

Connecting Peer Reviews with Students' Motivation

Onboarding, Motivation and Blended Learning

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Abstract: This paper evaluates the onboarding phase for students who are exposed to a blended and open learning environment for the first time, where self-directed learning is key to success. The study was undertaken in a very restricted environment, where the primary motivation of students is the achievement of good grades in the most efficient manner due to extreme time constraints. In past research, we have shown that students have difficulty to move from the traditional setting of frontal lecture and final exam to an open learning environment that focuses more on self-directed learning and peer created content than grades. This work builds on findings that blended learning environment should be adaptive to learner types and gamification features need to be implicit. Adaptivity is not guaranteed through a single platform but instead by involving students in constructing their learning environment. This paper reports on the final set up of the course and the student evaluation thereof. We show that the current environment with student involvement leads to mostly positive attitudes towards most aspects of the course across virtually all students. Forums are perceived as a barrier as are individual contributions to the class content and are not appropriate features for onboarding. In contrast and despite being difficult, effective use of peer reviews can be shown to match student motivation across all learners. Their use is understood as a means to obtaining a good grade and learning.

1 INTRODUCTION

This paper is the fifth in a series of publications about the results of gamifying a course in Software Engineering. The gamified version of the course, builds on mastery and autonomy. Both are different from traditional classrooms, where a single exam results in a grade and not necessarily mastery of the subject and teacher driven content often does not leave too much room for autonomy. A course that insists on mastery of the material (repeated hand-ins until perfection) and self-driven learning is difficult because firstly, it is so different from anything previously seen in teaching and secondly, the rate of learning appears to slow down even while enhancing long-term retention (Björk, 2013; p.421). The first experience with a gamified version of the course resulted in a lack of acceptance by students and exposed the mismatch with student motivators, geared solely towards grade and efficient learning to the test due to time constraints. Explicit gamification was perceived as inappropriate for the serious business of study in this culture (Berkling and

Thomas, 2013). The need for an adaptive environment geared towards different learner types and scaffolding during “onboarding” was also shown in previous work (Thomas, Ch., 2013). Not only are autonomy and mastery difficult for students, but they are difficult to implement for a single teacher with around 100 students. It would mean giving feedback to homework on a weekly basis. To afford this feedback loop, peer reviews are introduced into the classroom.

Peer reviews have become popular as a method of grading in large scale settings of MOOCs. According to Piech et al. who have studied Coursera MOOCs in detail, aspects of peer review (incentive, presenting complex scores back to students, assigning reviewers) are still open research problems (Piech, 2013). Studies look at how accurately the peer grade reflects the expert teacher grade in order to justify peer review as student grade. Some studies show the difficulty that peer reviews pose to students from the feeling of power to not understanding their use. According to one study, professionalism is lacking, loyalty to fellow students

interferes and inadequate effort is apparent because it is not required (Nilson, 2002). In line with these findings, in a previous version of this course, peer reviews have been shown to be a difficult component and were simply neglected by students. As a result, they were not appreciated for their potential usefulness.

Platform adaptation and scaffolding through extrinsic motivation changed this. (In this paper, adaptation relates to the fact that students choose their own environment. There are currently no system-based adaptive learning platforms available to us.) Feedback was made public on platforms that are chosen and controlled by students. The importance of modern social platforms in communication and learning reflects studies by several researchers (Herbert 2010, Aydin 2012, Timaz 2012, Prizo 2011). The completion of peer reviews is recorded and figures directly into the final grade, thereby creating an immediate incentive as a scaffolding device. With these changes, autonomy through defining their own environment and project and mastery through reworking homework based on peer feedback now show a clear and immediate connection to the final grade. While small changes and tweaks will always remain, the basic framework of the onboarding process is finalized as presented in this paper. We report on a student survey regarding their perception of this learning environment. 81 participants took part in this survey, taken from three different classrooms of 27, 23, and 31 students each.

