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A study on student activity in a learning management system forum with gamification elements

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Abstract

Learning Management Systems (LMS) have become a standard tool in higher education institutions; however, their use is often reduced to repositories of teaching material. The forum is an LMS tool that allows students' active engagement, participation, and learning. This study examines the impact of a 'badge system', a gamification tool we designed for the discussion forum tool of the Open eClass, a learning management system. We redesigned the existing OpenEclass forum tool, introducing gamification elements like badges, points, levels, and a progress indicator. An A/B study was run in authentic course conditions to compare the two designs and their effect on students' activity. We draw conclusions on engagement, interaction, and academic performance. This research highlights the potential of gamification in enhancing student engagement and interaction in blended learning environments.

Keywords: learning management system, discussion forum, a/b testing, gamification

Introduction

The recent pandemic saw increased adoption of digital platforms like Learning Management Systems (LMS) by teachers and students in higher education institutions. In the post-Covid era, in blended learning conditions (Oliver & Trigwell, 2005; Driscoll, 2002), this trend continues (Papanikolaou et al., 2023). In an LMS like Moodle (Xin et al., 2021), instructors can organize teaching materials, engage, communicate with learners, and distribute assignments (Ellis & Calvo, 2007). Most academic institutions in Greece use the platform *Open eClass*, an open-source platform developed organically by the association of Greek universities, to support blended learning. Maintaining student engagement in these platforms results in better user experience and academic performance (Rodgers, 2008). According to (Moore, 1989), there are three levels of interaction in distance learning: learner-content interaction, learner-instructor interaction, and learner-learner interaction. As discussed by Avouris (2016), reporting on the user's activity in the modules of the LMS, 65% percent of the page views were related to content delivery modules, while the usage of communication modules, which promote the other two types of interaction, was only 24%. Especially in discussion forums, as argued by Mason (2011), student engagement is low.

To enhance engagement in a course, educators often use gamification, i.e., implementation of game mechanics, such as leaderboards, badges, points, and rewards in non-game environments (Deterding et al., 2011). Gamification has made eLearning platforms more engaging (Tan & Hew, 2016; Cheung & Ng, 2021). The use of gamification in eLearning discussion forums has been studied by Reischer et al. (2017), who redesigned and studied the *iMooX* MOOC discussion forums, where they used badges, points, levels, and progress bar; they evaluated their design by comparing the forum interaction with a course, comparing the

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redesign with the previous design. Even though with the new design there was lower participation, students and teachers claimed that '*the new design offers usability, flexibility, and is fun*.'

According to a recent systematic literature review (Khaldi et al., 2023), the most common game elements that experimental studies use in gamified e-learning are points, levels, badges, and leaderboards. In most studies, like in (Marín et al., 2018), users gain points and badges by completing challenges or several actions where they gain points and badges when they confront a challenge correctly. However, the implementation of reputation points in blended e-learning has not yet been explored at its full potential. The introduction of reputation points in an interactive environment such as a discussion forum may enable more peer learning, like in the case of platforms such as stack overflow, a popular programmers' forum, where users gain reputation and badges with their use and help to other users.

In the context of *Open eClass*, to address the limited use of communication modules (Papanikolaou et al., 2023; Avouris, 2016), we decided to rebuild the discussion forum tool of the LMS, enhancing it with gamification elements. For this, we applied the *Octalysis* gamification framework (Chou, 2015) and created a 'badge system,' a parametric gamified tool. The badge system combines levels and badges with reputation points representing a user's forum participation. To evaluate this new experimental design, we used it in the context of an academic course for an extended period of an academic semester, during which half of the course's student population used the gamified version of the forum and the other half the original version. The main research question addressed during this study is how the badge system affects the forum participation of a user. We formulated three research hypotheses. **H1:** The new design and gamification elements will result in more engagement in the forum than in the original one. **H2:** The badge system is a valuable tool to monitor overall participation. **H3:** The users with higher forum interaction will have better academic performance in the assignments.

Forum redesign

The *Open eClass* platform offers multiple tools for an online course, including a discussion forum. If the course designer activates this tool, it is available to the learners through the course navigation bar shown in Figure 1a.

First, we briefly describe the existing forum design. By selecting the *forum* option, learners are directed to the forum page, which consists of 4 levels: category, forum area, topic, and reply. The instructor creates and manages the categories and forum areas, as seen in Figure 1e. The instructor can manage, edit, and delete topics, while the learner can only post topics or replies. Figure 1e shows a forum area where users can inspect the posted topics (Figure 1f). The user can select 'new topic' (Figure 1c) or an existing topic and move to the topic's page. On the topic's page, there is a discussion, as seen in Figure 1e. The user can reply to a post by selecting 'new reply,' as seen in Figure 1b.

