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Towards the Social Gamification of e-Learning: a Practical Experiment

Luis de-Marcos, Antonio García-Cabot, Eva García-López

Universidad de Alcalá. Dpto. Ciencias de la Computación. Edificio Politécnico. Campus Universitario. Ctra. Barcelona km 33.6. 28871. Alcalá de Henares. Madrid. Spain. E-mail: luis.demarcos@uah.es, a.garciac@uah.es, eva.garcial@uah.es

Abstract: Gamification is the use of game mechanics and game design in non-game contexts to engage users and motivate action. Although gamification has a great potential in higher education, existing research focuses on competitive approaches and presents contrasting evidence. We present a social gamification approach and tool designed to address the situated motivational affordances of students (relatedness, competence and autonomy). An experiment (N=374) is conducted to test it in an undergraduate course, comparing students' performance with a traditional blended-learning approach. Students' attitude towards the new tool is also analyzed. Results suggest that social gamification can be used to improve the overall academic performance in practical assignments and to promote social interaction. However, our findings also raise and important caveat. The creation of gamified experiences for higher education requires a deep knowledge of the motivational affordances of students and a careful design of the rewards that are introjected by students and that eventually stimulate participation.

Keywords: gamification; game-based learning; learning performance; e-learning

1. Introduction

Games are learning tools [1]. Games offer a clear set of goals and rules that constraint possible actions, and a feedback mechanism that provides a seamless sense of progression. Players learn not only what the rules of the game are but also how to master them while honing the skills necessary to achieve the game goals. Koster [2] suggests that games have had an important role in our evolution and McGonigal [3] goes even further suggesting that games have the potential to impact in our daily lives if they are used to tackle real world problems. Gamification is the use of game design elements in non-game contexts [4, 5]. The underlying idea is to try to harness the potential of games for learning and motivation. Bringing game mechanics like points, badges and rewards to other systems is not a new idea. For instance, customer loyalty programs (like frequent flyers) are a classic example. Internet-based information systems enable to keep automated track of users' interactions and to implement gamification in business models. With social networking and the web 3.0, information systems can leverage gamified approaches that also include social features. Gamification has a great potential in education where unmotivated students are a recurrent problem [6]. However, gamification is a significant task, because game mechanics by themselves result insufficient [7]. Good games have the potential to keep players continuously motivated and engaged by

constantly matching challenges at hand with player's skills in a goal-directed, rule-bound action system that provides clear objectives and immediate feedback, resulting in a feeling of flow or optimal experience [8]. Educational games, sometimes referred as serious games, have already shown their value for instruction impacting on learning, knowledge acquisition, content understanding and even on motivation and other affective outcomes [9-11]. We believe that good gamified activities have the same potential.

Education is the most common context for the implementations of gamification [12] but experimental research points to limitations like the overstress on competition [13] questioning its effectiveness [14]. Research on player types [15, 16] suggest that competition is important for a few users but also that other users feel motivated by different needs. Particularly, user needs and abilities for exploration and socialization are usually not accommodated. A social approach to the gamification of learning could also employ peer-assessment to provide feedback, promote reflection and mitigate teachers' workload [17]. Social experiences would engage students and foster collaborative knowledge production by means of challenges, rewards and social game's mechanics [18]. Students perceive that online social networks improve their learning interactions [19]. Social game mechanics could also motivate students to create and maintain social bonds influencing learning when properly aligned with learning objectives.

Motivational theories suggest that addressing situated motivational affordances of students is critical to foster intrinsically motivated behaviors. Among these theories, Self-Determination Theory [20] proposes that there is a kind of continuum between extrinsic motivation, when learner may be motivated by extrinsic rewards like getting a good grade, and intrinsic motivation, when the learner is motivated just by the sake of learning. Extrinsically motivated behaviors are not inherently interesting, but they can be used to engage students in the initial stages. After initial onboarding, three motivational aspects bring about intrinsically motivated behaviors: autonomy, relatedness and competency. Autonomy is the capacity to set one's own objectives and to work independently towards them. Relatedness is the sense of belongingness to a group with a specific goal. Competence is the feeling of efficiency with respect to a goal. An online gamified experience will keep its users engaged as long as it addresses these situated motivational affordances [21].