The purpose of this survey is to determine the student contentment with their learning environment given the new circumstances. The expectation is to find that with this change, diverse learner types feel comfortable with the course. The second motivation for the survey was to better understand the onboarding process. It is important that the students do not perceive the learning environment as threatening, which has been shown to happen in our non-scaffolded setups. In this work we show that peer reviews are difficult but accessible with scaffolding and modern social platforms. After the first rounds of difficulty, students understand the impact that peer reviews have on their motivation of obtaining a good grade. The use of other elements (such as Forum, e-Portfolio) of the blended course have been less successful without the necessary scaffolding.

The paper is structured as follows. After a review of the theoretical and historic foundations for this work in Section 2, Section 3 will describe the course setup. Section 4 will explain the design of the survey. Section 5 will discuss results that describe

students' perception of the components that make up the course. Section 6 offers conclusion and future work.

2 BACKGROUND FOUNDATION

The software engineering course is designed to take gamification into account in an implicit manner, due to the local culture, where explicit gamification may not match the seriousness of the situation of studying (Berkling and Zundel, 2013). There are implicit elements to the course that are motivated by gamification and the underlying motivational theory of Pink's universal motivators: Mastery, Autonomy and Relatedness or Purpose (Pink, 2010). In particular the vocabulary from gaming is used to think of the first semester as onboarding process designed as player journey (Kim, 2010), also emphasized in J.Tagg's work on scaffolding (Tagg, 2003). In the language of gaming, Points, Badges and Levels are comparable to the traditional form of grading students. A slow transition to intrinsic motivation akin to mastery and autonomy is accomplished by weaning students off the "cheap" scaffolding reward system, leading towards learning as the key accomplishment. (see also Self-determination theory Ryan Deci (Ryan, 2000; Gagné, 2005)). While the course uses gamification principles, the vocabulary is not used during teaching due to cultural aspects (Berkling, 2013).

In that sense, we are also looking at students as gamers according to the classification of (Bartle, 1996). Learner types play a role as we have seen in the past (Berkling and Thomas, 2014) but to assess a student's learner type is too difficult in a simple survey and students are not able to directly and accurately classify themselves as participant, avoidant, independent, dependent, collaborative or competitive (Riechmann, 1974). We therefore use a simplified model to classify the students according to gamer type (by asking students to sort game examples according to how likely they are to enjoy them) and personality traits: collaborative, competitive, creative and open to new experiences. This gives us a two-dimensional very rough classification of students' players and learner types.

As predicted when technology is aligned with motivation and content (Derntl, 2005), student perception of the course is currently mostly positive for scaffolded components after understanding and aligning student motivation with content and platform - despite the novelty of the setup.

3 COURSE SETUP

The Software Engineering course is setup to be taught across several cohorts of student groups of about 30. Students are asked to define their own software projects and determine their team for the duration of the course, which lasts two quarters. Each week, there is one lecture and one homework that relates directly to the lecture and the project. This homework is posted on the groups chosen platform and design, mostly blogs. The homework is then peer reviewed according to criteria by any group across all cohorts. In previous versions of this course, students' work, submissions and peer reviews as well as forums were located on a single MOOC platform, chosen by the instructor. The most significant complaint in the past was dominated by a criticism of the infrastructure and lack of useful feedback by other students. The most significant change for this instance of the course was the student choice of platform and the public peer evaluations that had to be shown to the instructor to gain points towards the final grade in the course. The students were in complete charge of their platform. In the past, peer reviews were private and not taken seriously by all students; all reviews are now publicly displayed with group name and their publication under the control of the blog owner.

Autonomy is expressed through self-determination when choosing a project, the technology to realize the project and choosing a team. The key difference in student perception of the course consisted in extending the autonomy to the platform for displaying student work in public and hosting peer reviews. The scaffolding consists of providing deadlines for set homework, evaluation criteria and enforcing the use of public peer reviews on student blogs and including this work as part of a grade.

