Development of a Social Gamified Platform for e-Learning

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Abstract

The way in which nowadays education is evolving, makes it possible to associate it with MOOCs courses and gamification techniques to improve learning outcomes of students. It is indeed a new combination, but with a high potential. To this end, this paper shows the development of an educational e-learning platform built upon the Elgg open-source social framework, where a set of gamification elements were added to enhance engagement and motivation of students: Points, achievements, leaderboards and rewards. Points are the platform's baseline. Achievements and leaderboards, apart from being motivating, are social and visual elements. Finally, rewards maintain motivation and encouragement. The platform incorporates a peer-review feature where the student evaluates the proposed solution of a, randomly-assigned, classmate. Elgg's social features include an activity feed, friendships, and communication tools. For the future, effectiveness validations will be carried out with students as well as further developments with other types of gamification elements.
Keywords: Education, MOOCs, Gamification, Elgg.

1. Introduction

Nowadays, technological evolutions make it possible to apply game techniques (also known as gamification) in educational environments, enhancing students' engagement and motivation [26], thus producing better learning outcomes and students willing to stay longer in the e-learning platform.

In any case, the relationship between gamification techniques and education systems is rather novel, with a growing interest by educators and researchers, showing both positive results and caution remarks [23].

This paper presents, first, a literature review in gamification techniques eligible to be applied in Massive Open Online Courses (namely, MOOCs), trying to overcome the highly students' dropout rates presented in this type of online courses. Thereon, a social gamified platform was developed to improve engagement and motivation of e-learning students.

This paper is structured as follows: Section 2 presents the background of gamification and its techniques applied to educational contexts. After that, in Section 3, the gamified platform developed for this study is shown. Finally, Section 4 offers some conclusions and future works of this study.

2.   Gamification

First, the term gamification could be defined as the use of designed game-elements in non-game contexts [4], [13], [24], as a methodology to drive user behavior [23, 24], [28, 29], but presenting a highly dependency of context and users [23]. For some authors, like Mekler et al. [28], gamification techniques should be applied in short term maintaining student motivation, while for longer approaches more elements should be applied.

It could be highlighted that gamification techniques have been applied in many areas, apart from education environments, such as an online community [8], a mobile app for physical exercise [22] or in business contexts [1], [34], among others.

2.1.   Gamification in Education

In connection with education, gamification techniques, as a way to encourage students learning, have been studied and discussed by researchers over the past years; although it has been extensively studied since 2008. Nevertheless, researchers suggest further analysis [3], [21], [27] about gamification elements applied in education, along with new technologies and methodologies (e.g., mobile contexts or MOOC courses).

Mainly, gamification techniques applied on educational environments have two primarily benefits on students. Firstly, gamification helps in motivating the student to continue learning [15], [21] and, secondly, this partnership produces better learning outcomes than traditional learning environments [11], [38].

On the other hand, some studies identified that the partnership of gamification techniques and educational contexts presented some deficiencies and drawbacks [18], as wells as a lack of effective evidences on better learning outcomes [6], [14].

2.2.   Gamification in MOOC

In educational systems, but in e-learning contexts specially, MOOCs platforms are growing in importance as an alternative learning format. To our best knowledge, there are not so many references linking MOOC platforms and gamification techniques. This could probably suggest that this is a rather novel association that should require more research, given that previous studies noticed that this technology helps in engagement and motivation of e-learning students.

On one side, Gené et al. [20] suggested that MOOCs associated with gamification elements helps in the persistence and economic viability of MOOC platforms. Additionally, for Chang et al. [10], gamification may help MOOC platforms to be effective and efficient for learning.

On the other hand, Spector [36] considers MOOCs and gamification an immature alliance, while Baker et al. [5] reckon that creating effective MOOCs with gamification is not clearly apparent.

2.3.   Gamification Techniques

Once previous literature review applying gamification techniques in educational environments has been presented, a list of gamification elements in education is introduced:
- **Points**. Consists of providing points to the student for completing activities/tasks. Actually, they are the baseline for other gamification elements such as levels or leaderboards [40]. Mainly, points provide a success feeling [30], followed by a visual

status [14] (to oneself or for the rest of students) and instantaneous feedback to promote motivation [2], [7].