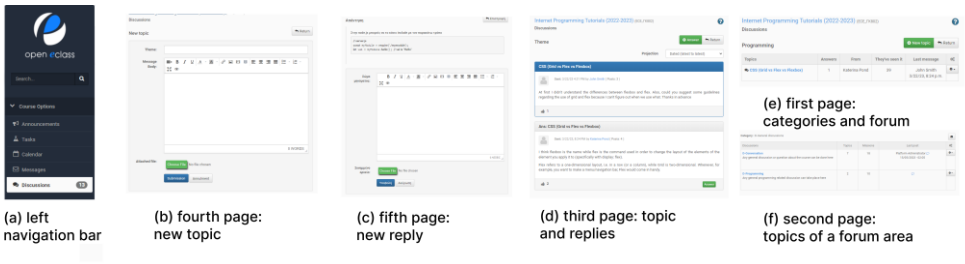

Figure 1. Original forum module: categories, areas, topics, replies

Next, we describe the redesign of the original forum tool and the frameworks and models we used. The *Octalysis* gamification framework (Chou, 2015) allowed us to evaluate the current design and guided the redesign, indicating the gamification elements to add. *Octalysis* is a user-centric gamification approach that connects user actions to 8 Core Drives, encompassing intrinsic and extrinsic motivation. Employing the Hook model's (Eyal, 2014) trigger-action-reward-investment phases in the re-design process, we enhanced it so that learners regularly used the forum. Through heuristic evaluation (Nielsen & Molich, 1990) of current forum, the existing features of the tool were improved. This aligns with Weber et al. (2022), who studied the Octalysis framework as an evaluation tool and advised combining it with other evaluation methods. The main redesign decisions were the following (see figure 2): We changed the term '*forum area*' to '*thread*' and '*topic*' to '*discussion,*' and we made the forum navigation shorter, reducing it to 2 pages from 4 that was the original design. The categories, threads, and recent activity are on the first page, as seen in Figures 2c and 2d. On the second page, shown in Figure 2e, there is a thread navigation bar, discussion filters, and discussions. Here, the user can create a new discussion as seen in Figure 2g or answer an existing post, as seen in Figure 2h. Also, we added a search function in discussions and threads, as shown in Figures 2e and 2d, to see the threads or discussions containing the search terms. Also, in discussions, the user can view the images in a post without downloading them as in the original forum. Following the Hook model, we provided a motivation trigger to the user, showing them the total unread discussions in the forum, category, and thread (see Figures 2a, 2c, and 2d). In addition, we allowed the learners to edit or delete their posts.

Finally, we added the option for the author of a discussion post, whether a teacher or a student, to mention if their question was answered and which reply gave them the correct answer, as seen in Figure 2f. According to the Octalysis framework, the original forum design used *left-brain gamification* as it relied on the intrinsic motivation of a user. So, we added gamification elements that promote extrinsic motivation. Therefore, the gamification elements we added are badges, points, levels, and progress bar. We used a reputation point system for the point system that calculates a user's participation in the forum. By acquiring points, a user can level up, and when they get to a certain level, they gain a badge. Points, levels, and badges show the degree of participation in the forum. We added three participation badges; another badge shows if they contributed multiple correct answers. The *participation badges* are a bronze one indicating low participation, a silver, medium participation, and a gold, high participation in the forum. The *helping badge* is acquired when the user gives a certain number of correct answers. The points and badges are not visible to

other users, only the most recent degree of participation badge and the helping badge, as seen in Figure 2f. These gamification features constitute the '*badge system.*' The instructor can change all the badge system parameters on the first page and hide the badges from the users; the badge system settings are seen in Figure 2b.