Mastery is realized by delaying the grading on content until submissions undergo several reviews and revisions, creating a peer pressure towards excellence in the public forums. Through the use of peer reviews, guidelines for evaluation and reflecting on their own homework, final understanding of the course material is supported.

Blended learning environment consists of 4 hours of in-class time and virtual extension of the classroom through the online activities described above. Each week a lecture is given that covers exactly one new aspect that relates to the next step required in the project. The subsequent week, some of the groups present the homework in class and receive feedback from the teacher. This feedback is

then often used when giving peer reviews to other project homework, propagating the information to other groups. This approach blends live feedback by a teacher with peer reviews. Homework is then revised and has often been rechecked by peers to verify the correctness of the change (this point was not required by the instructor). While the general guidelines for homework and projects are given, the specific technical implementation is not prescribed. As an example, students are required to use an MVC framework to build a web application and the lecture focuses on the principles of the Model View Controller architectural pattern. The programming language and chosen framework for its realization is optional. As a result, Laravel (PHP), Rails (Ruby) or Django (Python) enter into the classroom. Principles of their use are reviewed by peers and presented as homework in the classroom, broadening the course with student-built content. Lecture is then usually followed by in-class peer review sessions and project work as time permits. 2 peer reviews were required by each team each week. Completing the peer reviews included answering peer reviews with a feedback. Both had to be shown to the teacher to obtain points that counted 20% towards the final grade.

Table 1: Overview of Categories in Student Survey (Details are given in Appendix A).

<p>Rank these games according to which type best fits for you (Egoshooter, Facebook, Geocashing, Monopoli) Rate each of these characteristics from 1-4: (I am creative, I like to explore new things, I am competitive, I like to work in a team.)</p>
<p>Grades: How do you rate this course. What grade do you expect to obtain. What grade is sufficient for you. I feel insecure in this course.</p>
<p>Tools: Topics followed by specific questions (See Appendix A) Peer Review Blog E-Portfolio Self-Determinism Forum/Platform/Classroom</p>
<p>Open Questions: What do you think about joining all three cohorts for a single lecture and then splitting into groups? Which parts of this course setup did you perceive as particularly difficult in the beginning? Which difficult parts turned out to be useful? Which parts do you like.</p>

In addition to the team work, individual grades are given for individual contributions bringing students' expertise to the classroom with topics that are related to the course content. These are called e-Portfolios and their successful completion consists of an online tutorial on a topic and a hands-on

presentation and exercise to be done in class. The result is posted in a Forum. Over the years this content is built up to support incoming students with tutorials on topics that are directly related to the course.

4 STUDENT SURVEY

Onboarding for the Software Engineering course is considered to go far into the first semester of the course. In the past, onboarding has been demanded of students without any scaffolding. As a result, students' perception of the class was negative (site self). The goal of this survey is to find out how the current set-up is perceived and whether this perception is valid across all learner types, based on the rough self-diagnosis queried in the first section of the survey. The survey regarding the components that make up the course and the perception of their effectiveness is given at the end of the first of two semesters and was designed keeping reliability and validity in mind (Schumann, 2012). Because three classes were taught in parallel, it was possible to calculate reliability of results across cohorts. The survey was given within the span of one week to all three groups (Monday, Tuesday and Thursday).

Students were asked to evaluate their experience on a four point Likert scale (avoiding the middle value to get a clear tendency) from "agree completely" to "disagree completely" regarding the tools. The questions were very simple and designed to be closed-ended for comparison. To compensate, the final section of the survey allowed students free text to express their thoughts on difficulties and a different setup of the classrooms. 81 students currently enrolled in the course answered the survey during class time.