- o **Reputation Points**. A special type of points, derived from rewards, implemented to encourage students [40]. These points are not related to traditional points and are not eligible for other gamification techniques, such as levels.
- **Levels**. Typically implemented with points, levels are used in order to make the student raise his/her status (while displaying progression information) [7], [30] and contribute to the engagement [14] and feedback [7]. Initial levels are usually agile and the effort required is less than in advanced levels. Higher levels require, on the contrary, more effort and skills [30].
- **Achievements / Badges**. These elements are special marks rewarded to the student when particular activities/tasks are completed, and also increase the quality of contributions [9], [12]. They are highly related to visual status and social engagement aspects [14], [30]. This gamification element is highly motivating, fun and encouraging [15], [21], [30], [35]. In this matter, it is important to let the student see all badges.
  - o **Challenges and Badges**. When badges are associated to challenges, they give the student high levels of autonomy to reach certain learning objectives [7].
- **Rewards**. They are given as a recompense based on time or after a certain number of actions/tasks are completed [32] or as bonuses [29]. These prizes could be virtual or real, but they are better in multiple small prizes than in one big prize [30]. It is highly important to have a scheduler to distribute them along the full course (regular and consistency delivery) [30], [32]. Rewards are considered as feedback [14], motivating, funny and encouraging for the students [15], [21], [30].
- **Leaderboards**. This element consists of a list of names/nicknames/avatars showing the current/total score of the competitors (students). This promotes visual status and social engagement [14], along with competition and high levels of motivation feelings [7], [15], [21], [30] and enhances learning performance [25]. To face the feasible demotivation attitude of the students (created by the competition introduced within leaderboards), a possible solution could be balancing the global leaderboards [40].
- **Avatars**. Graphical designs for students. It helps to the visual status and social engagement. For a better effect, it is recommended to enable personalization and upgrade features (based on skill, as a reward, on progression, among others) [14].
- **Progress Bar**. This element helps on a constantly feedback and information on progression of learning objectives [21], [32], [40].
  - o **Storyline**. Related to progress bars, storylines help on giving a context for learning and interest [30].
- **Distribution of Learning Contents**. Although learning contents are not gamification elements, careful attention should be paid to them. They should be linked to the "*Cascading Information Principle*" [29], [32], which requires that the course contents need to be divided into small pieces of information, with additional resources (optional contents), regular activities/tasks (makes the student motivated to return to the system) and in-advance information on following contents (motivates the student and preserve flow-state of learning).

3. Gamified Platform Developed

In this section, the gamification features and main functionalities of the system that were implemented on the platform are explained.

3.1. System Architecture and Technology

It should be highlighted that the developed system was built upon the well-known Elgg framework [17], an open source engine, written in PHP object-oriented programming language, with scalability options through custom-built modules. As depicted in Fig. 1, the system architecture for Elgg-based systems is the popular client-server model architecture.
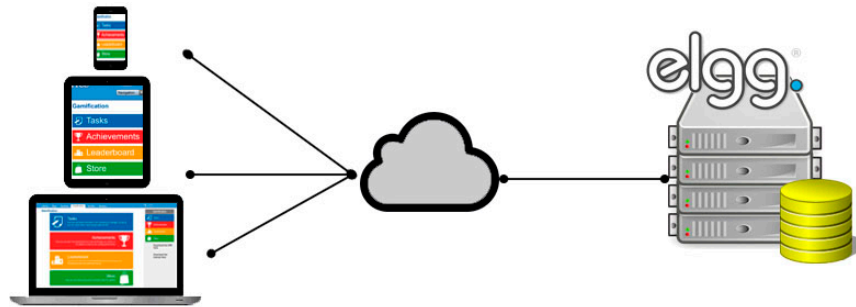
Fig. 1.   System architecture of Elgg platforms, based on a Client-Server model

