obligatory assignments earlier.

We have also shown in theory that our rewarding system is well balanced for different player types. Besides this, we created a set of features that shall make the learning platform more playful and more fun to use.

However, we have not yet been able to test the system with a massive group of users in a production environment. This marks the first point for future work. Once online in a real course setting, we will conduct a detailed user study on the effect on motivation and learning outcome, also compared to earlier courses without gamification features.

Further exploitation of additional gamification concepts also looks promising. We want to investigate on the introduction of tools for users to generate content and leverage the courses, such as crowd-based video annotation tools or a quiz editor for user-generated quizzes. With the introduction of a social graph to the platform, we can also introduce social leader- board and a "quiz battleground", where students can compete against each other, but are also encouraged to explain their opponents, why the might have answered a question wrong.

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