IMPLEMENTING GAME ELEMENTS INTO DIDACTIC PROCESS: A CASE STUDY

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Abstract:
This article discusses the impact of implementing the gaming elements such as points and leader boards into the learning process on the technical university. The pros and cons of the discussed solution are presented.

The discussion is supported by results of the case study: students were divided into two groups. The study path of the first group was enriched with gaming elements, while the other was taught using the traditional didactic methods. After the whole semester the results of both groups – attendance, number of additional tasks completed, the grade average and so on were collected and analysed.

Keywords: gamification, learning improvement, didactic methods

1. INTRODUCTION

Technological development of game elements like innovative ways of interaction with players, including augmented reality, linking other systems and services like social networks, communication channels, GPS and so on into the games leads to new and more enriching gaming experience. The number of players of all ages, genres and ethnical and cultural backgrounds has been increasing significantly in recent years due to the expansion of online social and mobile games designed for smartphones and tablets. And many of those players are digital-game natives, people that have grown up playing computer and video games (Erneli, 2012; Simőes et al., 2013).

Research indicates that people play games not as much for the game itself as for the experience the game creates: an adrenaline rush, a vicarious adventure, a mental challenge (Lazzaro, 2004). Each experience provides the opportunity to have one or many different kinds of fun during the game. Therefore, it is worth to be considering implementing some game elements and mechanics into learning process in order to enhance its attractiveness and increase students' engagement.

By definition, the process of applying game-thinking and game mechanics to a non-game context is called **gamification** (Deterding et al., 2011). This notion is used for improving both the users' engagement and their experience.

The use of computer game elements to enhance the enjoyment of non-game applications dates back to research as early as the 1980s (Malone, 1980; Bowman, 1982; Malone 1982). Although the concept has been explored primarily in the marketing area, especially as a tool for customer engagement or in order to convince users to use application properly (Werbach & Hunter, 2012; Wolpe, 2013), the potential of its application has recently been extended to other fields, such as Health, Environmental Care, Business, Government or Education.

Education is an area with high potential for applying gamification concept since it seeks to promote people motivation, engagement and certain behaviours (Jensen 2012; Simőes et al., 2013). But this leads to the following questions: can it be used to make learning process more attractive? Furthermore, what game elements can be used for improving student engagement in the learning process? Will adding game elements, mechanics or dynamics (Werbach & Hunter, 2012) to the teaching process improve the students' results?

2. USING GAMIFICATION IN EDUCATION

2.1. Related work

As it was mentioned above the research concerning gamification starts in the 1980s by works of Malone and Bowman (Malone 1980; Bowman, 1982; Malone 1982). They theorized about what makes computer games so attractive to players and how those aspects could be applied in education in order to improve student motivation and engagement. Over time many researchers conducted both theoretical and empirical studies on this topic.

The potential of using video games in learning was emphasized by Prensky and Gee (Prensky, 2001; Gee, 2003). Theirs studies were rather related to game-based learning[1] than gamification, however they have shown many potential advantages of videogames in education such as immediate feedback, motivating cycles of expertise, self-regulated learning[2], productive learning , information on demand or team collaboration. Moreover, it described the influence of game play on cognitive development and identified 36 learning principles that could be found in video games (Gee, 2003). The studies on GBL and serious gaming and its positive outcome were continued in more recent publications (Connolly at el., 2012)

The studies indicates that gamification can address well-known issues concerning online learning. Due to research of Liaw (Liaw, 2008) its potential benefits may address the lack of student motivation related to the limited capacity of interaction with teacher as well as with classmates in e-learning.

[1] **Game based learning** (GBL) is a type of game play that has defined learning outcomes.
[2] **Self-regulated learning** (SRL) is learning guided by metacognition, strategic actions (like planning, monitoring and evaluation) and motivation to learn.

Comparable results, indicating the increase of motivation and higher overall students' performance, were also presented in the experiment of using gamification plugin for e-learning platform in an university course (Domínguez et al., 2013).

