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Measuring the effects on learning performance and engagement with a gamified social platform in an MSc program

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Abstract: New generations of students are highly involved with technology. Therefore, while coming to traditional classrooms, it is required to call for different forms of teaching that are more motivating and engaging for them. One approach to this problem is combining games and education. Gamification could be defined as the use of game design elements in non-game contexts. The research gap in the literature could be found in requiring more experimental studies assessing if gamification can improve learning outcomes. To this end, this paper further contributes to determining if a gamified social e-learning platform can improve the learning performance and engagement of MSc students. The developed platform combined submission of activities with points, achievements, leaderboards, and rewards (with a virtual store) and social elements such as friends, forums, Q&A, blogs, and microblogging. Results show that, indeed, social gamification is a suitable technique to improve the learning outcome of students, at least for those skills related to programming, providing more communication skills and producing more engagement and motivation while using the platform.

Keywords: gamification; social; education; engagement; learning performance

1. Introduction

Educational paradigms have recently evolved in academic environments, somehow mixing education and technology in harmony. The aim is improving the learning outcome of students. In this context, educational environments are being self-encouraged to face a new type of students: Digital natives; young people who have grown up fully immersed with technology [1, 2], living together with physical natives (also referred to as "digital immigrants"); older people that grew up without the current-in-time widespread usage of technology [3]. One of these technologies is videogames, although they are not only limited to educational environments. On top of that, it is observed that videogames are being widely used by the general public, within the past decades [4]. Gamification, in its broad definition, makes use of different game elements into non-game contexts [5-7]. We refer to a game element as a design technique that underlies features of actual games (i.e., mechanics, aesthetics and game thinking). In other authors' views, gamification is seeing as experiences to be boosted rather than game elements [8]. There is a significant difference between gamification and serious games. The former is focused on targeting, extracting and adapting game attributes to non-game contexts. On the other hand, in the latter case all game elements are put on the game, but in different proportions [9]. However, in most of the concepts, gamification involves the remodeling process of an existing procedure that aims to improve the impact on learners [10]. More precisely, gamification represents a

methodology able to increase motivation and engagement, as well as to guide towards a desired behavior for all participants in a gamified activity [11-14].

In previous years, gamification techniques have been applied in many areas [10, 15], such as online communities [16], social networks [17], mobile applications [18], and even in business processes [19-21]. Among those fields, gamification applied to educational environments has been seen, in the past few years, as an innovative and emerging combination, designed to improve motivation and engagement of students [11, 12, 14, 22]; meant to improve learning, but not to fully replace traditional classrooms [9, 11].

Gamification studies on higher education have shown a grown in the last years, commonly applied to computer science subjects [23]. In the last year, gamification on higher education has some examples: from courses applying basic techniques (such as badges [24] or badges and leaderboards [25]) to complex gamified systems (with points-based levels, badges and leaderboards) [26].

Gamification depends on the context and, even more, on users [13, 27]. It should be applied in the short term [28, 29], in order to easily and effectively drive student behavior [28], as long term reduces the effect on user engagement [14, 27]. Nonetheless, it is not easy to create the desired effect [6, 12, 30], and, in some cases, it is not easily validated [6, 30-33]. Moreover, it should be noted that gamification should be applied together with other techniques to produce a goal-oriented procedure [14, 34]. Any task/activity could be, in theory, gamified, but it requires students to be motivated, capable, and ready to participate in the gamified activity [11]. From this point of view, teachers are only required to set the learning context and all gamified learning paths, not to consider gamification as a computer-based learning methodology [13].

A gamified course should be planned in layers in order to boost a better engagement for the students, their interactions, and learning context [7, 14, 29, 34], but in a way that could create a complete learning experience [12, 34]. Along with the objectives in the short, medium and long term, this gamification structure helps students to acquire their learning objectives gradually, maintaining engagement, and reducing cognitive fatigue [14, 35]. Existing research points that gamification could, indeed, be used to improve performance, but this is not achieved through intrinsic motivation (at least, with points, levels, and leaderboards), as authors would have expected [33].

Special attention must be paid when gamification is applied to educational environments. According to Erenli [36], the fact that adding elements of games to learning could produce addictions, so it is necessary to monitor if these types of attitudes appear in the classroom and proceed accordingly to those affected students.

Gamification provides plenty of techniques that could be applied to a given system. The following elements could be used to gamify educational environments (either a learning course or a specific activity):

- **Points**. They are considered the baseline for any other gamification element to be added to the system [37]. A specific quantity (number) of points is provided to the student after the required tasks are completed. The main benefits of this element are feeling of success [32], visual status (individually or as a group) [30], and motivation boost [38, 39].
- **Levels**. Usually, when a certain amount of points is achieved, a certain level is completed, and a new one is unlocked. As in traditional games, initial levels should be planned to be completed in an agile and effortless way, while top levels should require

more effort and knowledge skills [32], due to it is focused on learning environments. The main benefits of these elements are feedback [39], engagement [30], and visual progression and status [32, 39].