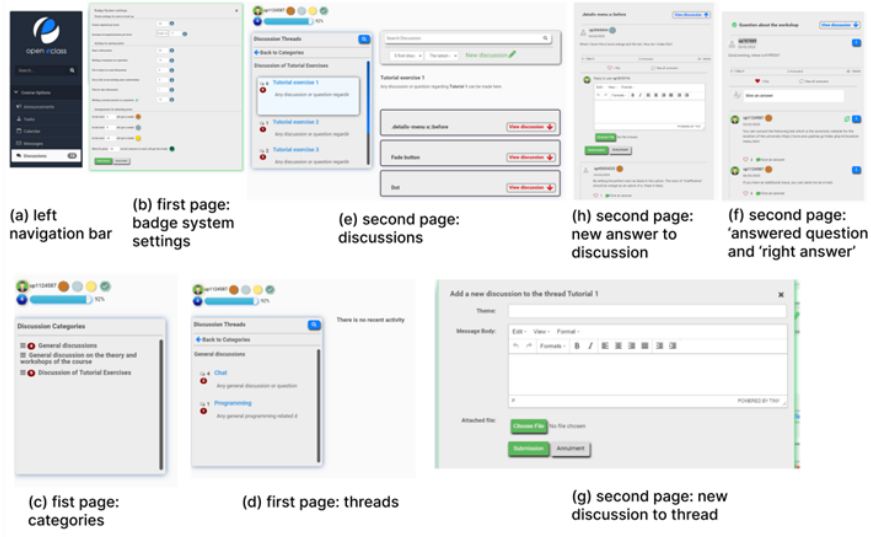

Figure 2. Experimental forum features

Methodology

This section describes the evaluation study of the new forum design in an authentic class activity context. We set up and deployed a new Open eClass installation in addition to the institutional installation the students regularly use. Students attending the Internet Programming course were asked to join this new installation to discuss and submit optional assigned homework. The students were familiar with the platform as the university's institutional LMS is Open eClass. The new installation had limited use; only *exercises*, *announcements*, *calendar*, *messages*, and the *forum* were active modules. As an incentive for using this additional installation, the learners were given an extra 10% of their course final grade for submitting the homework. We conducted an A/B experiment, where the users assigned as the experimental group would use the redesigned forum, and the control group users would use the original forum. The users of the two groups interacted with the same forum content, the only difference being that they used a different version of the forum tool. The assignment of a user to either group was random. Three assignments were given to the students; these were discussed and submitted through this new Open eClass installation.

We conducted the registered users of the course, and we announced this optional activity, clearly stating that it is part of a study on an experimental forum design. In total, N=78 students opted to participate in the activity. The students who participated were registered in the new installation and were sent details of their login information and the platform URL. Upon entering the course, the users were assigned randomly to the experimental or the control group. So, in total, the experimental group and the control group had 39 users each.

Badge system parameters

The badge system was set up to assign points and medals to all users in the experimental or control groups. While the badge system was active in both groups, to measure participation in both groups, the data of the badge system was visible only to the experimental group. On the other hand, the control group did not know about it. So, for example, if a user in the control group had participated in the forum enough to acquire the bronze badge, this would be shown to the users in the experimental group but not to the ones in the control group.

The settings of the badge system were the same throughout the experiment. The required points per level were 20, with a gradual increase of 5 points. The users earned 20 points for starting a discussion, 10 points for providing an answer to a discussion, 8 points for obtaining a reply, 5 points for acquiring a like from other users, 1 point for their discussion earning a new view, and 10 points for when their answer was declared as 'correct answer.'.

The settings to acquire the badges were the same throughout the experiment. For a user to acquire the bronze medal, an indication of low participation in the forum, they must get to the 2nd level. For the silver medal indicating medium participation in the forum, they must get to the 5th level. To acquire the gold medal indicating high participation, a user must get to the 15th level. Finally, to acquire the medal that shows a user has given a significant contribution of correct answers, they must give 15 correct answers.

Data on the user's activity came from different log systems, namely the platform's usage statistics and the forum's custom actions log.

This study examines the learner's engagement, interaction, and academic performance with the newly redesigned discussion forum, including the reputation system and gamification elements. We analyzed the user's activities and actions in the course and the forum. The experiment was conducted for seven weeks of the academic semester.

The study follows a between-groups design, so we used a method that examined independent variables of unequal variance to examine the statistical significance of the data. We applied the Student's t-test for the data that followed a normal distribution and the Mann-Whitney U test for the data that did not.

User participation

Seventy-eight students were registered, 39 in the experimental group and 39 in the control group. From the control group, 27 users visited the course and 21 the forum. From the experimental group, 32 visited the course, and 31 attended the forum. Users from both groups performed 404 actions in the forum: 353 were new views in topics, 11 were new topics, 21 were replies, and 16 were 'likes.' The overall forum actions comprised 87.36% new views on topics, with 50.24% from the experimental group and 37.12% from the control group. New topics accounted for 2.72% of the actions, with 0.99% from the experimental group and 1.73% from the control group. New answers represented 5.19% of the actions, with 3.96% from the experimental group and 1.23% from the control group. Actions such as like and un-like totaled 4.47%, with 2.69% from the experimental group and 1.48% from the control group.

User Engagement

No significant difference in forum participation was observed between the two groups. *Visits in the forum* $z=0.1684$, $p=0.8662$, Mann-Whitney U test, data not normally distributed. For the *new views on topics,* no significant difference was found between the two groups, the control

group (M=8.82, SD=5.77, N=17) and experimental group (M=7.80, SD=4.34, N=26) with t (41) =0.6573 and p=0.5146>0.05, Student t-test. So, we concluded that the groups showed similar engagement in the forum. We also tested forum actions like new views on topics, writing new topics, writing new replies, as well as likes and un-likes between the two groups, and found no significant differences (z=0.5322, p=0.5946>0.05, Mann-Whitney U test).