The potential benefits, challenges and potential conflicts of applying an achievement system in Higher Education are explored in (Fitz-Walter et al., 2011; Decker and Lane Lawley, 2013). The studies presented the gamified learning process in which most activities are taken in reality, while supported IT system is used primary for discovering and validating activities, viewing progress, and communicating and collaborating with other players. According, the work of Sheth and others (Sheth et al., 2012) presents the prototype of gamified platform called HALO uses MMORPG (Massively Multiplayer Online Role Playing Game) motifs to increase student engagement and learning throughout the entire software development lifecycle (HALO encourages students to test their code with a series of quests).

Although, the framework for social gamification (Simões et al., 2013) was designed and tested for K-6[3] learning environments it worthy of attention because of the adopting gamification principles to motivate students to improve their skills as well as to motivate teachers and parents to reward students' progress.

The dynamical model for the gamification of learning was proposed in studies of Kim and Lee (Kim, Lee, 2012).The main idea of this model is based on the correlations of four primary factors (curiosity, challenge, fantasy and control). The model presents the meaningful positions of four primary factors on the equation for educational effectiveness of gamification.

2.2. Gamification guidelines

According to Cook, any process meeting the following assumptions can be transformed into a game (Cook, 2013):

- the activity can be learned,
- the actions of player can be measured,
- a feedback can be delivered to player in a timely fashion.

From those assumption the gamification guidelines are be indicated directly.

One of the most popular means of gamification is to implement the PBLs (Points, achievement Badges and Leader boards) to the gamified process (Huotari & Hamari, 2012), thus adding both the reward and the competitive factors to it.

Furthermore, the teachers or tutors are advised to organize the contents and activities considering the following guidelines (see Klopfer et al., 2009; Lee & Hammer, 2011; Linehan et al., 2011):

- Allowing repeated experimentation – learning activities should allow student-player to repeat experimenting in order to reach a goal.
- Including rapid feedback cycles – immediate feedback helps students in improving their strategy and get a better chance of success in the next try.
- Adapting tasks to skill levels – good games help players to realistically estimate their chances of success, different levels of goals adapted to students' skills improves their motivation.
- Intensifying tasks' difficulty along with students improving their skills – adapting tasks to the skill level of each student improves hers/his expectations on completing the task successfully.
- Dividing complex tasks into shorter and simple sub-tasks – this helps students in dealing with complexity of task.
- Providing different routes to success.
- Incorporating reward and recognition activities of students by teachers, parents and peers – being rewarded and appraised promotes students' social status.

3. THE EXPERIMENT

In order to answer the following questions concerning gamification:

1. Has the gamification any influence on students' attendance?

[3] K-6 refers to a school that includes the grades from Kindergarden to the sixth grade.

2. How does the addition of simple game elements influence on student's overall performance? the experiment was purposed.

Students of Software Engineering course at the first level degree (engineering) programme at Lublin University of Technology were divided into two groups. First group (non-gamefied) was taught using the traditional didactic methods, both theoretical and practical like lecture, laboratory work, tests and so on, while the other (gamified) was educated using the gamified course. This means that in addition to traditional elements of classes (e.g. lecture, tests) the several game elements mentioned in previous section have been introduced to the gamified group. The experiment lasted for the whole academic semester.

Each student from the gamified group gained points for completing several simple tasks. The number of gained points depends on a task completion (like attending classes) or actual student performance (like writing tests or completing the final project). The list of tasks and points associated with them are presented in Table 1.

Table 1: List of tasks and points assigned for task completion in gamified group

Task	Points	Number of tasks	Total number of points for task
attending classes	50	15	750
completing the test	250 (max.)	3	750
final project	500 (max.)	1	500
bonus task	100 (max.)	5	500
Total numer of points in the course			2500

Source: own work

In the gamified group, if the student missed any test or failed to pass it, he was given negative points as a penalty.

During the semester each group was given with three bonus voluntary tasks, thus in gamified group allow students to gain the additional points and in non-gamified group - the additional marks, with no penalty for not completing it.