Regarding to its internal characteristics, it could be noticed that the Elgg framework is based upon a Model-View-Controller (namely, MVC) structure-like software pattern, as depicted in Fig. 2. The Model component is the "ELGG Object" element, an abstraction item from the physical database implementation (MySQL databases, typically). The View component is made of output visual-representation files (i.e., view, style and script files). Finally, the Controller component consists on a threefold structure: the action files, the page files and preprocessing handlers (in charge of analyze incoming requests, hooks or events, and redirect them to their corresponding action or page files).
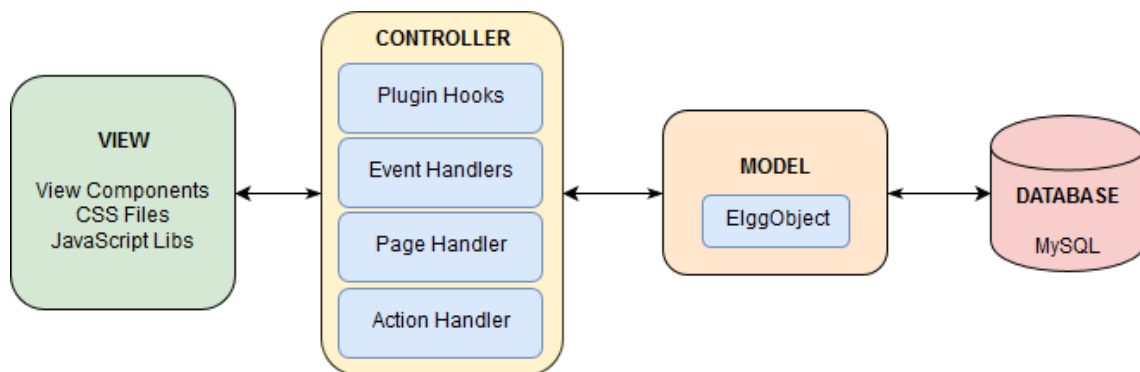

Fig. 2.   High-level diagram of the Elgg MVC structure

The Elgg framework is highly modular, so new features are easily added to the platform through the development of custom modules (namely plugins, in words of the framework). The baseline code of the system is placed in the core section (i.e., an internal API), and should not be modified. Thus, the new modules should be in the modules section, replicating the MVC structure-like composition, adding new features and calling already defined functions through core calls.

3.2.   Applied Gamification Features

In this subsection, the gamification elements that were applied to the system are described.

Points

This was the basic element that supported the gamified functionality of the system; the baseline of other gamification features, as seen previously by [40]. By giving points, users increased motivation and feeling of success while learning [2], [7], [14], [30].

Achievements

Achievements were rewarded (automatically) by the platform to users based on actions performed through the entire system. An example of the deployed achievements could be seen in Fig. 3. As they were, in some cases, activity rewards [32] and, in other cases, bonus rewards [29], they were planned to be acquired by users through the entire course duration [30], [32]. Additionally, when the user got rewarded with an achievement, he or she was granted with some extra points.
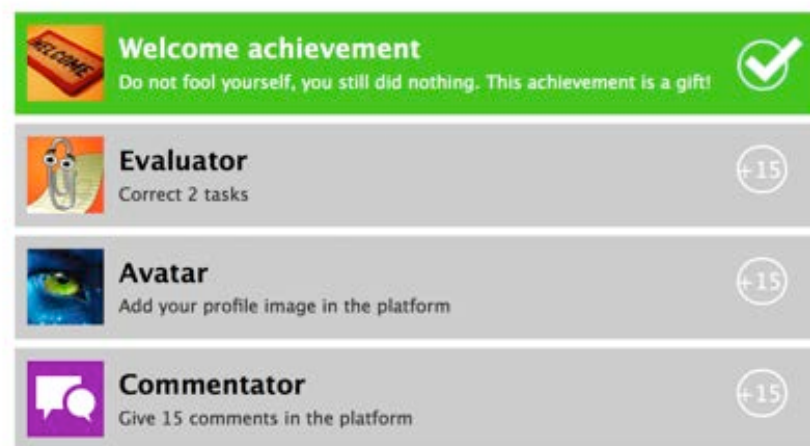

Fig. 3.   Example of available achievements in the platform

Leaderboards

The leaderboards implemented in the platform were tables showing some statistics of the current course (see Fig. 4): Points, friends, comments and tweets. The "Points" section presented all the granted points got by each user and the acquired achievements. The "Friends" section presented the number of relationships made by each user. The "Comments" section presented the total number of comments sent by each user on the whole platform. Finally, "Tweets" section presented the number of micro-blogging entries in *TheWire* web feature.