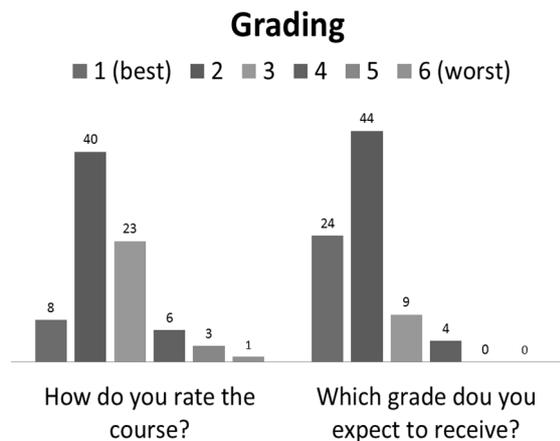


Figure 1: Student evaluation of course and expected grade.

The student survey included four components: (1) Gamer Type ranked from 1 through 4 (to enforce a choice) and Learner Types which was chosen on a likert scale from 1-4 (2) Grading on a likert scale from 1-6 (German grading system), (3) survey of the different components used in blended learning on a likert scale from 1-4 and (4) open ended questions for qualitative feedback regarding the timing and room setup and questions pertaining to what was perceived as the most difficult component during onboarding. Table 1 lists all Questions. Appendix 1 lists the entire questionnaire.

4.1 Overall Results

Overall, the result of the survey showed that students are mostly happy with the course and its format. Figure 1 shows the grades given to the course and the expected grade the students will receive (final grading will take place at the end of the second semester only and final results are not available at this time). The hypothesis when evaluating the survey is that most learner types will feel comfortable with the course because the course was designed to meet several learner type needs (Thomas, Ch., 2014). The final step, of including student control over their platform was met this year. Results seem to show that the goal of addressing most students needs seem to have been met (see Figure 1).

4.2 Self-diagnosed Learner Types

Our past experience shows that students are not easily able to identify their learner type. According to the simplified classification based on favourite prototypical game (according to gamer types) and personal characteristic, the following student distribution makes up the three classrooms as shown in Figure 2.

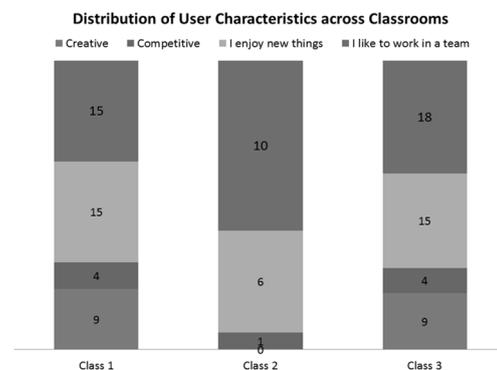


Figure 2: Number of students according to user characteristics (multiple selections possible).

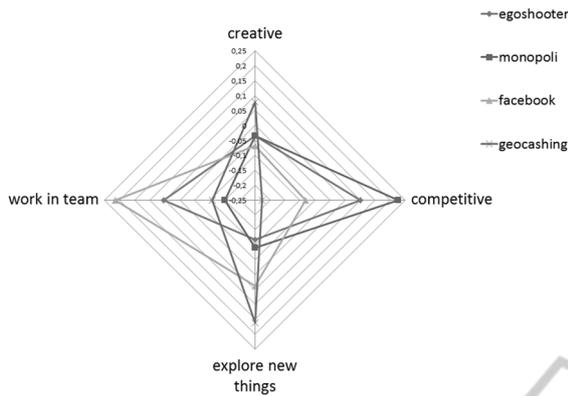


Figure 3: Mapping characteristics onto favourite chosen game.

The combination of game type and characteristics is displayed in Figure 3. It is not surprising that student have multidimensional characteristics.

4.3 Overall Results across Classes

For each of the five questionnaire categories a correlation score is computed across the three courses. Table 2 lists the results. It can be seen that there is a high correlation across all courses for the topics of Self Direction, Blog and Peer Reviews, which were at the focus of the first semester onboarding process. This indicates that the areas in focus have had similar acceptance across different student groups. R-values larger than 0,7 are generally accepted to show a high reliability. The rest of this paper focuses mostly on the categories that correlate well across the classes, namely Peer Review, Blog, and Self-directed decisions.

