

An Empirical Study on the Use of Gamification on IT Courses at Higher Education

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Abstract. The aim of this work is to evaluate the effectiveness of a gamification platform during an IT course at Corvinus University of Budapest. A total of more than 2500 students attended the course during 2015 and 2016. We used a gamification environment within the Moodle e-learning platform during the course. Gamification steps included a reward system, alternative learning paths, various feedback options and social interaction platforms. Course quality was assessed based on students' willingness to participate in voluntary on-line tests, completion and results of final exams, as well as results of student satisfaction surveys. Our results indicate that gamification is able to improve IT course quality though it cannot solve all possible problems arising during such courses.

Keywords: Gamification · Blended learning · Information technology education
Case study

1 Introduction

Gamification can be defined as the use of game elements and game design techniques in non-gaming environments [1]. Gamification is being increasingly used to promote the engagement and motivation of the involved individuals in business, education, health industry, societal responsibilities and many other fields of everyday life.

Gamification has recently become one of the most popular strategies to improve the methodology of promoting motivation and engagement in education. The popularity of using gamification in education is understandable as there are obvious similarities between games and the classroom. Game players work to achieve specific goals and win, while classroom students work to achieve specific learning objectives and do well academically; game players progress from level to level based on performance, classroom students must pass prerequisite courses and understand the given subjects before progressing academically [2].

Gamifying educational environments and teaching processes have massive potential as the lack of student motivation is a constantly recurring problem and an increasing number of students cannot complete the school. Although gamification could easily be applied to education applications, there are a number of challenges such as the different attitudes of individuals to gaming (especially in older adults), the involvement of game developers in educational activities, or the application of gaming principles in more

difficult educational tasks. Obviously, gamification should not be considered as a magic bullet that will always and consistently solve all educational problems but rather as one of many tools available to improve education efficiency. Given that gamification is a relatively new tool, its cost-benefit ratio has yet to be assessed and compared with other available tools.

If we can increase the engagement of students then this can have a significant positive impact on the effectiveness of education. Gamification can be a good tool to accomplish this by adding alternatives, personalize the curriculum.

One of the most important factors of gamification is that gamified applications mostly use on-line, digital technologies. Importantly, current students belong to Generation Y (people born between the mid-1980s and the mid-1990s) and Generation Z (born between the mid-1990s and the early 2000s), and they have radical differences in learning and gaining knowledge from previous generations. Members of these generations use internet and social media often and securely as it was part of their life and socialization from the beginning [7, 8]. Another major trait of the members of Generation Z is the decreased skill to pay attention [9] which could also be addressed by gamification as the learning process is divided into small pieces and the motivation is also expected to improve by small positive reinforcements [7].

The impact of gamification can be even bigger if we gather information from gamified platforms and analyze them. Results of such analyses allow us to adapt the educational gamified proposal to learners' special needs and pace in learning.

Here we describe an approach to use gamification as a way of teaching computing at university level to students of economic sciences. In 2015, we gamified a university course in Information Technology using an online learning platform, the Moodle (Modular Object-Oriented Dynamic Learning Environment) [3] system. The data received from Moodle platform such as achieved points, failure rate, course evaluations and students' feedback were analyzed. The course was then improved based on the findings of the study. In total, over 2500 students have been educated using gamification. Although gamification cannot solve every problems (a course requires good quality content and proper teaching skills as well), but our results suggest that gamification can lead to better course experience for the students and to better overall course outcomes.

2 Gamified Course: Information Technology

Information Technology is a compulsory, half-year undergraduate course for every full-time or part-time student with Business and Economics majors at Corvinus University of Budapest. The course is taught in blended learning format with gamification elements for everyone except for Business Informatics major since the fall of 2013, due to the large number of students (the course is taken by more than 1000 students a year). The blended form means that it combines face-to-face instruction with computer-mediated instruction [13]. In the examined courses the students attend seven lectures in a classroom and they obtain a practical material to be processed independently every week on the online educational platform of the course. The evaluation of students is based on points earned from weekly tests, assignments, and the final exam [12].

On average, approx. 1500 students participated in the research during each semester, including 1100–1400 full-time and approx. 200 part-time students (see Table 1).

Table 1. Attendance of the course each year

Year	Attendance		
	Full-time	Part-time	Total
2015	1427	189	1616
2016	1127	194	1321

2.1 The Gamification Platform: Moodle

We chose to apply gamification to Moodle as our Information Technology course already used this platform. Moodle is an open-source, PHP based education framework that allows creating a customizable learning environment. Moodle has different features such as grading and online tests support system, forums, and file-management capabilities.