- **Rewards**. Virtual or real prizes awarded based on time spent in the system after certain activities are completed, as bonuses or in exchange for other elements [11, 14]. These rewards should be divided into multiple small prizes, better than a big one, in order to maintain motivation [32]. Rewards should be scheduled along with the gamified activity, to maintain delivery as regular and consistent as possible [14, 32]. Feedback, motivation, entertainment, or encouragement are the main benefits of this element [12, 30, 32, 34].
    - **Achievements and Badges**. In a gamified environment, virtual rewards are usually in the form of visual marks awarded to users. It has been noticed that students better contribute (in quality terms) to the proposed activities in the platform [40, 41]. It is also important that awarded achievements/badges should be available to be shown anytime. Similar to generic rewards, achievements/badges are related to visual status and social engagement [30, 32], but they should be considered as highly motivating, fun, and encouraging [12, 32, 34, 42].
- **Leaderboards**. List of participants (name, nickname, and/or avatar) displaying current score (usually points, but it could be any other element) for each. Leaderboards could introduce demotivation to the students, as competition-like attitude could face with students not being in the top places of the list. Balancing global leaderboards could be a feasible solution [37]. Visual status, social engagement, competition, or motivation could be pointed as the main benefits of this element [12, 30, 32, 34, 39, 43].
- **Avatars**. They are graphical designs for students' profiles that look for a suitable continuous integration with gamification. Avatars should enable personalization (or visual upgrade) of features, such as a reward, based on skill/level, or similar [30]. Visual status and social engagement are the main benefits of this element.
- **Progress Bar**. It consists of a storyline-like bar providing information on the progression of learning objectives. Constant feedback and information for learning context are the main benefits of this element [14, 32, 34, 37].
- **Distribution of Learning Contents**. Since learning contents are not gamification elements, some authors pointed out the usage of the "Cascading Information Principle" [11, 14]. This principle requires that learning contents related to the gamified activity are divided into small elements, additional resources, regular activities, and information about future learning contents. All of this aims to maintain motivation, desire to return, and flow of learning.

This paper is focused on analyzing the effects of gamification on higher education students, specifically on a Master's degree. Although, indeed, there are already studies on gamification methods applied to educational contexts, almost half of current studies show mixed positive-negative results [44].

Few studies are stating completely positive results of applying gamification techniques to educational environments. For instance, Landers and Landers [43] added leaderboards in a wiki platform for major students, and they reported fully positive results to increase students' learning outcomes. In another study, Tsay et al. [26] used points, badges, and leaderboards with undergraduate students, and they found that gamification helps to increase engagement and grades, and it is useful to challenge students. With an alternative point of view, instead of adding gamification elements, Thom et al. [44] tested the effects of removing the gamification platform

(points, leaderboards, levels, and badges) from a social platform in an IT company, after ten months of usage. Results showed that employees' motivation dropped and user activity was negatively impacted. Finally, Jurgelaitis et al. [45] added gamified plugins (badges, levels, leaderboards, and rewards) to an existing online platform intended for undergraduate students. Their analysis showed that grades and motivation increased.

Current gamification studies return mixed positive-negative results. All these studies generally agree in the need to require more studies to be able to validate whether gamification is a positive technique or not for students. Barata et al. [39] used badges and leaderboards with a Master of Science (MSc) students. Their results show that engagement and motivation increased, but required more work from students when compared to the traditional classroom. On Attali and Arieli-Attali's work [38], applying points to tests for middle-grade students reported mixed results: gamification may increase the response speed of test's questions, but there is no clear evidence on effectiveness.

Furthermore, Buisman and van Eekelen [46] used points and leaderboards in a management platform for undergraduate and graduate students and also reported mixed results: gamification could be good to increment the use of the platform and enjoyment, but it is not significant to increase engagement, involvement or motivation of the students. In another work, Christy and Fox [23] mixed leaderboards and virtual classroom for undergraduate women to enhance math abilities, and the authors reported that leaderboards could be both positive and negative, depending on how the student socially compares (e.g. their result was worse in classes where there were more men). More recently, Ortiz-Rojas et al. [47] added leaderboards to an existing learning management system for undergraduate students in a programming course. Their results showed that learning performance significantly increased; although motivation, engagement, and self-efficacy were not affected. The authors concluded that to improve the results of gamification, teachers should take part in the designing phase of the course.

On the other hand, there are some gamification studies with negative outcomes. Hanus and Fox [48] used badges and a leaderboard for undergraduate students and found a clear reduction of motivation and satisfaction. Also, students' grades were negatively affected. In another study, Kyewski and Krämer [25] imparted an online seminar with badges for college students. The authors reported no effects of gamification at all to students, concluding that gamification is not useful in educational contexts.

This study sets out to overcome these limitations. We present a gamified social system which is then empirically tested in real case scenario (a graduate course in mobile applications programming) to assess its impact in terms of learning performance and of the engagement of students. We also collected data about the same course with a traditional e-learning platform and we compared the different results obtained.

The rest of the paper is structured as follows. Section "2. Material and Methods" presents, along with the research questions, experimental setting, and instruments required to carry out this experiment. Section "3. Results" presents the outcomes of the experiment. Then, in section "4. Discussion", results are compared with similar works. Finally, Section "5. Conclusions" presents conclusions, limitations of the study, and possible future works.

2. Materials and Methods

This section presents the research questions, the setting, the instruments, and the procedure of the experiment.

Research Questions

The purpose of this study is to determine if a gamified social e-learning platform can improve the learning performance (that is, grades obtained) of students in a Master's degree. To do so, we are going to answer the following research questions:

- RQ1: Do students improve their learning performance when using social platforms?
- RQ2: Is there a positive relationship between the number of interactions in a gamified social e-learning platform and the students' learning performance?
- RQ3: Do students feel more engaged, motivated, and involved when using gamified social platforms rather than traditional e-learning platforms?

Experimental Setting

Students were enrolled in the Mobile Applications subject, which is a subject included in the postgraduate Master of Science (MSc) in Software Engineering for the Web at the University of Alcala. The content of this subject is essentially about programming for the Android platform. Students had to complete two assignments: The purpose of the first one (referred to as intermediate assignment) is for students to get basic competences in Android programming and, the second one (referred to as final assignment), for getting advanced developing competences. The final grade earned was obtained by weighting the individual grades earned in the intermediate assignment (37.5%) and in the final assignment (62.5%).