Trying to reduce possible demotivation of leaderboards [40], these leaderboards scrolled automatically down to the user's position in the ranking, leaving some (typically three) users before he/she; this way the platform motivated students to improve in the ranking position (this detail could be seen in Fig. 4, a).
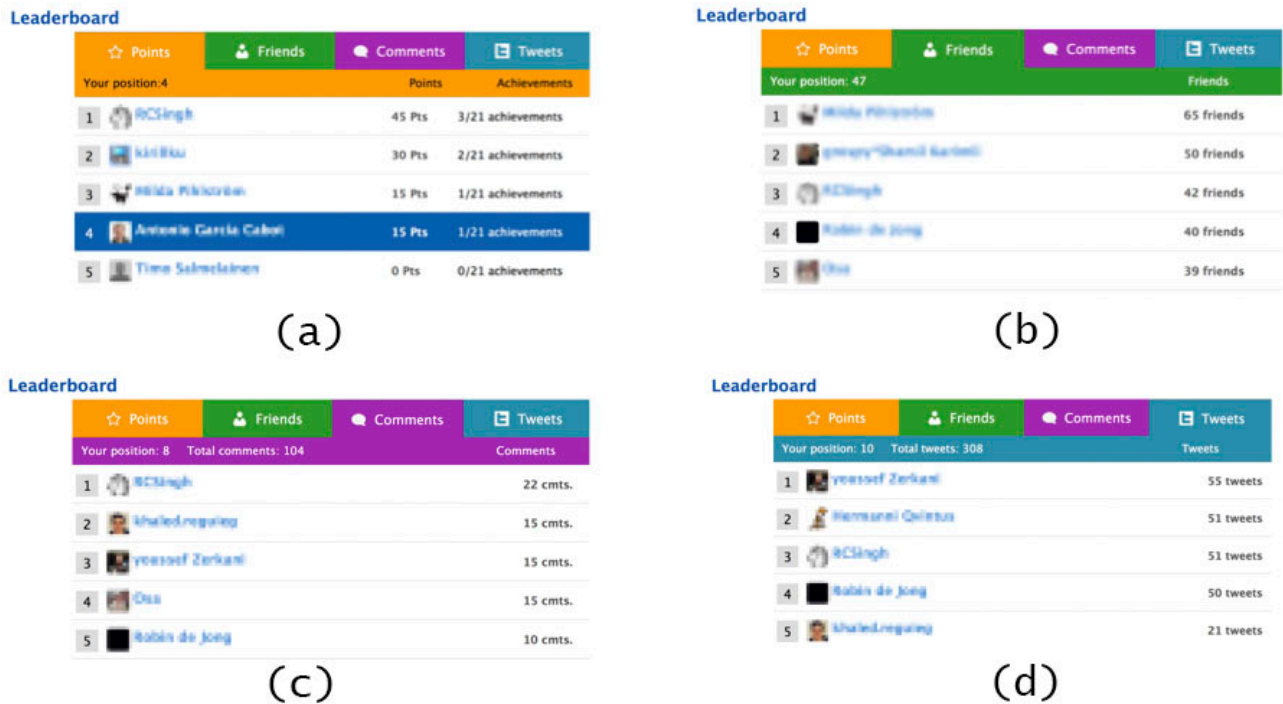
Fig. 4. Details of leaderboard sections in the platform: points (a), friends (b), comments (c) and tweets (d) sections

Rewards

In the platform, this gamification element was supported in the "Store" web-section, where users could claim some types of rewards in exchange of points (Fig.5). The available rewards were the following: "*extra score*" (this will get 0.2 extra score in the final course grade, but it could only be purchased up to five times), "*image in profile*" (this reward enabled the option to add a background image in the profile) and "*custom notifications*" (with this, all user's notification in the activity feed would appear with a custom background image). It should be highlighted that redeemed points, although they appeared in the leaderboard chart, they were deducted from the user's redeemable points.
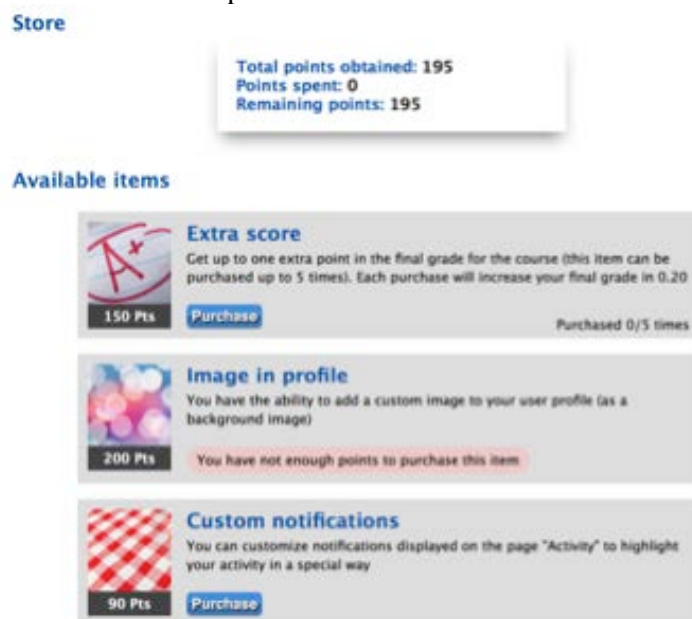