Building on motivational theories, we suggest that social gamification can satisfy the situated motivational affordances of students impacting on learning performance and students' attitude in higher education. This paper sets out to design and test a social gamification approach in an undergraduate course. The rest of the paper is structured as follows. Section 2 reviews current literature. Section 3 presents our approach and design for the social gamification of learning. Then we present the experimental design to evaluate its effectiveness. Results follow. The final sections present discussion and summarize conclusions.

2. Literature review

Gamification has been applied across different domains. In a literature review, Seaborn and Fils [22] pointed that top fields for gamification research are education, health and wellness,

online communities, crowdsourcing and sustainability. Education accounted for over one quarter (26%) of the scientific publications about the practical application of gamification found by Seaborn and Fils in 2013. Constructs more frequently measured included effectiveness, attitudes, engagement, assessment and cognitive [23]. Reported results range across the complete spectrum from positive to negative. This suggests that there is need for research that integrates theory and practice. New approaches that integrate innovative techniques and technologies can also shed further light about the benefits of gamification in specific contexts.

The effects of gamification in social networks have also been widely studied. Not surprisingly, the social website Foursquare, that implements gamification mechanics, has been extensively used as a test field to analyze the influence of game elements and dynamics on the social network [22]. Thom et. al. [24]. studied the effects of removing gamification features from an enterprise social network. They found that contributions declined suggesting that gamification in social settings promotes action but also the repetition and continuation of the action. Social networking in education is also a fruitful field of study. Positive effects were reported in a wide variety of cognitive and affective aspects when either popular social networking sites or specific educational networks are meaningfully integrated in learning actions [25, 26]. Previous studies suggest that the underlying social network plays a vital role in learning performance and in learning interactions [27, 28] in traditional as well as in technology mediated learning environments. Social networking technology just made explicit the underlying network facilitating communication and interaction, but also making possible to automate the running and operation of the network. Recent research shows that social networking technology noticeably changes communication patterns and values during learning [29]. Technology facilitates the development and computation of new measures, like network presence, that was used to explore the influence of the network in creativity and flow in groups of students [30].

When it comes to studies that deal with gamification and social networking in education, Simões et. al. [18] presented a theoretical framework with an implementation but it was not empirically assessed. Lampe [31] compared both approaches suggesting that they complement each other offering great opportunities if combined. We also found comparative studies like [32, 33] that analyze both approaches, and compared them with others like traditional e-learning or learning games. Although these studies provide a solid foundation and interesting insights about what approach can work better in specific contexts, they do not consider the integration of gamification and social networking. Recently, de-Marcos et. al [34] studied the relation between the position in the social network and learning performance in a gamified e-learning course with social mechanics. They concluded that position influences learning pointing that social mechanics play a vital role in the gamification of learning. The social gamification of learning that we present in this study builds on these previous works but it also differentiates because we deal with integration of social networking and gamification in a twofold feedback loop. Firstly, gamification dynamics are used to foster and promote social actions. Then such actions feed learning-driven mechanics.

3. Designing the social gamification of learning

The model of situated motivational affordances [21] suggests that an experience engages users when it satisfies their situated motivational needs of competence, autonomy, and relatedness. An online gamification instrument that addresses such needs was designed and implemented. In terms of competence, learning activities were presented as short-term challenges with clear goals in increasing levels of difficulty. Students could submit their work and then review the activity of another student. Peer assessment was used. Existing research indicates that student generated rating scores can be valid and reliable, and also that rating compels students to reflect on their own work [35]. Peer assessment was based on teacher-generated rubrics. Students could comment, resubmit and engage in a discussion about each learning activity. In this way, assessment is approached as part of learning, so that mistakes are opportunities rather than failures. Peer assessment then also addressed the motivational need for competence by facilitating discussion about learning activities. Our approach used a social network to provide additional opportunities for social interaction and bonding. The Elgg open source social network engine [36] provided the backbone. Students and teachers participating in the social learning environment were included in a private instance of Elgg that provided functionalities for creating and sharing contents (blog, videos, questions and answers, tweets), liking and friends. All public interactions with the platform were shared in an activity dashboard, which was the home page. Dashboards and other activity streams have the potential to activate students and promote action [37]. Participants also had different options for customization that provided social status. Several of them were initially locked and students had to work and participate to earn points to get them.