At the end of semester, each student was given a final mark according to grade system used in Polish higher education system. The marks vary from 2.0 (fail) to 5.0 (the best score) with a step of 0.5. In order to get the lowest passing grade a student had to achieved 50%+1 of all possible points. But the final scoring was also gamified - an ersatz of leader board was implemented – the highest grade was given only to the student with the best score, 4.5 was given to students with second and third scores, and so on.

4. RESULTS

The experiment results f show some minor and significant differences of students' attendance and the performance between the groups led in traditional way and the gamified group. The results are presented in Table 2.

First of all, the gamified group has higher attendance than the group led in the traditional way. The gamified group was better motivated to attend class, as their attendance had direct impact on their final score.

Secondly, students from gamified group tended to assign for bonus voluntary tasks more often than students from other group, despite the fact that those tasks were distributed along the whole semester. This confirms that completing those tasks was a voluntary act caused by competitive factor not by the need of gaining the minimum of points to pass out classes.

Table 2: The results of experiment

Factor	Non-gamified group	Gamified group
number of absences (avg.)	1.8348	0.6666
number of students w/o absences	5	8
1st test results (avg.)	3.5975	3.30
2nd test results (avg.)	3.428	3.6533
3rd test results (avg.)	3.39725	3.413
number of bonus tasks completed (avg.)	29%	48%
number of final projects turned early	0	3
number of unreturned final projects	1	1
final projects results (avg.)	3.5016	3.2321

Source: own work

Moreover, the significant diversity was observed on the student performance. At the beginning students from both groups tend to have same attendance and gain similar grade distribution, while at the end of course the majority of students from gamified group failed the last exam. Despite the higher attendance level and number of extra projects done, the final results show that the students motivation was decreasing by the end of semester. This may be due to the knowledge of the student current position on leaderboard. People with lower results were not as motivated to work as people with higher positions on the list, since only the best score was awarded with the highest grade. Thus students who gathered enough points to pass, but were aware that they are not able to keep up with the best are not as motivated, as people below passing threshold (who still have to fight their way to pass) or in the top of the leaderboard (who are interested in getting the best mark).

5. CONCLUSIONS

In conclusion, the experiment showed promising results. Elements of gamification may be implemented into learning process, as they seem to have positive impact on at least some factors, like class attendance or voluntary tasks. However, keeping the motivation at high level during whole course became a challenge, therefore implementing stronger motivational mechanisms should be considered.

The experiment should be extended for larger group to examine students' attitude before and after course, as well as if students tend to compete between each other.

Moreover, the usage of support IT tool to present students achievements are considered (Fitz-Walter et al., 2011; Decker and Lane Lawley, 2013). The achievement system could facilitate students access to their scores, promote the personal achievements (as a part of promoting student social status) among peers as well as increase the competitiveness during the course. Also the concept of the integration of gamified courses with existing e-learning platform (like Moodle) seems to be promising although the e-learning platform have the implemented mechanism for collecting, measure and validate student activities.

REFERENCE LIST

1. Bowman, R. F. (1982). A Pac-Man theory of motivation. Tactical implications for classroom instruction. *Educational Technology*, *22*(9), 14–17.
2. Connolly, T. M., Boyle, E. A., MacArthur, E., Hainey, T., & Boyle, J. M. (2012). A systematic literature review of empirical evidence on computer games and serious games. Computers & Education, *59*(2), 661–686.
3. Decker A. & Lane Lawley E. (2013). Life's a Game and the Game of Life: How Making a Game Out of it Can Change Student Behavior, *Proceeding of the 44th ACM technical symposium on Computer science education*. ACM Press, New York, USA, 233-238.
4. Deterding S., Dixon D., Khaled R., & Nacke L. (2011). From game design elements to gamefulness: Defining "gamification". *Proceedings of the 15th International Academic MindTrek Conference*. ACM Press, New York, USA, 9–15.