Table 2: Correlation/(R-value) across classrooms.

Correlation	Class 1/2	Class 1/3	Class 2/3
Peer	0,83	0,96	0,91
Blog	0,98	0,99	0,95
Self-Direction	0,96	0,96	0,97
e-Portfolio	0,75	0,68	0,97
Forum	0,97	0,60	0,77

The overall evaluation scores of the survey items are depicted in Figure 4 for each of the three classes. It can be seen that the general rating trends are the same. However, one classroom was more severe in rating of question group 5 regarding blogs, while maintaining the same basic relative pattern. (Class 1 also complained about the lack of time in their current schedule to the instructor.)

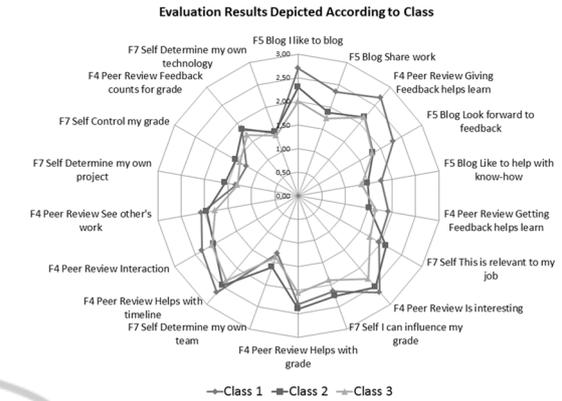


Figure 4: Evaluation results according to classroom, sorted by disagreement.

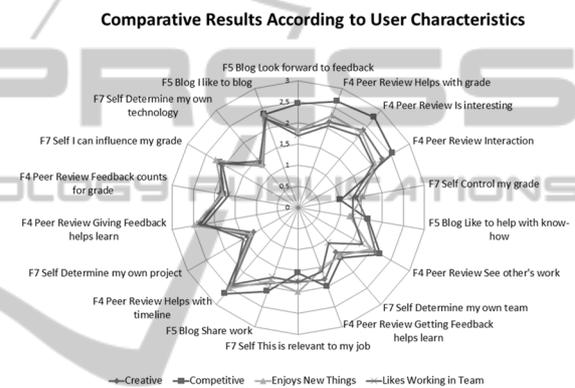


Figure 5: Evaluation results according to user characteristics, sorted by disagreement.

Figure 5 shows how the results compare across groups of users who have chosen particular user characteristics with the score of 1 (1=applies completely – multiple selections possible). It can be seen that the groups are very similar, while the competitive students are more severe at rating some Blog and Peer Review questions.

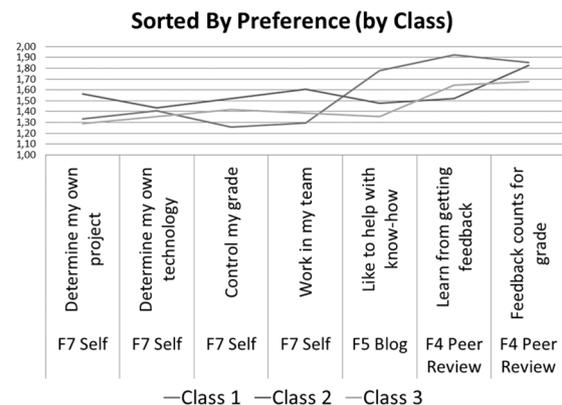


Figure 6: Highest rated features across three classes.

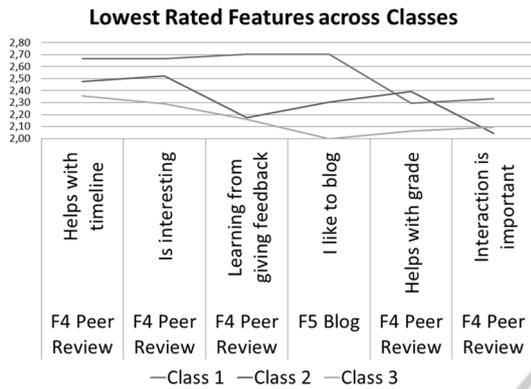


Figure 7: Lowest rated features across three classes. (2=sort of agree; 3=sort of disagree; 4=disagree).