Academic performance

We studied next if the activity in the forum affected academic performance. We used the grades of the submitted three assignments and the students' lab work as background academic performance. First, we examined the background performance (lab work) and found that there was no significant difference in the mean values of the two groups (p = .2931 > *0.05*). This was expected as the samples were randomly chosen. We then compared the performance of the two groups in the three assignments discussed in the forum to that of the same group in the lab work. For the control group, we found a non-significant difference between the grades of lab work (M = 9.2, SD = 3.7) and the assignments (M = 9, SD = 1.3), t(14) = 0.2, p = .814, paired t-test. On the other hand, for the experimental group, we found that there was a significant difference between the grades of the lab work (M = 8.4, SD = 1.2) and the assignments (M = 9.2, SD = 0.8), t(17) = 2.3, p = .035 < 0.05, paired t-test. So, we found that the experimental group that used the new forum design significantly improved their performance as measured through their assignments' grades. In contrast, the control group did not have any significant performance improvement. This may be due to the easier interaction with the forum content for the experimental group.

When we further focus on the lurkers' groups, i.e., those who only viewed the discussions in the forum, without any active involvement, the *lurkers* of the control group were found with no significant difference between their grades in lab work (M = 8.5, SD = 0.7) and in assignments (M = 8.8, SD = 1.6), t(7) = 1.6, p = .158, while the for the *lurkers* of the experimental a difference between their grades in lab work (M = 8.4, SD = 1.4) and assignments was found (M = 9.3, SD = 0.8), t(11) = 2.2, p = .048.

Discussion

This study examined how learners engage and interact with the new design of the Open eClass forum module, reputation system, and gamification elements and if the badge system used would be a valuable tool to monitor the overall participation in the forum.

Hypothesis 1 stated that the experimental design will affect the forum's engagement. From the metrics of the *user's engagement*, we conclude that the *unread topics* in the navigation bar of the course page might motivate the users from the experimental group to visit the forum at least once. However, both groups viewed the same number of topics. Therefore, we cannot claim that the experimental design resulted in more engagement in the forum. The same applies to forum actions between the two groups. Although the experimental group seemed more active in the forum than the control group, as they posted more replies and likes in messages, there was no significant difference between them.

Regarding hypothesis 2, that *the badge system is a valuable tool to monitor overall participation*, we can see from the interactive forum actions, user's points, and the forum content that the badge system is a good indicator of the user's activity in the forum. So, suppose an instructor

can implement in their educational design the forum using the badge system. In that case, this not only provides some extrinsic rewards to the users but also indicates users' participation in the forum.

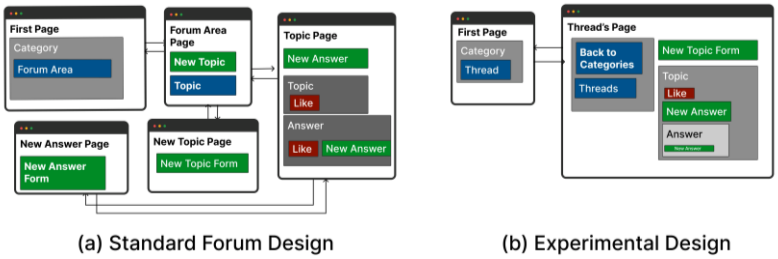

Figure 3. Standard and experimental forum design

Comparing the two forum designs (Figure 3), we can see that in the original design, for a user to interact with a topic, they must choose a forum area, then a topic, and then move to the reply form, in total four steps. In the new design, they choose a thread, then a topic, and select '*Give answer*,' the new reply form on the same page, in total three steps. As far as a user wishing to reply to another topic of the same forum area when they are already in a topic, the user of the original design must go back to the forum area, choose the topic, select a new reply, and go to the new reply page, in total three steps. In the new design, when they are already in a topic and wish to reply to another topic of the same thread, they scroll and select '*Give answer*,' and the new reply form appears, in total two steps. The other forum actions, *new replies*, and *new views* took the users the same number of steps. Regarding the extra options that the experimental group was provided with, one user edited an existing message, and another deleted theirs. However, none of the users who posted topics selected the actions '*question answered*' and '*right answer.*'

Finally, regarding the academic performance of the users, it seems that the forum increased the user's academic performance in the assignments, as the users had the forum to support them more than their lab work, for which there was no forum support. This can be seen from the paired t-test about the users who participated in both activities, especially for the experimental group. The lurkers in the forum benefit academically, in line with the studies of (Alzahrani, 2017) and (Brunton et al., 2022).

Limitations

The results from this study are exploratory. To better understand the engagement and interaction with the gamified module and their impact on learners, the experiment must be carried out for a longer duration, with a larger scale, and examine educators who did not participate in the design in detail. We must also examine further the tool's impact on the learners' academic performance. Finally, another limitation is that we did not interview any of the participants in the experiment.

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