2.2 Core Elements of IT Course Gamification

In this section we describe the elements used in the gamification of the IT course.

Reward system: points, badges, levels

Points are the basis for most gamified projects. Students get points when they take the right actions in the right way, by means of which they move levels, etc. Collecting points will cause a continuous gamification experience.

Alternative learning paths

The curriculum is made up of four modules, and the undergraduates should reach a minimum level of each module to complete the study period of the course. Each module has weekly tests, as well as minor (so-called ‘life-belt’) tests. The weekly tests can be completed two times, and the better result counts. The minor tests have not got any limitations as for filling, but only the modules’ minimum level can be reached with them. The required minimum level can be achieved with both types of tests, however, achieving the modules at top level rewards the student with a badge which gives an extra point to the final exam. [10]. For each semester (14 weeks), a total of 13 weekly tests and 28 minor (‘life-belt’) tests could be completed.

Apart from the tests, optional assignments can be completed. If the assignment is accepted, the student gains another badge with a surplus point. If a student collects all of the badges (maximum one badge can be missing), he/she receives automatically the highest grade without taking the final exam.

Instant feedback

The students are constantly receiving feedback on their performance including their score and rating for each module, along with textual information on the further options.

Feedback themes

Students were offered seven different options to choose how they would receive their feedback. Besides the default, simple scoring theme (levels, badges, etc.), students could choose to receive their feedback as they would in a popular fiction environment (e.g. as from Professor Dumbledore in Harry Potter's Hogwarts school), through a sports theme (e.g. in a Judo learning environment) or according to a business ranking system (different ranks in a commercial enterprise). Note that such optional feedback themes have only been offered during the 2015, but not during the 2016 semester (see below).

Social interactions: forums and chats

Forum and chat are Moodle activities that allow students' interaction. Teachers can also answer questions that students ask in forums.

2.3 Changes During the Research Period

There have been a few smaller changes during the two-year research period (i.e. between 2015 and 2016) that should be mentioned:

- Apart from optional consultancy opportunities, there was no systematic direct personal interaction between students and teachers during the first year (2015). In the second year (2016), two mandatory computer lab-work lessons were provided, where students could ask questions from the instructors and they worked together in groups to deepen their knowledge.
- Since there was little interest in using the different feedback themes during the 2015 semester (see below), we decided to abandon that feature and only offer a single, basic feedback theme during 2016.

3 The Effectiveness of Gamification

The effectiveness of gamification during the IT course during the two-year research period is summarized below.

3.1 Impact of Gamification on Participation and Course Completion

The effectiveness of the engagement factor of the course is measured by the level of activity, and the ratio of failures in the mid-term section of the course.

Feedback themes

Students had six different options to choose how they would receive feedback about their performance. If they did not actively select any of the custom options, they remained in the default (basic) theme. The list of themes and the number of students choosing them is shown in Table 2. As shown in the table, only 14% of the students actively selected one of the custom themes, whereas 86% of them remained in the default theme. Furthermore, some of the themes have been selected by a very low number of students. These results indicated that there was little interest in selecting custom

feedback themes in the 2015 course period. Therefore, this option was discontinued and only the default theme was offered in 2016.

Table 2. Selection of feedback themes in the 2015 semester

Feedback theme	Actively selected?	Full-time students	Part-time students	Total	Total (%)
Basic	No (default)	1227	165	1392	86.14%
Basic	Yes	48	6	54	3.34%
Dumbledore		85	4	89	5.51%
Materials		15	3	18	1.11%
Duck		18	3	21	1.30%
Business		14	7	21	1.30%
Judo		20	1	21	1.30%
Total			1427	189	1616

Weekly tests

The activity of students in the course was examined by their willingness to fill out the tests.

Each weekly test could be filled out at most twice, and from the two results, the better one was counted towards the final evaluation. It is important to note that it was not mandatory to fill out these tests, but it helped to earn part of the points that could be gained through the study period of the semester [10].

In 2015 a slight gap could be realized between full-time and part-time students (Fig. 1A). On average, 65.4% of full-time students filled out the tests at least once (with the deviation of 1.8%). On the other hand, the weekly tests among part-time students were not as popular as among full-time ones. Even the first test reached only 57.2% of part-time students, and only 37.6% of them tried to solve the test on the 8th week. (The average fill-out rate was 57.2% with a deviation of 8.1%).

The course in 2016 had a better reach among both types of students, and a substantial gap could be realized between full-time and part-time students. As for the full-time participants, the average fill-out rate was 89.7% (dev. 4.0%), and among part-time students 66.97% of them completed the test on an average week (dev. 9.2%). Though the ratio shows an almost constantly decreasing trend, at part-time students the lowest fill-rate of 2016 is about the same level as the average rate in 2015 (Fig. 1B).