Fig. 5. Detail of the Store section

3.3.   User Tasks Functionality

From the point of view of the user, tasks were the main functionality of the platform. By submitting solutions to proposed exercises, obtaining positive corrections to submitted activities and reviewing fellow's activities, students could obtain points and achievements. In other words, this feature linked the gamification elements with the learning process.

For clarity purposes, tasks section provided a list of available tasks with status icons (submission status and review status) (see Fig. 6), each one composed of introductory information about the task (required details to complete the task) and, optionally, a set of auxiliary files.

Fig. 6.   Example of available tasks

Once the student uploaded the proposed solution, he/she was eligible to evaluate the proposed solution submitted by another student, assigned to he/she randomly on demand. In other words, this constitutes a peer review process (review form is depicted in Fig. 7). As an alternative, in case of conflict, it could be possible to request the assistance of a teacher in the review.

Fig. 7.   Detail of a peer-review form

Taking a closer look to the sequence process of tasks (Fig. 8), it should be differentiated two process: Submitting and reviewing. The former, the submitting phase, consisted in upload to the platform the proposed solution to the task, granting some points to the user and notifying the upload to the rest of the course. The latter, the reviewing phase, consisted in request a task to be reviewed, evaluate it and submitting the review to the system, granting some points, giving (if any) an achievement, both for the destination student and only when a positive correction was given, and notifying the review to the rest of the course.
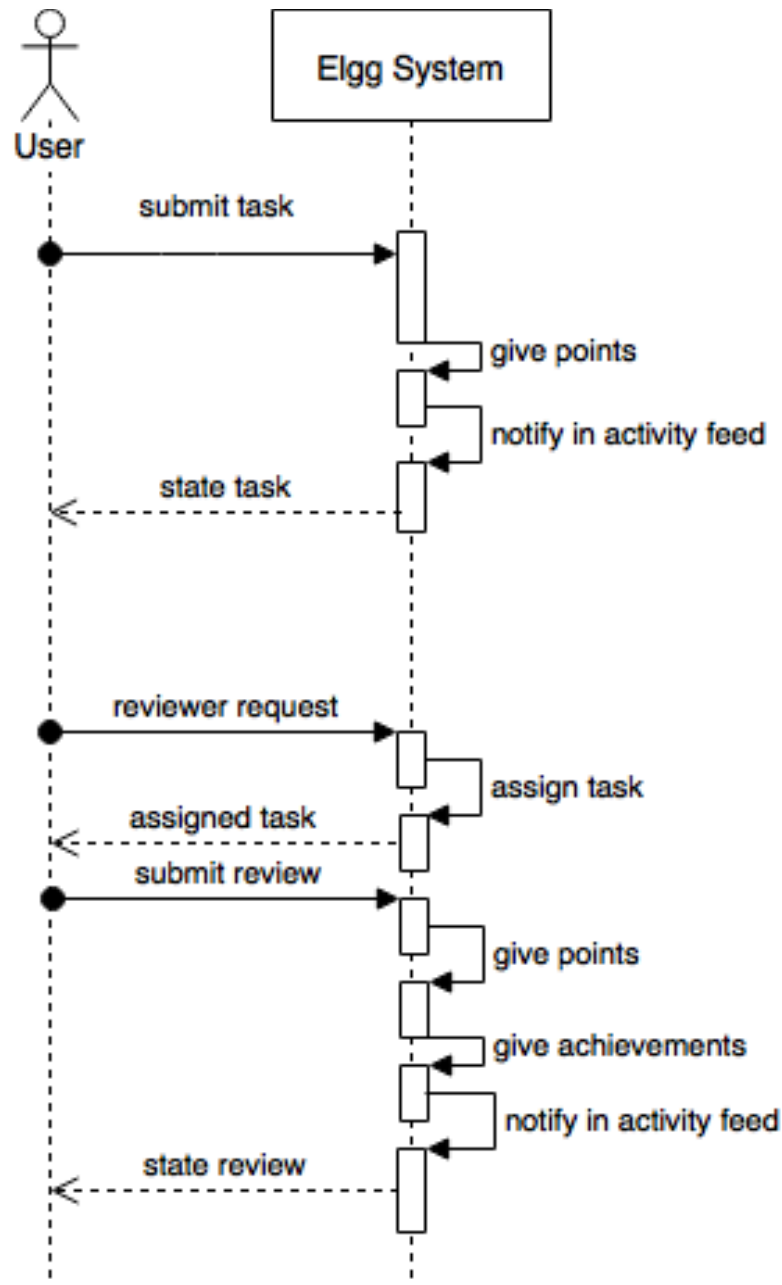