Instruments

The gamified social platform was developed using the Elgg engine [49] as a baseline, which is an open-source engine (written in PHP) to create social networks. The gamified social platform aimed to combine the benefits of gamification and networking in a single instrument. Activities were gamified in a social networking environment addressing the specific needs for both competition and cooperation (Figure 1).

Figure 1. Screenshot of the main section of the web platform (in Spanish).

As seen before, the deployed platform tried to provide more benefits than a standalone gamified platform, thanks to the inclusion of a set of social network features. While engaged in both gamified and social activities, students are expected to improve and enhance their experiences [50-53]. Thus, the social features included in the gamified social platform are the following:

- Friends: This feature facilitates that students establish bidirectional relationships with other members of the course.
- Activity (see Figure 2): This feature includes a list of recent events accomplished by the students within the course. It provides a sense of recognition of the activities where students are involved.
- Blog: This functionality enables creating individual publications on the system.
- Questions: With this feature, the students can submit their questions to the platform, in order to be answered by the teachers or even by other students.
- "The Wire": It is a feature that adds a micro-blogging (messages of 140 characters or less) section to the system, which is shown as a very helpful tool for learning [54].

Figure 2. Screenshot of the platform, showing the activity feed (in Spanish).

In addition to the previous social features, already included in the core of the Elgg platform, some additional gamification features were built:

- Points: As said previously, points are the baseline for other gamification elements and, being so, they are able to promote motivation, feedback and success [30, 32, 38, 39]. In this platform, points are given to the student when they complete tasks or when they are rewarded with achievements. Although, for Nah et al. [32], points should be applied as an investment or as a measurement of performance. Nonetheless, we have applied points in a twofold way: as an investment to be used in the store (exchangeable for rewards) and also in the leaderboard, as one of the available rankings. We thought that

this approach could be the smoothest connecting link with all gamification elements added to the platform.

- Tasks (see Figure 3): A list-like with the assignments of the course. Tasks are considered as one of the main design principles in educational gamified environments [30, 32, 55]. Each task presents an introductory information about what students have to do to finish the task and (optionally) a series of additional files. This section includes peer-review to provide room for meta-reflection: when a student submits his/her assignment, he/she is eligible to evaluate a randomly paired assignment submitted by another classmate. Points are given for submitting the assignment, for providing peer-review and for receiving positive assessments on own assignments.

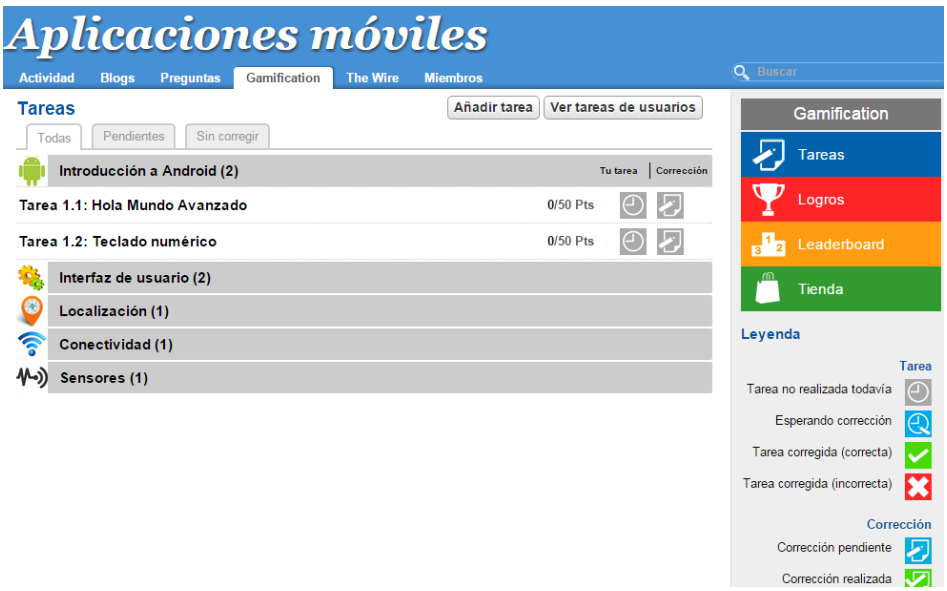

Figure 3. Screenshot of the list of available tasks (in Spanish).

- Achievements (see Figure 4): Achievements are given in reward for accomplishing certain course activities and for making significant contributions to the social network. When a student receives an achievement, he/she is also rewarded with some extra points. As they are rewards (both for completing activities [14] and as bonuses [11]), a scheduler is required [14, 32]. They are planned to be issued gradually along the course. Derived from the studies by Nah et al. [32], and Raymer and Design [14] related to prizes and rewards, in order to be optimally deployed, they are better to be awarded in multiple small rewards than a unique reward. Trying to face this, all achievements were distributed to be granted through the duration of the subject.