To address autonomy, the system implemented a wide set of possibilities together with game mechanics aiming to provide a sense of progression. Achievements, points, virtual shop and leaderboard were used. Achievements were digital badges that had a visual representation, a witty title and a description of how to get them. Lecturers and instructional designers planned achievements to encourage students to complete tasks and to interact with the online system. Students got points for completing and reviewing tasks and getting achievements. A virtual shop was also included enabling students to use points as in-game currency to buy different items that provided personalization and social status. Points were also used to create a public leaderboard, giving students the opportunity to compete.

Although gamification is intended to motivate action, several concerns also need to be considered about external rewarding and regulation. Self-Determination Theory suggests that if the student feels that the learning process is tightly regulated by an external entity, motivation can be undermined [20]. The effectiveness of regulations depends on the degree of acceptance and introjection by students. Autonomy and relatedness facilitate introjection. This suggests that regulations included should not be mandatory or restrictive, and they should try to foster social relationships between students. In our design, students may feel that gamification mechanisms, especially the competitive meta-game and rewards, act as external regulations. We expect that the social aspect of such mechanisms can facilitate introjection. For example, when a student gets an achievement for answering a question submitted by a classmate, the answer also establishes a learning-oriented social relation between students. In the future, the student will be motivated to ask or to answer more questions to keep that

relation, to establish new ones, or just to learn more (intrinsic motivation) instead of doing it just to get more points (extrinsic motivation). Additionally, points and the virtual shop were designed to foster student's autonomy. Students could obtain points in different ways, focusing either on the challenges or on the social aspects of the platform. Students could also decide how to spend their points.

4. Experimental design

4.1. Study site

The course 'Qualification for ICT users' is 15-week undergraduate course covering the basics of information and communication technology providing basic knowledge and skills of computing and office applications. The course includes the following learning modules: [1] Introduction to the computer, the operating system and networks, [2] word processing, [3] spreadsheets, [4] presentations and [5] databases. Syllabus is based on the European Computer Driving License (ECDL) and the International Computer Driving License (ICDL) certification programmes [38], which are intended to become vendor independent de-facto standard certifications of digital literacy. The course has a blended learning approach including readings and additional activities delivered online using an e-learning platform. Students have 2 hours of lectures every week. Each learning module has two or three activities designed to practice the core skills of the learning experience. Activities are introduced on the lectures but students have to complete them on their own. Textual descriptions in documents as well as sample solutions are delivered through the e-learning platform. The course has five evaluation items. Modules 2 to 5 mostly include practical skills so students are required to complete four practical assignments. A final written examination covering all modules is also required. Students are also credited for participation in class as well as for their contributions in the e-learning platform. Participation represents a 5% of the final score.

4.2. Research questions

Our underlying assumption is that social gamified features designed to satisfy the situational motivational affordances of students may impact positively on learning performance and students' attitude. Therefore our experiment aims to explore the following research questions:

1. Does social gamification impact learning performance?
2. Do students have a positive attitude towards social gamification tools?

4.3. Instruments

The main instrument was a social gamification tool as described in the previous section. Eleven activities were gamified (2-3 activities per module) representing the core of the learning experience. Gamified activities and social features provided the basis to create 28 complementary achievements. Instructional designers and lecturers designed achievements using activities completed by students (e.g. 'Database expert' for completing all database

activities), actions performed by students (e.g. 'Reviewer' for reviewing 7 activities) and social interactions (e.g 'Compulsive liker' for liking 50 items).

We compared this approach with a traditional e-learning approach. The control instrument was the current course delivered online through the BlackBoard learning management system. Students had documents with the contents of each learning module, documents of the activities with sample solutions, self-assessment tests, complementary materials and references, and the set of tools offered by traditional learning management systems including forums, messaging and a schedule.

An attitudinal survey was also used on the experimental group to gather quantitative and qualitative data about students' perception and attitudes about the instrument. The attitudinal survey had 10 items based on a 5-point Likert scale.

4.4. Method

A pre-test post-test quasi-experimental design was used to compare students' performance. Interactive tests were used to assess students' pre-test performance for each practical module. Post-test data comprised scores of assignments for each practical module as well as the final examination score, and also a participation score for each student. The participation score was automatically computed based on attendance to lectures and contributions in the e-learning platform. Engagement with the experimental instrument was scored using the same standards as in the e-learning course. All scores were normalized to a 0-100 scale. Pre-test and post-test data were compared using Kruskal Wallis tests.