Figure 6 ranks the top seven rated features of the course. Adaptation, achieved by letting the students make their own choices regarding technology, including blog and peer review as well as technology used for implementing their project is appreciated by the students. It is of interest to note that the peer review seems to be integrated with the student primary motivation of obtaining a good grade. The students agree that receiving peer review feedback is useful in learning the material and improving it.

Keeping in mind that feedback for all categories is mostly positive, Figure 7 shows the lowest six ranked items. Giving feedback on peer reviews appears here as less highly rated than receiving it. The answers also seem to reflect that lack of time to spend on peer review which may not be directly considered as working in a linear way toward receiving a grade without wasting time with extra things (as expected, see also Björk, 2013).

Overall, results can be considered positive and consistent across three different classrooms. While the ratings on the items still reflects the straight forward motivation of students, it can be seen that the peer review has been integrated into the process of being successful in obtaining a good grade.

4.4 Differences across Students

Despite the rough estimate, it is interesting to see whether there are differences in onboarding for various user types (Creative, Competitive, Exploring new things, Likes to work in teams). Figure 8 compares those survey items for which the variance is below .5 for each subgroup. It can be seen that competitive students agree that peer reviews mostly do not help with keeping up with the timeline, whereas other groups of students do not agree within

their subgroup on this point. In contrast, all groups regardless of their characteristic agree that having control over their grade is the most important item. The only other item where all groups agree is the importance of working in a team.

Items by Learner Type with Strong Agreement

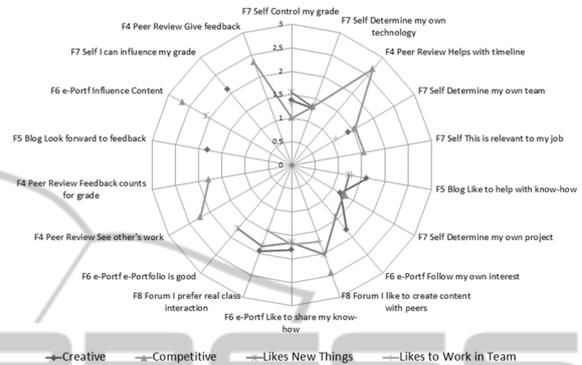


Figure 8: Features for which students agree on their assessment within subgroup (variance < .5).

Looking at the two largest groups of students according to preferred game style and user characteristics, two groups have a large enough student sample to be compared according to their different ranking of the items in the questionnaire.

Number of Students per favorite Game / Characteristic

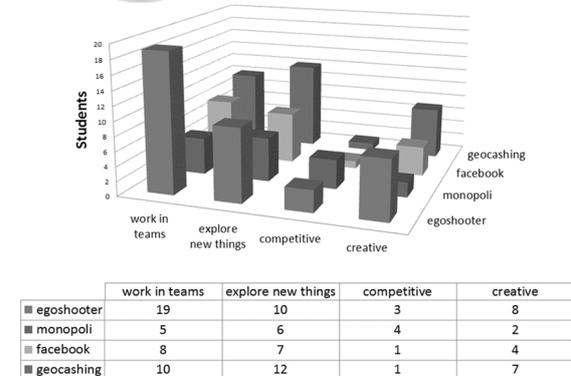


Figure 9: Number of students according to favourite game and characteristic (multiple selections possible).

While these subgroups are very small, some tendencies can be seen that are in line with the characteristics.

Figure 10 shows that explorers, who like Geocashing and finding out about new things (12 students) enjoy the interaction with other teams that the peer reviews support. They also like to help others with their know-how. Students who identify most with Egoshooting games and enjoy working in a team (19 students) rated teamwork uniformly at 1.