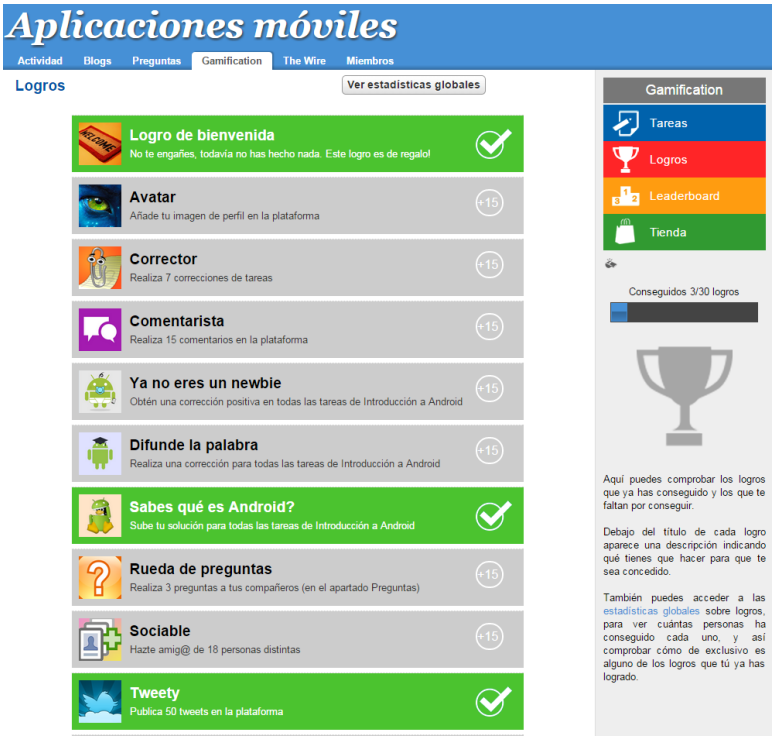

Figure 4. Screenshot of achievements page (in Spanish).

- Leaderboard (see Figure 5): Players' leaderboards are divided into four types (tabs): Points, friends, comments, and tweets. The "Points" tab shows the points got by every user over the course and the rewarded achievements. The "Friends" tab shows the number of friends made by each student (i.e., number of followers). The "Comments" tab shows the number of comments written by each user on the platform. Finally, the "Tweets" tab shows the number of microblogging entries in "The Wire" section. There is a bit of debate with the real effectiveness of applying leaderboards in educational contexts. For some authors, like Nah et al. [32] and Barata et al. [39], they are undoubted motivators and engagers. On the other hand, some authors like Dominguez et al. [12] affirm that leaderboards are not enough by themselves to provide motivation, given that it is a source of competition and, additionally, not all students are encouraged enough to compete against classmates. Other authors, more neutral with their results (like Landers and Landers [43]), found that leaderboards could be, indeed, helpful to improve learning outcome, but in an indirect way, and it is recommended to better determine firstly which is the behavior to target and then set the mechanisms.

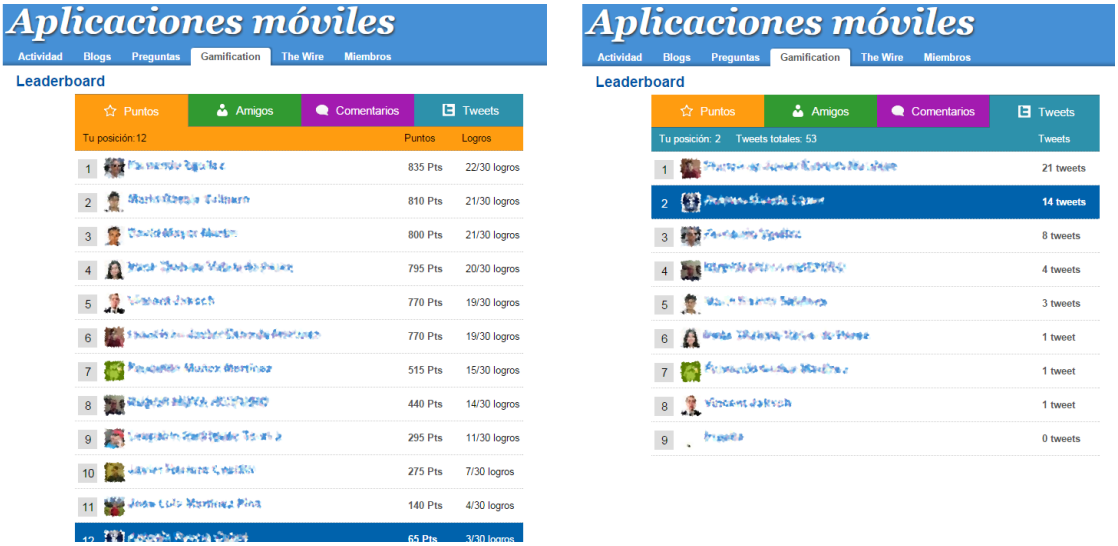

Figure 5. Screenshots of different available options in the leaderboard section (in Spanish): (left) Points and (right) the wire.

- Store: This course section is where rewards are provided. Students can exchange their points for some extra rewards. The available items are “extra score” (0.20 extra score on the overall grade, it can be purchased up to five times), “image in profile” (a background image in the users’ profile) and “custom notifications” (a background image in the activity section). Redeemed points are deducted from the user’s account but remain for the leaderboards.

In summary, the platform used is a basic learning management system with an integrated plugin with gamification and social features. Gamification is built upon the learning management system, since tasks’ workflow is related to the gamification outcomes. Although social contributions could be seen more into community perspectives, they are not standalone contributions but related to gamification outcomes (for example, achievements for participating in the course forum).

Population

It should be noted that learning modules were the same for all addressed conditions (both experimental and control groups). For the control group, a traditional blended-learning approach was used: materials and further communication tools were available on a BlackBoard e-learning platform. We want to stress that students were required to complete the same learning activities in all cases. The experimental conditions determined how contents and activities were delivered to the participants. In the control group, learning modules and assignments were delivered as documents, while in the experimental group assignments were delivered within the gamified platform. Students in all groups had a total of two 5-hour lectures, delivered in two different weeks, including one introductory lecture and one advanced lecture. Lectures introduced the learning goals, main theoretical concepts, and practical skills that students had to learn and practice. The assignments were introduced in the lectures and students had to work on their own (while not in lecture time) to achieve the learning goals and complete the assignments.