Fig. 8.   Sequence diagram for user tasks, showing submission and reviewing process

3.4. Social Features

These were the default social built-in features of the Elgg platform. Thence, the Elgg platform worked as a social network, which has been proven to be an improving and enhancer tool for students [19], [31], [33], [39].

Activity

This feature included, as the main page of the platform, all the current events in the course, as a feed-list characteristic (Fig. 9). This acted as an acknowledgment tool for completed actions in the platform.
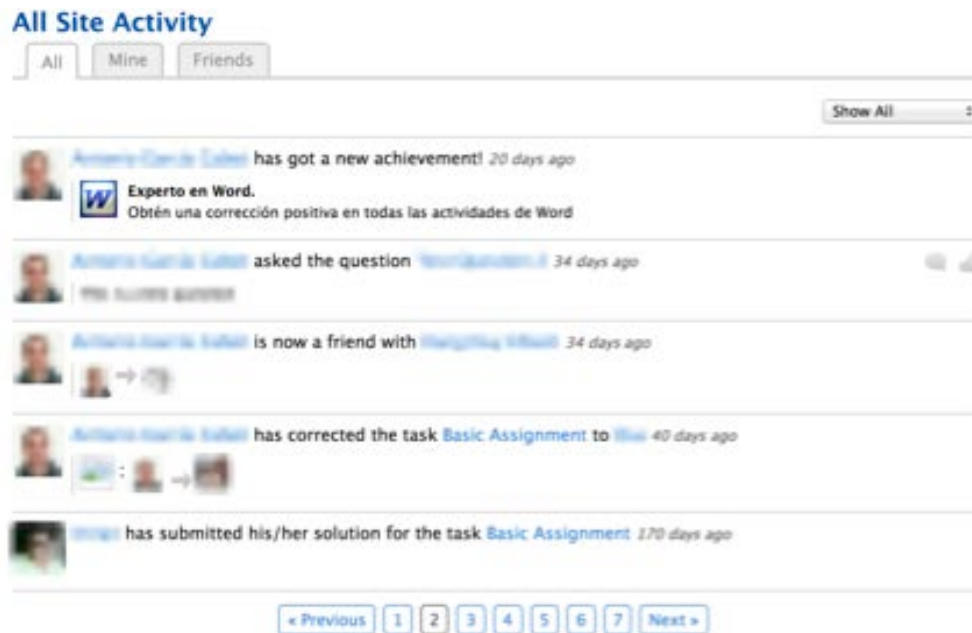

Fig. 9. Detail of the activity section

Friends

The Elgg platform supported bi-directional friendships between course members (i.e., the relationship was stablished when target user accepted the friendship request). Notice that making a predefined number of friends granted achievements to students. In the research of Staubitz et al. [37], it was studied that building relationships between students was a highly motivating mechanism.

Communication Features

The Elgg platform provided a set of features that enabled the communication (or information exchange) between users. The system had the "Blog", "Questions" and "The Wire" sections available for users. The "*Blog*" section enabled the creating of individual (medium/long size) publications in the platform. Regarding the "*Questions*" section, it was possible to create questions to be answered by other students of (if necessary) by the teachers. Finally, the "*The Wire*" section enabled the creation of individual (short size, with less than 140 characters) messages, which was reported by Ebner et al. [16] to be helpful for the learning process, although it could produce an overload of information.

It should be noted that creating new publications (regardless of the section), submitting messages and replying to messages (i.e., creating an active social environment), these actions granted points and achievements to students.