There are, however, no major differences in rating apparent, which agrees with our expectation in an environment that is adaptive to user style.

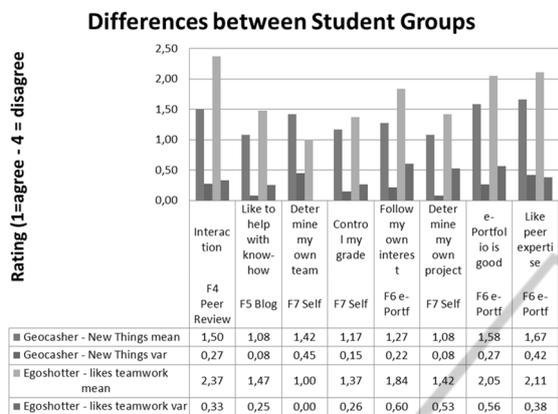


Figure 10: Minor differences between student groups by game preference and user characteristic.

4.5 Qualitative Feedback

Asking students which parts of the course were most difficult during onboarding resulted in extensive written feedback. The comments reflect the difficulty of getting into the habit of doing the peer reviews. Furthermore, the amount of time needed to do the homework was criticized. Table 3 lists the key attitudes towards the course that are equally reflected by almost all comments.

Table 3: Points agreed upon by most students.

Positive Considerations	Needing Improvement
The basic setup of the course is good, self-driven project work, peer reviews, and mastery through reworking of hand-ins.	1 peer review per week was too much work per week. Time investment had better reflect positively in grade!
Working across classrooms was interesting.	The weekly assignments were not clear enough; they also should have been listed in their entirety at the beginning of the semester.
Peer reviews help improve understanding of the homework.	It is very difficult to get used to the concept before understanding the usefulness.

Some of the following citations demonstrate the thoughts of students in the course.

Table 4: Comments regarding peer review.

<i>"The basic idea is good, however there is never enough time."</i>
<i>"Constant reworking of homework takes some getting used to but is the only way to learn. Forming a habit of consistent improvement contributes to deep comprehension."</i>
<i>"I think it is good to have a weekly homework in order to be forced to keep up to date, rather than pushing everything towards the end of the semester."</i>
<i>"It is good that the homework is public. You have to hand in the homework on time and receive feedback to improve it. Working across courses results in more feedback."</i>
<i>"Peer reviews take a lot of getting used to. But you can learn a lot from others."</i>
<i>"It took a long time to get used to the peer reviews, the grading system and overall organization of the course. This improved with time... It was difficult to determine the homework within all the information."</i>
<i>"If the amount of time spent on this course results in a good grade, it will have been worth the effort. Otherwise this course is definitely too much work."</i>
<i>"Because the course has a different structure from others, it was difficult to get used to it. But it grows on you and was fun."</i>
<i>"Difficult to get used to but good."</i>
<i>"Reworking homework and practical application helps to fully understand the material. However, it was difficult to understand the full requirements of the weekly work. This improved with time."</i>
<i>"Building habit of weekly assignments was difficult but turned into routine. This kind of work routing, feedback and taking charge of my own grade was good."</i>

5 DISCUSSION

The survey showed that there is general content with the course. While there are some issues with time and clarity of content, the overall framework was accepted by students even though it is perceived as difficult. It was shown that the same feedback can be reproduced across three different classrooms. It was also attempted to show that roughly estimated learner types seem to react in similar ways to the course.

Some changes to teaching are still required (clarifying homework and listing these at the beginning of the semester) but these are minor

compared to the fundamental restructuring that has successively taken place since moving away from teacher centric learning. The survey showed which parts of the framework for the class presented more difficulties for students and which ones were manageable. We found that peer reviews worked much better this year with the new setup of student chosen technology and public peer reviews. While creating some difficulty for students, these difficulties were mastered and their benefit understood. This goal has not been achieved in previous sessions of the course using tool functionality out of the box rather than student created blogs with open reviews and feedback.