The traditional e-learning platform was used by the control group, which was composed of 15 students (12 males and 3 females), while the gamified social platform was used by 12 students (11 males and 1 female). All the students were aged between 25 and 40 years old.

Procedure

A quasi-experimental design was used to compare the learning performance of the experimental and control group. Scores for each assessment item and the final score were collected (0-10 scale) and appraised. The lecturer of the course gave scores. Only one lecturer participated in the course and she assessed all students using the same criteria. Conditions were applied to groups randomly.

Experimentation took place during Spring 2015. Students in the control group used a traditional e-learning approach in which all educational contents and activities were available in the e-learning platform, as well as traditional communication tools including forums or chats. Students had to submit their individual assignments (both the intermediate and the final one) that were assessed by lecturers and that were used to measure their learning performance.

When the course finished, the students of each group filled out a questionnaire about their satisfaction regarding the platform they used (depending on the experimental condition). The questionnaire was composed of some questions retrieved from other research works. These questions were divided into different groups, according to the variable to be measured. The components measured were: control variables (based on [46], see Table A1), engagement (based on [56], see Table A2), motivation (focusing on intrinsic motivation, extrinsic motivation and amotivation; based on [57], see Tables A3, A4 and A5), involvement (based on [58], see Table A6), and communication and relationship ties (based on [59, 60], see Tables A7 and A8).

3. Results

In order to answer RQ1 ("*Do students improve their learning performance when using gamified social platforms?*"), the grades obtained by the students were analyzed and compared for both groups. The overall grades obtained were higher in the experimental group (gamified social platform) than in the control group (traditional e-learning platform), as seen in Figure 6 (as said previously, the overall grade was calculated by weighting intermediate, 37.5%, and final, 62.5%, assignments).

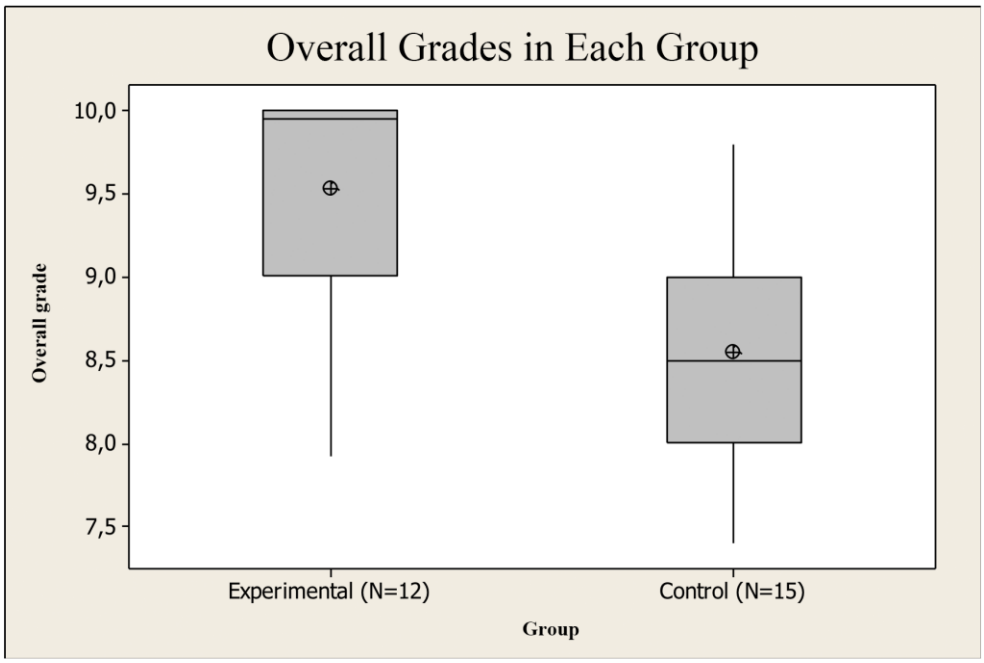

Figure 6. Overall grades earned by students in both groups, experimental and control, participating in the study.

As seen in Table 1, significance ($p<0.05$) was found for the intermediate assignment and for the final grade, which suggests that students who used the gamified social platform got better grades than those who used the traditional e-learning platform. However, no significance was found for the final assignment. Therefore, the results suggest that using the gamified social platform influences positively students' learning performance, especially when learning basic concepts of Android programming.

Evaluation item	Group	N	Mean	Std. Error	Std. Dev.	Significance
Intermediate assignment	Gamified social	12	9.438	0.297	1.029	W=241.0 p=0.0003*
	Control	15	6.267	0.550	2.129	
Final assignment	Gamified social	12	9.583	0.276	0.955	W=195.0 p=0.1696
	Control	15	9.533	0.114	0.442	
Final grade	Gamified social	12	9.529	0.205	0.709	W=230.0 p=0.0025*
	Control	15	8.547	0.187	0.726	

Table 1. Results of the grades for the control and experimental groups. Significance is computed using Mann-Whitney tests

As for RQ2 ("*Is there a positive relation between the number of interactions in an e-learning social platform and the students' learning performance?*"), Pearson correlation between the number of interactions and the grade obtained in the intermediate assignment was found ($p=0.04$), as well as for the final grade ($p=0.017$), whereas it was not found for the final assignment ($p=0.032$). This suggests that students who interacted more with the platform obtained better grades in the intermediate assignment and the final grade. Interactions are measured by the number of questions, answers, blogs, tweets, likes, messages, and comments that students write on the platform. Therefore, the results suggest that interacting with the platform helps students get better grades, especially in the early learning stages (intermediate assignment).