4.   Conclusions

This article represented a case study on how gamification elements were integrated to MOOC courses in a social e-learning system (i.e., Egg framework), which had explicitly developed a gamified plugin committed itself to these techniques: Points, achievements, leaderboards and rewards. Clearly, these techniques have been reported as engagement and motivation encouraging and, additionally, the standalone Elgg platform has been used in traditional e-learning courses producing learning outcome improvements. Hence, it is expected that this platform will help on increasing motivation as well as on reducing the dropout rates of MOOC courses. Therefore, to test these points, we are planning some experiments with real students in real MOOC courses; results that will be compared to results from control groups (i.e., using non-gamified platforms).

As a future work, we are also planning to include other gamification elements to the system, such as badges (e.g. Mozilla Open Badges) because they were reported to increase, even more, the motivation of students, since they remain after the course has finished and they can be accessed anytime and anywhere. Additionally, students can use those badges in their own curricula vitae to prove their acquired skills.

Acknowledgements

References

1.   APM: Introduction to Gamification. Association for Project Management (2014)
2.   Attali, Y. and M. Arieli-Attali: Gamification in assessment: Do points affect test performance? Computers & Education. 83: pp. 57-63 (2015)
3.   Aydemir, M., E.E. Özkeskin, and A.A. Akkurt: A Theoretical Framework on Open and Distance Learning. Procedia-Social and Behavioral Sciences. 174: pp. 1750-1757 (2015)
4.   Bacelar, F. and L. Morgado: Gamification of a Social Learning Network in a Virtual University: Implementation Proposal an Academic Network. In: EDEN 2015 Annual Conference, pp. 841-850. European Distance and E-Learning Network, Barcelona, Spain (2015)
5.   Baker, P.M., K.R. Bujak, and R. DeMillo: The evolving university: Disruptive change and institutional innovation. Procedia Computer Science. 14: pp. 330-335 (2012)
6.   Baker, R., et al.: Why students engage in "gaming the system" behavior in interactive learning environments. Journal of Interactive Learning Research. 19(2): pp. 185-224 (2008)
7.   Barata, G., et al.: Engaging engineering students with gamification. In: Proceedings of the 5th International Conference on Games and Virtual Worlds for Serious Applications (VS-GAMES), pp. 1-8. IEEE, Bournemouth (2013)
8.   Bista, S.K., et al.: Using gamification in an online community. In: Proceedings of the 8th International Conference on Collaborative Computing: Networking, Applications and Worksharing (CollaborateCom), pp. 611-618. IEEE, Pittsburgh, Pennsylvania, United States (2012)
9.   Boticki, I., et al.: Usage of a mobile social learning platform with virtual badges in a primary school. Computers & Education. 86: pp. 120-136 (2015)
10.   Chang, J.-W. and H.-Y. Wei: Exploring Engaging Gamification Mechanics in Massive Online Open Courses. Journal of Educational Technology & Society. 19(2): pp. 177-203 (2015)

11. De-Marcos, L., et al.: An empirical study comparing gamification and social networking on e-learning. Computers & Education. 75: pp. 82-91 (2014)

12. Denny, P.: The effect of virtual achievements on student engagement. In: Proceedings of the SIGCHI conference on human factors in computing systems, pp. 763-772. ACM, Paris (2013)

13. Deterding, S., et al.: From game design elements to gamefulness: defining gamification. In: Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments, pp. 9-15. ACM, Tampere, Finland (2011)

14. Dicheva, D., et al.: Gamification in Education: A Systematic Mapping Study. Journal of Educational Technology & Society. 18(3): pp. 75-88 (2010)

15. Domínguez, A., et al.: Gamifying learning experiences: Practical implications and outcomes. Computers & Education. 63: pp. 380-392 (2013)

16. Ebner, M., et al.: Microblogs in Higher Education–A chance to facilitate informal and process-oriented learning? Computers & Education. 55(1): pp. 92-100 (2010)

17. Elgg WebSite, https://elgg.org/. Accessed April 1, 2017

18. Erenli, K.: The impact of gamification: A recommendation of scenarios for education. In: Proceedings of the 15th International Conference on Interactive Collaborative Learning (ICL), pp. 1-8. IEEE, Villach, Austria (2012)

19. Forkosh-Baruch, A. and A. Hershkovitz: A case study of Israeli higher-education institutes sharing scholarly information with the community via social networks. The Internet and Higher Education. 15(1): pp. 58-68 (2012)

20. Gené, O.B., M.M. Núñez, and Á.F. Blanco: Gamification in MOOC: challenges, opportunities and proposals for advancing MOOC model. In: Proceedings of the Second International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'14), pp. 215-220. ACM, Salamanca (2014)