Some items, like use of Forum and e-Portfolio were less well scaffolded than others and agreement between students was not clear. Both of these have less direct effect on the grade than peer reviews and may therefore be skills for higher levels in the "game". Future work will show how these can be better integrated, perhaps across years and not classrooms, where one class provides information that is appreciated by subsequent years. This in turn may motivate those students to provide more information to students in lower years. The time-gap between effort and profit is much larger. A typical quote: "Why should I spend time learning X, when I don't need it for my project right now. I will learn it when I need it. (And by then everything will have changed anyway)". The student is probably correct in today's IT world. However, learning things that are not imminently of use is also a step further down the process of turning extrinsic rewards like grades into intrinsic rewards of knowledge building and sharing even if they have no impact on the points/badges/levels system of the old-school grading system (Ryan, 2000).

Finally, peer-review and adaptive learning platforms with respect to user type are open research questions. By looking at how students design their own working environment (adaptive in that sense) more insights can be gained into how to design automatic systems to perform at the same level.

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APPENDIX A

The following table lists all items of the questionnaire used to evaluate the onboarding process for Software Engineering based on principles of gamification with blended learning.

<p>Game Rate the order in which each of these games most match your interest G: Egoshooter (killer) G: Monopoli (achiever) G: Facebook (socializer) G: Geocashing (explorer)</p>
<p>User Type On a scale of 1:agree completely to 4:disagree completely rate the following: T: I am creative and like to show that in class T: I am competitive and want to be the best T: I like to explore new things T: I like to collaborate in teams</p>

<p style="text-align: center;">Grading</p> <p>On a scale of 1:best grade 6:worst grade (German grading system) grade the following:</p> <p>R: How do you rate the course? R: What grade do you expect in this course? R: What grade is enough for you? R: How secure do you feel in this course?</p>
<p style="text-align: center;">Peer Reviews</p> <p>On a scale of 1:agree completely to 4:disagree completely rate the following:</p> <p>P: Interaction with other teams is important P: I like to see what the others are working on P: Giving feedback helps me to understand material P: Receiving feedback helps understand material P: It helps me to improve my grade P: It helps me keep my time schedule P: It is good that the activity counts toward my grade P: It is interesting</p>
<p style="text-align: center;">Blog</p> <p>On a scale of 1:agree completely to 4:disagree completely rate the following:</p> <p>B: I like to create our blog for the project B: I like to share my work with the others B: I look forward to receiving feedback B: I like to help others with what I know</p>
<p style="text-align: center;">e-Portfolio</p> <p>On a scale of 1:agree completely to 4:disagree completely rate the following:</p> <p>eP: I like to influence the topics in this course eP: I like that my interests are incorporated eP: I am interested in peer expertise eP: I like to share my know-how with peers eP: Forum is a good place to share this information eP: e-Portfolio of others are interesting for me (if I had the time) eP: I don't have time to be interested in ePortfolios</p>
<p style="text-align: center;">Self Determination</p> <p>On a scale of 1:agree completely to 4:disagree completely rate the following:</p> <p>S: I like to define my own project S: I like to define my own technology S: I like to work in a team S: It is important to have control over my grade S: I feel that I can influence my grade S: The content of this course is relevant for my work</p>

<p style="text-align: center;">Forum – Platform - Classroom</p> <p>On a scale of 1:agree completely to 4:disagree completely rate the following:</p> <p>F: I prefer asking my peers to tutorials in the web F: I prefer interacting in the classroom to virtual F: I like to work with peers to create knowledge F: The ePlatforms for this course are functional</p>
<p style="text-align: center;">Open Text Questions</p> <p>Classroom setup and hours This course has four hours of in-class time and 4 hours of out-of-class study time. How would you like to change that setup?</p> <p>Difficulties with Onboarding This course has a different set up from usual lecture and exam style. Which aspects did you like and which aspects were difficult to get used to.</p>