Regarding RQ3 ("*Do students feel more engaged, motivated, and involved when using gamified social platforms rather than traditional e-learning platforms*"), engagement, motivation, and involvement were measured by the questionnaire that the students filled out after the course. The results of the questionnaire are shown in Table 2 to Table 6. It is important to note that answers to questions 3.13 and 3.14 have been reversed to be analyzed because they are negative. It is important to note that Cronbach's Alpha of the questionnaire was 0.9553; thus, the internal consistency of the questionnaire is high.

Question	AVG control	Std. Dev. Control	AVG gamified social	Std. Dev. social gamif.	W	p
1.1.	4.27	0.884	4.50	0.522	177.0	0.6432
1.2.	3.53	1.125	4.08	0.793	192.0	0.2285
1.3.	3.07	1.280	2.83	0.718	158.0	0.6203
1.4.	3.07	1.580	1.67	1.557	124.0	0.0211*

Total	**3.48**	**1.308**	**3.27**	**1.469**		

Table 2. Results of the questionnaire (Control variables) and Mann Whitney test

Question	AVG control	Std. Dev. Control	AVG gamified social	Std. Dev. social gamif.	W	p
2.1.	3.00	0.756	3.41	0.669	195.5	0.1545
2.2.	3.47	0.915	3.75	0.754	183.0	0.4239
2.3.	2.80	0.862	3.16	0.835	188.5	0.3010
2.4.	3.00	0.655	3.58	0.669	210.0	0.0274*
2.5.	3.00	0.756	3.50	1.000	194.0	0.1887
2.6.	3.40	1.056	3.75	0.866	184.5	0.4087
2.7.	3.60	0.986	4.08	0.793	191.0	0.2394
2.8.	2.47	0.834	2.75	1.485	174.5	0.7596
2.9.	3.00	1.134	3.25	1.055	180.0	0.5599
2.10.	2.33	0.816	2.92	1.240	195.0	0.1716
2.11.	2.87	1.125	3.42	1.084	190.5	0.2634
Total	**2.99**	**0.960**	**3.42**	**1.012**		

Table 3. Results of the questionnaire (Engagement) and Mann Whitney test

Question	AVG control	Std. Dev. Control	AVG gamified social	Std. Dev. social gamif.	W	p
3.1.	3.67	0.900	3.92	0.900	182.0	0.4743
3.2.	3.80	0.862	3.75	0.965	165.0	0.8975
3.3.	3.93	0.884	4.17	0.577	179.5	0.5507
3.4.	3.87	1.125	4.00	0.739	169.5	0.9588
3.5.	3.07	1.163	3.92	0.996	204.5	0.0680
3.6.	2.80	1.146	3.25	0.866	183.5	0.4411
3.7.	3.00	1.195	2.75	1.288	157.5	0.6090
3.8.	2.93	1.100	2.67	1.303	155.0	0.5259
3.9.	2.47	0.990	2.58	1.240	174.0	0.7806
3.10.	2.80	1.014	2.58	1.084	159.0	0.6653
3.11.	3.73	0.704	3.08	1.084	141.0	0.1636
3.12.	3.80	0.862	3.25	1.138	144.0	0.2245
3.13.	4.27	1.033	3.92	1.084	148.5	0.3196
3.14.	4.60	0.737	4.67	0.651	170.5	0.8989
Total	**3.48**	**1.137**	**3.46**	**1.173**		

Table 4. Results of the questionnaire (Motivation) and Mann Whitney test

Question	AVG control	Std. Dev. Control	AVG gamified social	Std. Dev. social gamif.	W	p
4.1.	4.27	0.884	4.25	0.754	163.5	0.8318
4.2.	3.53	0.990	4.42	0.669	216.0	0.0115*
4.3.	3.93	0.884	3.92	0.996	168.0	1.0000

4.4.	3.20	0.676	4.08	0.669	225.5	0.0025*
4.5.	3.73	0.961	3.67	0.778	164.0	0.8552
4.6.	3.47	0.915	4.25	0.622	213.5	0.0165*
4.7.	3.33	0.724	3.58	0.900	183.0	0.4385
4.8.	3.80	0.941	4.08	0.793	181.0	0.5120
4.9.	3.13	1.125	4.25	0.622	221.5	0.0070*
4.10.	4.13	0.834	4.08	0.793	162.5	0.7912
Total	**3.65**	**0.948**	**4.06**	**0.781**		

Table 5. Results of the questionnaire (Involvement) and Mann Whitney test

Question	**AVG control**	**Std. Dev. Control**	**AVG gamified social**	**Std. Dev. social gamif.**	**W**	**p**
5.1.	3.20	1.265	4.42	0.669	220.5	0.0081*
5.2.	3.87	1.187	3.58	0.996	150.0	0.3703
5.3.	2.93	1.163	4.08	0.669	220.5	0.0079*
5.4.	3.33	0.900	3.42	1.379	176.5	0.6803
5.5.	3.27	0.961	3.75	0.754	192.0	0.2166
5.6.	3.80	0.775	3.75	0.866	165.0	0.8925
5.7.	2.87	1.125	4.00	0.603	219.0	0.0076*
5.8.	3.40	0.986	3.50	1.000	170.0	0.9383
5.9.	3.00	0.926	4.08	0.515	227.5	0.0017*
5.10.	3.33	0.976	3.92	0.515	201.5	0.0724
5.11.	3.07	0.884	3.92	0.669	215.0	0.0145*
5.12.	3.20	0.941	3.75	0.866	198.5	0.1188
5.13.	3.13	1.457	4.33	0.778	212.0	0.0277*
5.14.	3.53	1.187	4.42	0.793	208.5	0.0404*
Total	**3.28**	**1.073**	**3.92**	**0.848**		

Table 6. Results of the questionnaire (Communication and relationship) and Mann Whitney

As seen in the previous tables, there are thirteen questions where the difference between answers for the traditional e-learning platform and the gamified social platform is significantly relevant.