21. Glover, I.: Play as you learn: gamification as a technique for motivating learners. In: Proceedings of the World Conference on Educational Multimedia, Hypermedia and Telecommunications, pp. 1999-2008. Chesapeake (2013)

22. Hamari, J. and J. Koivisto: Social Motivations To Use Gamification: An Empirical Study Of Gamifying Exercise. In: Proceedings of the 21st European Conference on Information Systems (ECIS 2013), pp. 1-12. Utrecht, Netherlands (2013)

23. Hamari, J., J. Koivisto, and H. Sarsa: Does gamification work?--a literature review of empirical studies on gamification. In: Proceedings of the 47th Hawaii International Conference on System Sciences (HICSS), pp. 3025-3034. IEEE, Waikoloa, Hawaii (2014)

24. Herzig, P., et al.: GaML-A modeling language for gamification. In: Proceedings of the 2013 IEEE/ACM 6th International Conference on Utility and Cloud Computing, pp. 494-499. IEEE Computer Society, Dresden, Germany (2013)

25. Landers, R.N. and A.K. Landers: An Empirical Test of the Theory of Gamified Learning The Effect of Leaderboards on Time-on-Task and Academic Performance. Simulation & Gaming. 45(6): pp. 769-785 (2015)

26. Lee, J.J. and J. Hammer: Gamification in education: What, how, why bother? Academic exchange quarterly. 15(2): pp. 146 (2011)

27. Lucke, U. and C. Rensing: A survey on pervasive education. Pervasive and Mobile Computing. 14: pp. 3-16 (2014)

28. Mekler, E.D., et al.: Do points, levels and leaderboards harm intrinsic motivation?: an empirical analysis of common gamification elements. In: Proceedings of the First International Conference on Gameful Design, Research, and Applications, pp. 66-73. ACM, Toronto, Ontario, Canada (2013)

29. Muntean, C.I.: Raising engagement in e-learning through gamification. In: Proceedings of the 6th International Conference on Virtual Learning (ICVL), pp. 323-329. Romania (2011)

30. Nah, F.F.-H., et al.: Gamification of Education: A Review of Literature. In: HCI in Business, pp. 401-409. Springer (2014)

31.   Ractham, P. and D. Firpo: Using social networking technology to enhance learning in higher education: A case study using Facebook. In: Proceedings of the 44th Hawaii International Conference on System Sciences (HICSS-44), pp. 1-10. IEEE, Koloa, Kauai, Hawaii (2011)
32.   Raymer, R. and E.-L. Design: Gamification: Using Game Mechanics to Enhance eLearning. Elearn Magazine. 2011(9): pp. 3 (2011)
33.   Roblyer, M., et al.: Findings on Facebook in higher education: A comparison of college faculty and student uses and perceptions of social networking sites. The Internet and Higher Education. 13(3): pp. 134-140 (2010)
34.   Robson, K., et al.: Is it all a game? Understanding the principles of gamification. Business Horizons. 58(4): pp. 411-420 (2015)
35.   Santos, J.L., et al.: Evaluating the use of open badges in an open learning environment. In: Scaling up Learning for Sustained Impact, pp. 314-327. Springer (2013)
36.   Spector, J.M.: Emerging educational technologies: Tensions and synergy. Journal of King Saud University-Computer and Information Sciences. 26(1): pp. 5-10 (2014)
37.   Staubitz, T., et al.: TOWARDS SOCIAL GAMIFICATION-IMPLEMENTING A SOCIAL GRAPH IN AN XMOOC PLATFORM. In: Proceedings of 7th International Conference of Education, Research and Innovation, pp., Seville (2014)
38.   Su, C.H. and C.H. Cheng: A mobile gamification learning system for improving the learning motivation and achievements. Journal of Computer Assisted Learning. 31(3): pp. 268-286 (2015)
39.   Tess, P.A.: The role of social media in higher education classes (real and virtual)–A literature review. Computers in Human Behavior. 29(5): pp. A60-A68 (2013)
40.   Willems, C., et al.: MOTIVATING THE MASSES-GAMIFIED MASSIVE OPEN ONLINE COURSES ON OPENHPI. In: Proceedings of the 6th International Conference on Education and New Learning Technologies (EDULEARN'14), pp. 4042-4052. iated Digital Library, Barcelona, Spain (2014)