5. Domínguez, A., Saenz-De-Navarrete, J., De-Marcos, L., Fernández-Sanz, L., Pagés, C. & Martínez-Herráiz, J.-J. (2013) Gamifying learning experiences: Practical implications and outcomes. *Computers and Education*. *63*, 380-392.
6. Erenli, K. (2012). The impact of gamification: A recommendation of scenarios for education, *Preceedings of the 15th International Conference on Interactive Collaborative Learning*, 1-8.
7. Fitz-Walter Z., Tjondronegoro D. & Wyeth P. (2011). Orientation Passport. *OzCHI '11 Proceedings of the 23rd Australian Computer-Human Interaction Conference*, ACM Press, New York, USA, 122-125.
8. Gee, J. P. (2003). *What vídeo games have to teach US about learning and literacy*. Palgrave Macmillan.
9. Huotari, K. & Hamari, J (2012). Defining Gamification - A Service Marketing Perspective. *Proceedings of the 16th International Academic MindTrek Conference*, ACM Press, New York, USA, 17-22.
10. Jensen, M. (2012). Engaging the learner: Gamification strives to keep the user's interest. *T and D*, *66*(1), 40-44.
11. Kapp, K.M. (2012). Games, gamification, and the quest for learner engagement, *T and D*, *66*(6), 64-68.
12. Kim, J.T. & Lee, W.-H. (2012). Dynamical model for gamification: Optimization of four primary factors of learning games for educational effectiveness, *Communications in Computer and Information Science*, Vol. 351 CCIS, 24-32.
13. Klopfer, E., Osterweil, S., & Salen, K. (2009). *Moving learning games forward:obstacules, opportunities and openness, the education arcade*. Massachusetts Institute of Technology.
14. Laskowski, M. & Wojdyga A. (2013) What can gamified university classroom teach us?. *Advanced Science Letters*, in press.
15. Lazzaro, N. (2004, March 8). Why We Play Games: Four Keys to More Emotion Without Story. Retrieved from http://www.xeodesign.com/xeodesign_whyweplaygames.pdf
16. Lee, J., & Hammer, J. (2011). Gamification in education: What, how, why bother? *Academic Exchange Quarterly*, 15(2). Retrieved from: http://www.gamifyingeducation.org/files/Lee-Hammer-AEQ-2011.pdf
17. Liaw, S. (2008). Investigating students' perceived satisfaction, behavioral intention, and effectiveness of e-learning: a case study of the Blackboard system. *Computers & Education*, 51(2), 864–873.
18. Linehan, C., Kirman, B., Lawson, S., & Chan, G. (2011). Pratical, appropriate, empirically-validated guidelines for designing educational games. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems.*ACM Press, New York, USA, 1979-1988.
19. Malone, T. W. (1980). What makes things fun to learn? Heuristics for designing instructional computer games. *Proceedings of the 3rd ACM SIGSMALL symposium and the first SIGPC symposium on Small systems – SIGSMALL '80*. ACM Press, New York, USA, 162–169.
20. Malone, T. W. (1982). Heuristics for designing enjoyable user interfaces. In *CHI '82 Proceedings of the 1982 Conference on Human Factors in Computing Systems.* ACM Press, 63-68.
21. Prensky, M. (2001). *Digital-game based learning*. McGraw-Hill.
22. Sheth, S., Bell, J. & Kaiser, G. (2012). Increasing Student Engagement in Software Engineering with Gamification. *Columbia University Computer Science Technical Reports*. Dpartment of Computer Science, Columbia University. Retrieved from http://academiccommons.columbia.edu/catalog/ac:154509
23. Simőes, J., Díaz Redondo, R., & Fernández Vilas, A. (2013). A social gamification framework for a K-6 learning platform, *Computers in Human Behavior*, Vol. 29, 345-353.
24. Werbach, K., & Hunter, D. (2012). *For the Win: How Game Thinking Can Revolutionize Your Business*, Wharton Digital Press.
25. Wolpe T. (2013, February 14). *Why gamification apps are playing out badly for business?* Retrieved from http://www.zdnet.com/why-gamification-apps-are-playing-out-badly-for-business-7000011184/