Firstly, it should be noted that students have more experience with the Blackboard platform prior to the course than with the gamified social platform (question 1.4), which is understandable because the latter is a new platform and has been used in the experimental condition.

There is also a significant difference in one question referred to engagement. This is, in particular, the fact that the gamified social platform inspires more the students than the traditional e-learning platform (question 2.4). This may be due to students interact more with their classmates than when using a traditional e-learning platform, which can help students to think more about the subjects of the course.

Involvement also seems to be better in the experimental condition because students think that the gamified social platform is more interesting (question 4.2), more exciting (question 4.4), more appealing (question 4.6), and even more involving (question 4.9) than the traditional e-

learning platform. All this is probably thanks to the gamified elements included in the platform, whose objective is making learning more fun.

Finally, the gamified social platform is seen by the students as a platform that improves communication (question 5.1) and its frequency with their classmates (question 5.3), as well as communication in solving problems with their classmates (question 5.7). All this suggests that the gamified social platform improves communication ties. Furthermore, students rated significantly higher the questions that state that the platform improves the degree to which they share objectives (question 5.9) and knowledge (question 5.11) with their classmates, as well as those that state that the platform improves the degree to which the mutual respect between classmates (question 5.13) and between students and teachers facilitates learning (question 5.14). This suggests that the gamified social platform also improves relationship ties. All these advantages may be provided by the social component of the platform, which helps students to interact and communicate more between them.

4. Discussion

A good approach of gamification to learning environments is applying social features in order to reproduce, as suitable as possible, a physical classroom, which is an environment in which students could feel more familiar. With this, students are expected to have better learning outcomes, as seen by Muntean's study [11]. Likewise, our gamified system does support this proposition with the combination of friend relationships, blogs, questions, trying to provide as similar as feasible, the type of interactions that may arise in a classroom.

Barata et al. [39] and Raymer and Design [14] noticed that the most important task in developing a gamified e-learning platform might be adding the correct amount of challenge to the student. Too much challenge is as bad as a few, but it should be highly related to the student skills, and his/her progression through the course. Otherwise, the student could be getting anxious or bored, respectively, to the demanded challenge. In our study, we have tried to equally distribute the load in the two required tasks to the students.

In quite the same way as our study, Barata et al. [39] applied points, leaderboards, and badges to an MSc course. These elements seemed to provide engagement and motivation, and their participation in the forums was more noticeable, although students admitted that the required work was higher than in non-gamified lectures. Nevertheless, students found this gamified alternative as an easy-to-learn and motivating tool. As in our study, the gamified platform boosted communication skills and engagement among the students. Their main limitation is a lack of association between the applied gamification elements and grades obtained.

A similar gamification approach was followed in the work of Tsay et al. [25]. They applied points, badges, and leaderboards; but addressed to undergraduate students of a business school. Like our platform, theirs had elements to boost social engagement. Their results reported an improvement in student's engagement and grades earned. However, and slightly different from our results, they reported that gamification could be useful to challenge students with high abilities. We did find that gamification is better for basic activities, but it could be different given that their study addressed undergraduate students. It could also suggest that MSc students could benefit from gamification in different forms.

As well as in this study, Jurgelaitis et al. [45] created some plugins to extend an existing learning system (Moodle, in this case) with gamification features. Added features were rather similar to ours: experience points, levels, leaderboards, and rewards (badges and coins). Their results

showed that learning performance and motivation boosted with gamification. Nonetheless, these were the only variables measured. Therefore, it cannot be concluded if there are any additional effects to the students (either positive or negative ones).

In the work of Turan et al. [61], school students followed a gamified strategy. Quite similar to our platform, they used points, leaderboards, badges, and rewards. A control group used traditional learning methods. Their results were aligned with our study, i.e., students in the gamified group got better scores and they were more engaged with the platform. However, as a negative part, the authors noticed that students in the gamified group suffered from higher cognitive load levels, which is completely understandable given that gamification may require more cognitive activities than traditional learning methods.

In another experimental study, made by Boboc et al. [62], gamified quizzes were applied to students aged between 19 and 28 years old. Results were compared with a control group applying a traditional paper exam, and it was derived that gamification can influence the grades earned by students, similar results as in our study.

Additionally, in the work of Davis et al. [26], a gamification system was deployed with undergraduate students in an introductory course in computer science. Results suggest that students have higher perceived learning when gamification is applied. Results also suggested that students who play videogames have higher engagement than non-player students. Concerning these, the time spent on games was not valued in our work as a factor, and it may be interesting to consider it for future work.

However, not all experimental studies came out with positive results on applying gamification in educational contexts. For instance, in the research of Hanus and Fox [48], badges and a leaderboard were used in a communications course with undergraduate students. Their results showed that students in the gamified course were less motivated, poorly engaged, and lower performing than those in non-gamified groups. These negative results could be due to an excessive challenge in the platform, stated as a limitation by authors, which is a problem previously discussed. About this, in the study of Attali and Arieli-Attali [38], where points were used in a mathematics course, this gamification element was tested to be a motivator, although it did not improve accuracy in students' answers, maybe caused by some limitations in the type of assignments given to the students.

Similarly, in the work of Kyewski and Krämer [24], an online seminar for college students was deployed. Authors studied the meaning and importance of badges' visibility. Contrary to our findings, badges did not influence students' grades, motivation, or platform activities. Their gamified results were rather similar to the control group applied.

5. Conclusions

New technological trends arrived at current educational environments, where students demand the use of more technology in the classroom. With all of this, it is possible to combine gamification (in terms of applying game design elements to non-game contexts) and education. In this paper, we presented the deployment of a gamified platform (including also a set of social elements) into an e-learning environment. The gamification elements added to the platform were points, achievements, leaderboards, and rewards (in the form of a virtual store), all of them achievable through activities' submission and reviews. Social features were mainly forums, questions, and microblogging.