Two groups of students were selected to participate in the experiment. The social gamification tool was delivered to an experimental group of 210 first- and second-year undergraduate students. The control group included 164 first- and second-year undergraduate students. The selection of groups was arbitrary. Experiments were run during spring 2013. Lectures took place on different physical spaces for the experimental and control groups (different campuses in different cities) and groups also had separated e-learning spaces.

5. Results

5.1. Achievement of students

Pre-test results (table 1) suggest that there was no significant difference between the experimental and control groups in the four evaluation items assessed. Post-test results (table 2 & figure 1) suggest that the experimental group outperformed the control group on the four practical assignments but, surprisingly, the control group outperformed the experimental group in the final examination score and this difference is statistically significant ($H=5.65$, $p=.017$) although small. Finally, there was no significant difference in both groups when comparing the participation score.

*** Figure 1 here ***

*** Table 1 here ***

*** Table 2 here ***

5.2. Attitudinal survey

An attitudinal survey was used to appraise the satisfaction of students and their attitude towards the social gamification tool. The instrument used was five-point Likert scale questionnaire with all questions scored in a positive scale. Answers were anonymous. 116 students of the experimental group provided feedback using this instrument. Questions and results are summarized in table 3. The average was 3.75, which suggest that the attitude of students was positive. The highest rated items were items 4, 5 and 6 suggesting that the tool was easy to use and it presented a sufficient number of activities that students found useful. Lowest rated items were items 8 and 9, which were related with involvement of students and their willingness to learn more about the topic. Although the score was not so bad, such results question the alleged benefits of gamification. All in all, at the end of the term students were not intrinsically motivated to learn more.

*** Table 3 here ***

Answers variability was low since overall standard deviation was .96 which roughly represents 1/4 of the mean, so answers could be considered homogeneous. An item analysis test returns a Cronbach's alpha score of .866, which was higher than a commonly used benchmark value of .7. This suggests that at least some of the items measured the same construct of students' attitude.

The attitudinal survey was also used to ask students that did not use the instrument for the reasons that prevented them from participating. 52 students provided feedback. Results are summarized in table 4. Students could argue more than one reason or no reason at all. Time available was the reason argued most frequently by students. Lack of interest was the second most argued reason. The reason argued less frequently was the difficulty to use or understand the online system. Under 'other reasons' students could provide additional feedback. Examples of answers provided by students were "I submitted the initial activities, but then I realized that nobody was reviewing my submissions, I got bored so I stopped using it" and "I registered but I never used it. Because it is not in the BlackBoard system, I forgot it existed". They pointed to potential problems to be considered.

*** Table 4 here ***

6. Discussion

We can now go back to the original research questions. For the first question (Does social gamification impact learning performance?), results suggest that there was a positive impact for those students who actively participated by submitting and reviewing tasks. Social gamification impacted learning performance on practical assignments but it did not impact learning performance on the final examination. Indeed participants in the control group got better scores in the examination suggesting that a traditional e-learning approach can still be effective to convey conceptual knowledge. Gamified tasks were designed to hone practical

skills, rather than to facilitate conceptual learning or memorization. It would be necessary to design different gamified tasks if we want to investigate whether social gamification can also improve conceptual learning.

The second research question is related to the attitude of students towards social gamification tools. Results suggest that students had a positive attitude towards the new tool. The lowest scored questions in the survey were those related to student's involvement and their willingness to learn more about the course topic. This suggests that students were not intrinsically motivated to learn, questioning the alleged benefits of gamification. Also according to the feedback provided by students, they needed more time to complete tasks. Changes may also be necessary in the procedure to assess tasks in order to have all tasks peer-reviewed. Other than that, students felt that the online social gamification approach and its content were properly designed and useful for learning.

No difference in the participation scores was observed between the experimental and control groups. This also raises concerns about the alleged benefits of gamification that have to do with promoting action. Besides, it also points to an important limitation of the social gamification of learning that is related with the challenges that designers face to create engaging experiences that motivate sustained participation. The motivational effect of social gamification decreased gradually for most of the players. One possible reason could be the rewarding scheme, which consistently rewarded active students who submitted tasks, but did not reward in the same way students that preferred to use only the social functions of the platform. This unbalance may drove those students lacking of any initial interest in task completion to consider rewards as a heavy external regulation, thus reducing their sense of autonomy and undermining their willingness to continue using the platform. Another possible reason that could account for the decreasing levels of motivation observed is that the duration and timing of the course were not considered as an essential factor during the design phase, resulting in motivational mechanisms that had a limited effectiveness in the middle and late stages of the course. Therefore social gamification requires that designers think carefully about how their rewarding scheme will be accepted and introjected by students over time. Furthermore, if the group of students that participates is heterogeneous, the design can be even more challenging since different students may be motivated by different types of rewards, and therefore the sequence and timing of the actions that they are likely to follow until they eventually become active participants would be probably different.