On average, approx. 60% of those students who decided to fill out the tests took the opportunity to use the second chance, and there is no significant difference between the two types of training [10]. This applies to the courses of both years.

Minor ‘life-belt’ tests

In contrast to weekly tests, the minor tests can be completed unlimited times, but the value of one test is at most only a quarter of the value of a weekly test, though the minimum level of each module can also be achieved only by them. [11]

The willingness to fill out the minor tests is lower than the rate of weekly tests, but 2016 had more positive results compared to 2015. Among full-time students of 2015, 40–55% of the students filled out the test at least once. Examining the part-time

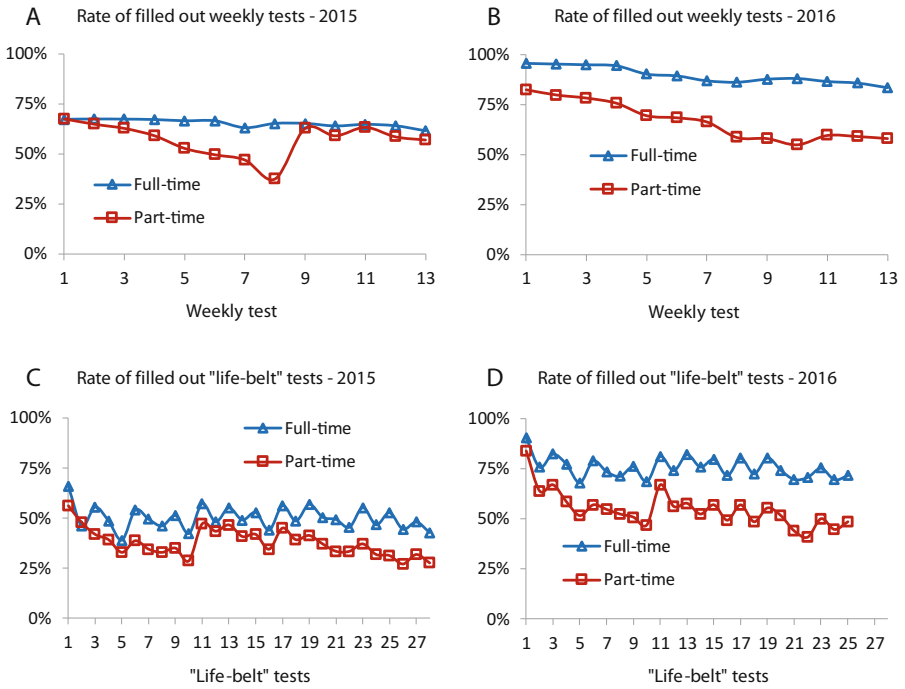


Fig. 1. Proportion of students who filled out the weekly and ‘life-belt’ tests at least once

participants, their completion rate had a wider fluctuation with a lower average level, it changed between 25% and 45% (Fig. 1C).

In 2016, the aforementioned completion rate among full-time students remained between 65% and 85%, while by part-time students the rate changed between 40-65% (Fig. 1D).

As the increased willingness can be realized in the aspect of weekly tests, the same rise can be seen in the case of minor tests as well.

Mid-term performance

According to the syllabus of the course, the final grade consists of the weighted average of the mid-term performance (30% weight) and the final exam (70% weight). From the mid-term, the gained points are counted only if the participant reaches the minimum level of all four modules. If even one of them is below the required minimum level, the student receives 0 point for his/her mid-term performance.

Another aspect of examining the engagement and activity of students is to check the aforementioned rate of earning 0 point on the mid-term part of the course.

In 2015, a relatively high portion of students could not reach all the required levels of the four modules. Among full-time students, 34.5% of them failed to gather points, and viewing the part-time participants, this rate rose up to 43.4%. In the following year, the rate of failure of part-time people was almost the same, with 46.9%, but a high

reduction could be realized among full-time students, their rates reduced to 13.6% (Fig. 2).