Thereupon, our platform was tested with MSc students within an Android programming subject. The students in the control group used BlackBoard, a traditional e-learning platform. Results showed, at least for Android programming subjects, gamification in e-learning environments is a suitable element to improve the learning outcome of the students. Thus, our RQ1, "Do students improve their learning performance when using gamified social platforms?", could be answered partially satisfactorily. Although not all assignments' scores were high with gamification, it could be argued that gamification seemed to have an impact on basic knowledge acquisition. Maybe gamification, for MSc students, is good to introduce basic topics. Additionally, the social components of the gamified platform made it possible for students to improve not only inter-relationships (i.e., communication skills), but also their overall grades earned. Therefore, RQ2, "Is there a positive relationship between the number of interactions in a social e-learning platform and the students' learning performance?", produced a positive result. For basic and introductory activities, it looks like students' participation in the platform is helpful for knowledge acquisition. Finally, all social components of the gamified platform make it possible for the student to consider the learning process as more involving, interesting, and attractive. Consequently, RQ3, "Do students feel more engaged, motivated, and involved when using gamified social platforms rather than traditional e-learning platforms?", also achieved a positive answer. This gamified platform, with more social components than a traditional learning system, allows (and, therefore, motivates) the student to participate more.

Therefore, if gamification is applied to this type of environments (less educational-focused), the results should be also positive from the point of view in which the user spends more time on the system (with more engagement and motivation), producing better results, as well as promoting more interactions between users.

Finally, it is important to note the limitations of the study. The main threat to the validity of this study is the small sample size that has been used. Perhaps a larger sample size could have provided similar or totally different results, but it is, indeed, an aspect to consider for future works. Additionally, it is true that the gender distribution is not very equitable, and the age range of the participants was the same. In the future, the study could be extended with different age ranges, larger samples, and more equitable gender distribution.

As future work, we also plan to continue testing the gamified social platforms with more students and another type of courses, in order to verify if these results are accurate in broader learning contexts. Furthermore, we plan to integrate more gamification elements (such as open badges or adapted gamification, for example) to the platform and we will study its effects on students' learning outcomes.

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Appendix

Appendix A

This appendix comprises the questions that composed the questionnaire applied as an instrument in this study.

1.1. To what extent did you enjoy working with this platform?
1.2. To what extent did you enjoy working with your team members?
1.3. How do you grade the difficulty of the assignments?
1.4. Did you have experience with this platform prior to this course?

Table A1. Control variables

2.1. While working with this platform, I feel bursting with energy.
2.2. I can continue using the platform for very long periods at a time.
2.3. To me, my job with this platform is challenging.
2.4. My work with this platform inspires me.
2.5. I am enthusiastic about my work with this platform.
2.6. I am proud of the work that I do with this platform.
2.7. I find the work that I do with this platform full of meaning and purpose.
2.8. I get carried away when I am working with this platform.
2.9. Time flies when I am working with this platform.
2.10. It is difficult to detach myself from the platform when I am using it.
2.11. I feel happy when I am working intensely with this platform.

Table A2. Engagement variables

3.1. While working with this platform, I experience pleasure in learning new things.
3.2. While working with this platform, I experience pleasure when discovering unknown things.
3.3. While working with this platform, I feel satisfied in achieving personal goals.
3.4. While working with this platform, I feel satisfaction in being able to excel in my studies.
3.5. While working with this platform, I enjoy communicating my own ideas to others.
3.6. While working with this platform, I generally experience pleasure and satisfaction.

Table A3. Intrinsic motivation variables

3.7. Working with this platform will help me get a more prestigious job eventually.
3.8. Working with this platform helps me prepare for my career path later on.
3.9. Working with this platform helps me feel important.
3.10. Working with this platform helps me show myself that I am an intelligent person.
3.11. Working with this platform helps me make a better choice regarding my career orientation.
3.12. Working with this platform helps to improve my competence as a worker.

Table A4. Extrinsic motivation variables

3.13. I do not really use this platform beyond what it is necessary. I really feel that I am wasting my time. [Negative]
3.14. Honestly, I do not know why I am using this platform and I do not care. [Negative]

Table A5. Amotivation variables

To me, using this platform in the course is…		
4.1	Unimportant	Important
4.2	Boring	Interesting
4.3	Irrelevant	Relevant
4.4	Unexciting	Exciting
4.5	Means nothing	Means a lot to me
4.6	Unappealing	Appealing
4.7	Mundane	Fascinating
4.8	Worthless	Valuable
4.9	Uninvolving	Involving
4.10	Not needed	Needed

Table A6. Involvement variables

5.1. This platform improves communication with my classmates.
5.2. This platform improves communication with my teachers.
5.3. This platform improves the frequency of communication with my classmates.
5.4. This platform improves the frequency of communication with my teachers.
5.5. This platform improves the accuracy of communication with my classmates.
5.6. This platform improves the accuracy of communication with my teachers.
5.7. This platform improves communication in solving problems with my classmates.
5.8. This platform improves communication in solving problems with my teachers.

Table A7. Communication ties variables

5.9. This platform improves the degree to which I share objectives with my classmates.
5.10. This platform improves the degree to which I share objectives with my teachers.
5.11. This platform improves the degree to which I share knowledge with my classmates.
5.12. This platform improves the degree to which I share knowledge with my teachers.
5.13. This platform improves the degree to which the mutual respect between classmates facilitates learning.
5.14. This platform improves the degree to which the mutual respect between students and teachers facilitates learning.

Table A8. Relationship ties variables