The main limitation of our study has to do with the generalization. Results are circumscribed to a specific case-study using a limited sample. Results and conclusions cannot be generalized. Further experimentation is required to determine whether results can be extrapolated or are transferable to other areas or subject domains. We have just used a web-based approach but current research suggest that mobility is required to capture and engage new students. For instance, Huan et. al. [39] suggested that perceived engagement is key factor in m-learning adoption. Similarly, our approach implements peer assessment but self-assessment has also demonstrated to be effective and complementary particularly in learning experiences with many learners [40]. Also, the integration of automatic mechanisms to produce personalized [41] and adapted contents [42, 43] can ensure that the experience is appropriately tailored to the needs of each particular student.

7. Conclusion

We approached the social gamification of learning by designing a technology-enabled learning experience that specifically addresses the motivational affordances (competence, autonomy and relatedness) of learners. The approach and the system were tested in an undergraduate course to assess their impact on learning performance and on students' attitude. Mixed results were found. While results suggest a positive impact on learning performance in practical assignments, the control group performed better on a written examination. No differences were found in terms of participation, although participation was measured using traditional means that did not considered new forms of interaction. Attitude of students towards the new approach was positive suggesting that the tool was easy to use. The attitudinal survey also pointed to potential problems like students' involvement and their willingness to learn more about the topic that ultimately question the effect that gamification has on intrinsic motivation. We argue that it is necessary to analyze students' needs and motivations in order to design and test carefully the rewarding scheme, considering also timing and duration, to address adequately the motivational affordances that create compelling socially gamified learning experiences.

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Luis de-Marcos BSc (2001) and MSc (2005) in Computer Science from the University of Alcalá (UAH), where he also completed his PhD in the Information, Documentation and Knowledge program (2009). Currently working as associate professor (UAH, 2015-). He participated in two Erasmus Intensive

Programs (2009-2013), two Erasmus+ Strategic Parnertship Projects (OpenQASS (2014-2017) and m-commerce (2014-16)), and in an EU IAPP MC project (Iceberg: 2013-2017). He was principal investigator in two national research projects (2011-2013). Luis was a research fellow at the Lund University (Sweden, 2007 & 2009), the University of Reading (UK, 2008) and the Monterrey Institute of Technology (México, 2010). He is member of the special interest group in Computer Science Education (SIGCSE) of the ACM. He has over 100 refereed publications in conferences and journals. His research interests are humanistic informatics, learning technologies, computer science education and gamification

Antonio García-Cabot BSc (2009) and MSc (2010) in Computer Science from the University of Alcala (Spain), where he now occupies an assistant professor position in the Computer Science Department. He finished his PhD (2013) in Information and Knowledge Engineering. His research interests include e-learning, mobile devices, usability, intelligent agents, adaptable and adaptive systems. He has more than 70 publications in relevant conferences and journals. He participates in different national and European research projects. He is head of the Master in Technologies and Mobile devices of the University of Alcala.

Eva García-López has a BSc (2007) and a MSc (2009) in Computer Science from the University of Alcala (Spain), where she is now an assistant professor in the Computer Science Department. She finished her PhD (2013) in Information and Knowledge Engineering. Her research interests include usability and mobile devices. She participates in different research projects and she has more than 60 publications in relevant conferences and journals. She is co-head of the Master in Technologies and Mobile devices of the University of Alcala.