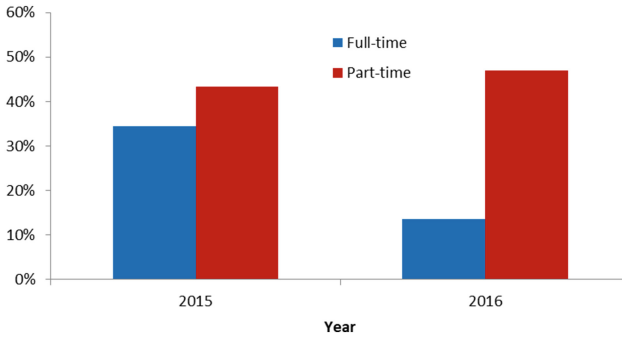


Fig. 2. Rate of failed mid-term performance by student types

3.2 Student Satisfaction

In order to measure the satisfaction of students, the result of ‘Professor and course evaluation’ system has been used. In this questionnaire, the students are asked to answer several questions with option between ‘1’ and ‘5’, where ‘1’ means the least true statement or least amount of work, and ‘5’ means the full approval with statement or the most amount of work.

As mentioned in Sect. 2, the examined Information Technology courses are enhanced with blended learning and gamification methods except for students attending the major of Business Informatics which course does not use gamification elements. This subject has the same syllabus as the gamified ones, therefore we could compare the courses with different teaching principles as to how they perform in the aspect of student satisfaction, and the results can be seen in Table 3.

Table 3. Result of questionnaire about student satisfaction

Question	Avg. score at gamified courses (out of 5)	Avg. score at non-gamified course (out of 5)	Percentage difference (in the view of gamified courses)
We are dealing with useful things	4.08	3.71	9.92%
My teachers evaluate my performance as I do	3.97	3.79	4.87%
The course and the related tasks are enjoyable for me	2.92	3.03	-3.54%

As for realizing the usefulness of the learned knowledge, the courses with gamification elements scored 9.9% higher average valuation, and the students scored 4.9%

higher on self-evaluation ('My teachers evaluate my performance as I do.'). On the other hand, the participants did not feel the mid-term exercises as enjoyable as the students of non-gamified course, there is a 3.5% difference between the average scoring in favor of the non-gamified course.

4 Conclusion and Future Work

In response to an increasing need to find new techniques for teaching academic-level information technology, we propose in this work to use gamification to improve student participation and success in higher education. Gamification may improve various aspects of higher education such as student engagement and motivation, interaction between students and teachers, providing regular feedback to students, and optimal use of available infrastructure and human resources.

Though our study was able to address certain aspects of the effect of gamification in IT education, a weakness of this study is that there is not any direct comparison between results in a gamified vs. a highly similar, yet non-gamified course. Our future plans include splitting the >1200 students/year into two or more smaller groups and test the effect of gamification between those groups that are in the same age and overall study environment. Such better-controlled experiments would be able to reveal fine differences in a very precise manner on the effect of gamification in a university education setting.

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References

1. Werbach, K., Hunter, D.: For the Win: How Game Thinking can Revolutionize Your Business. Wharton Digital Press, Philadelphia (2012)
2. Jackson, M.: Gamification in Education: A Literature Review (2016). http://www.westpoint.edu/cfe/Literature/MJackson_16.pdf
3. Moodle: Community Moodle. <http://moodle.org>
4. Yahr, M.A., Schimmel, K.: Comparing current students to a pre-Millennial generation: Are they really different? J. Appl. Res. High. Educ. (2013)
5. Training Millennials: Engaging Generation Y in Training. <http://www.growthengineering.co.uk/training-millennials-generation-y/>
6. Kapp, K.M.: The Gamification of learning and instruction: Game-based methods and strategies for training and education. Pfeiffer, San Francisco (2012)
7. Horovitz, B.: After Gen X, Millennials, what should next generation be? USA Today (2012)
8. Bíró, G.I.: Didactics 2.0: a pedagogical analysis of gamification theory from a comparative perspective with a special view to the components of learning. Proc.-Soc. Behav. Sci. **141**, 148–151 (2014)
9. Fromann, R.: Gamification: épülőben a Homo Ludens társadalma? ELTE TÁTK, Szociológia Doktori Iskola (2012). http://www.jatekkutatas.hu/publikacio_html_files/publikaciok-gamification.pdf
10. Barna, B.: Gamification in education. SEFBIS J. **10**(1) (2014)

11. Barna, B., Fodor, S.: Gamification és közgazdászképzés – Játszani is enged? *DIBIZ: Digit. Bus.* **1**(4), 34–36 (2015)
12. Baksa-Haskó, G.: Efficiency over 1000 students – the evolution of an on-line course: from e-learning to flipped classroom. In: Auer, M.E., Guralnick, D., Uhomoibhi, J. (eds.) *Interactive Collaborative Learning: Proceedings of the 19th ICL Conference*. Springer, Cham, pp. 237–245 (2017)
13. Bonk, J.C., Graham, C.R.: *The Handbook of Blended Learning*. Pfeiffer, San Francisco (2011)