Figures and tables

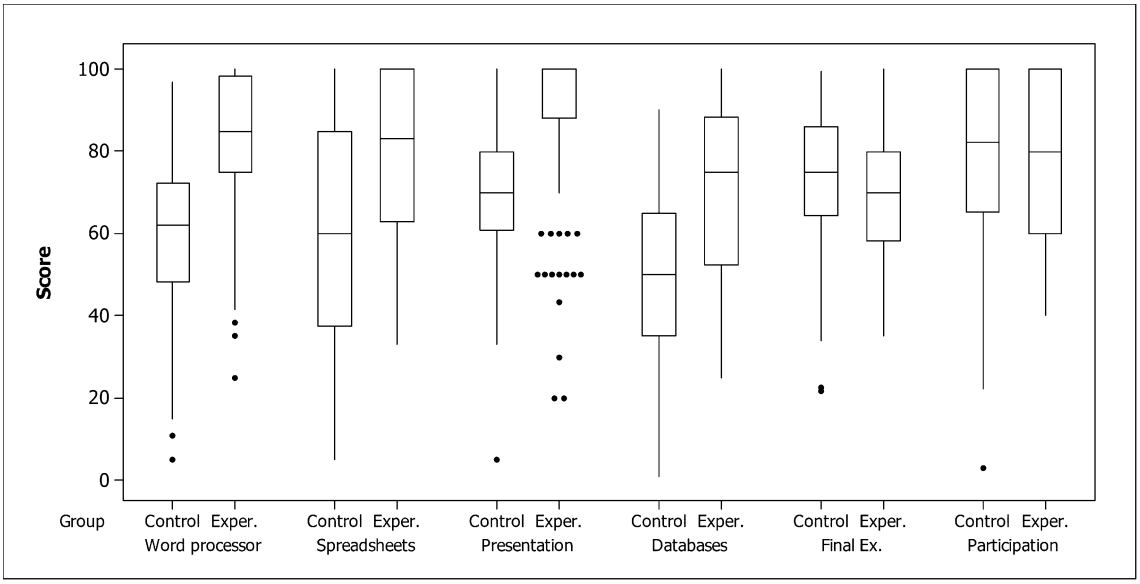

Fig. 1. Boxplots of the post-tests scores for the control and experimental group

Item	Group	n	Mean	Std Dev	Median	Significance*
Word processor	Control	129	44.63	15.90	44	H=.95
	Experimental	159	46.70	18.30	44	p=.330
Spreadsheets	Control	129	49.28	16.75	55	H=.01
	Experimental	159	49.89	16.93	55	p=.939
Presentation	Control	129	43.05	14.20	44	H=.98
	Experimental	159	44.48	12.02	44	p=.323
Databases	Control	127	52.45	18.58	55	H=.20
	Experimental	159	53.70	18.19	55	p=.658

Table 1. Pre-test scores of students for each learning module.
***Significance of Kruskal-Wallis tests**

Item	Group	n	Mean	Std Dev	Median	Significance*
Word processor	Control	124	60.40	18.64	62.00	H=94.31
	Experimental	169	83.51	16.03	85.00	p<.001
Spreadsheets	Control	124	60.25	26.16	60.00	H=51.92
	Experimental	165	82.02	18.26	83.00	p<.001
Presentation	Control	131	70.37	15.04	70.00	H=102.80
	Experimental	170	89.68	16.47	100.00	p<.001
Databases	Control	127	47.88	21.94	50.00	H=61.16
	Experimental	164	70.63	20.81	75.00	p<.001
Final examination	Control	139	73.70	16.07	75.00	H=5.65
	Experimental	175	70.10	14.89	70.00	p=.017
Participation score	Control	139	77.89	22.49	82.16	H=.02
	Experimental	177	78.08	19.15	80.00	p=.888

Table 2. Post-test scores of students for each learning module and the participation score.
***Significance of Kruskal-Wallis tests**

Item	n	Mean	Std Dev
#1 Content was presented effectively	116	3.88	1.01
#2 I learnt about the course topic	116	3.80	.94
#3 I enjoyed the experience	116	3.62	1.00
#4 Using the tool was easy for me	116	3.95	1.00
#5 The proposed practical activities were useful	115	4.00	.92
#6 There was a sufficient number of exercises	116	3.97	.97
#7 There was sufficient time to complete the exercises	116	3.73	1.07
#8 I was very involved	116	3.29	1.09
#9 I would like to learn more about the course topic	116	3.40	.98
#10 This was a worthwhile learning experience	116	3.84	.87
Average	**-**	**3.75**	**-**

Table 3. Results of the attitudinal survey

Answers provided in a five-point Likert scale (1-Strongly disagree, 2-Disagree, 3-Undecided, 4-Agree, 5-Strongly agree)

Answer	Frequency
I didn't know about it	10
I am not interested	13
I didn't have time to complete the activities	32
I found technical problems	6
The system was difficult to use / understand	3
Other reasons	9

Table 4. Reasons argued by students that did not use the gamified platform (N=52). Students could indicate more than one reason.