

Influence, principles and good practice of computer game elements: Mechanics and Dynamics

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Abstract— This paper gives basic overview of computer game elements (mechanics and dynamics) that can be found in various applications. Game elements can be used as a method for improving online teaching in education in general. We are showing the beginning of the Gamification phenomenon as a concept through the Gartner analysis of new innovation technologies. An overview of the basic Gamification elements (mechanics, dynamics) that can be included in the gamified systems is also presented. The position of Gamification is explained in relation to similar approaches to education. The basic principles of learning by means of Gamification is presented, as well as the research of selected authors on the topic of the influence of Gamification on teachers in higher education. The results of this paper indicate positive progress in the inclusion of Gamification in education systems in higher education. Article is concluded with the example of good practice in terms of commercial product DuoLingo, which is listed as one of the most successful Gamification systems for learning foreign languages.

Keywords— Computer Game Elements, Mechanics, Dynamics, Gamification, Hype Cycle

I. INTRODUCTION

Deterding is among the first to start talking about Gamification, which soon becomes involved in many profitable or non-profit work places. Deterding with research associates in 2011 article pointed out that Gamification is the process of introducing elements of computer games into a non-game area and represents an extremely fast growing trend in teaching [1]. Gamification can also be defined from a different point of view, according to Lombriser, which gives the following definition of Gamification: "The use of computer game mechanics and user design for the purpose of digital inclusion and motivation of the user to achieve certain goals". The basic elements of this definition are [2]:

- Computer Game Mechanics - rules, layout, tools to guide users through the system.
- User design - design according to which the user will interact with the system.
- Digital Inclusion - a phenomenon in which a user prefers to interact with a digital device than with another user.
- Motivation - behavior change, innovative approach to thinking, mastering skills.
- Achieving a goal - aligning the goal of the users with the goal of the system, where the organization will indirectly achieve its goals at the moment when the user fulfills his goals.

Sæter and Valle stated that "Gamification is a phenomenon that uses computer game mechanics, aesthetics, and logic to include and motivate users and direct them to learning and solving problem activities." [3]

Versteeg emphasizes common points that are seen in marketing and based on customer loyalty, eg in collecting points and gaining rewards in return. [4] Since 2011, Gamification has been included in Gartner's analysis of new Innovation Technologies "Hype Cycles" [2, 5]. In 2011 and 2012 Gamification is on the upward pace of modern trends [6, 7] while in 2013 it was at the very top of the Innovation Technology [8, 9]. Figure 1 shows the graph in accordance with Gartner's Innovation Technology called "Hype Cycles".

Figure 1 shows Gamification technology in the period from 2011 to 2018. A proper cycle and a relatively rapid shift from the very beginning of gaming as technology is visible.

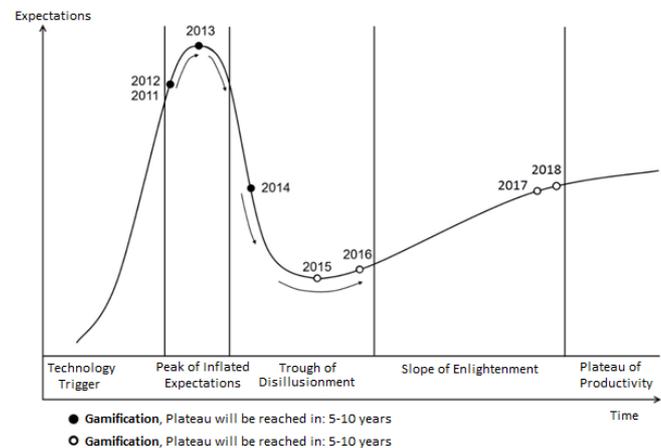


Fig. 1. Position of Gamification in relation to the innovation cycle

The black spot where the Gamification was displayed between 2011 and 2014, in figure 1, is a prediction where it is said that Gamification will reach the level of productivity for a period of 5 to 10 years. Gartner's statement is based on a market analysis in a given year. The circle that moves the Gamification from 2015 and 2016 to 2018, shown in figure 1, shows the expected shift of Gamification to the level of productivity. Due to the simplicity of the chart, all other technologies, their movement and the time of their arrival at the level of productivity have been removed. There are principles similar to Gamification, including the term "serious games", based on the elements and activities displayed through the computer game environment. Here are the most commonly discussed work tasks that are solved by computer game. A serious game as well as Game Based Learning is a game system whose primary purpose is not user entertainment [10].

Gamification should not be associated as a term with a specific content, purpose or scenario. When designing a gamified application, you should also consider the elements by which computer games are designed:

- a) graphic interface, badges, levels and order schedules,
- b) repetitive game mechanisms,
- c) guidelines for problem solving and scoring solutions,
- d) a conceptual model that relates to the story, curiosity, elements of fantasy,
- e) the method around which the game is being built.

Schönen [11] points out that computer games, if carefully designed, contain goals, whether they are short-term or long-term, which should be specific, measurable, achievable, realistic and time-limited. A simple transition and implementation of computer game elements into a work environment that is not related to the game is quite complex and not always possible. Games are based on emotion, intensity and long-term nature, as opposed to environments other than games where activities are reduced to tasks, productivity, and speed.

It is evident that in case of adding an additional or new informal rule, a gamified application can become a game. That is why the question arises what are the elements of computer games that could be used within the gamified applications. Ludwigsen and Wallervand conclude that almost every element found within the game can be part of a gamified system. [12] Souza-Concilio and Pacheco in [13] stated that the implementation of computer game elements is visible in various areas including education, health and fitness, task management, environmental sustainability, science, user-generated content, and so on. For those reasons, the scientific, educational institutions and business organizations should be oriented towards the creation of interactive and geo-motivated solutions that encourage collaboration, motivation and an innovative approach to problem solving [14]. It was noted that through the European Union project Horizon 2020, which was announced in the competition ICT-21-2014, calls for research of Gamification technologies, and its research, eight million euros were allocated [15]. The research continued within Horizon 2020 for 2016, and the call for H2020-ICT-2016-2017 was opened until 12 April 2016 [16]. This confirms the importance of researching the subject area and the spread of knowledge about Gamification as a teaching method.

II. GAMIFICATION ELEMENTS

A. Computer Game: Mechanics

Bernik stated his earlier work stated that Computer Game Mechanics is a term that describes a system based on rules for guiding and encouraging users to research and learn through feedback mechanisms. The most common mechanic elements that appear in educational systems are: Achievements, Bonuses, Countdown, Infinite Game Length, Ownership, Regular Reward, Obligations / Challenges, Detection, Levels, Points, Status, Combos Effect x3, Epic Meaning, Advancement, Collaboration, Surprise, Aware Risk, Tasks and Challenges, Commitment to the Game. [17]

B. Computer Game: Dynamics

The computer game dynamics is a combination of various mechanical elements in relation to the time spent in learning to create an interesting and ambient environment in which the user is located when using the Gamified System. "Computer game dynamics is a pattern of repetition for the game and the player with the aim to create a pleasant feeling when using the system." [18, 19]

Schönen shows an example in which a user's level of expertise can be indicated, where there is a (iii) novice, (ii) an expert and (i) master, as shown in figure 2. [11] Player in novice role needs to learn how to use the system, and achieving the goal, the expert places emphasis on new elements of the system, activities and challenges, while the master emphasizes the recognition and impact on the system and other users. The balance between challenges and user skills is an important aspect that is related to flow theory, which is shown in the figure 2.

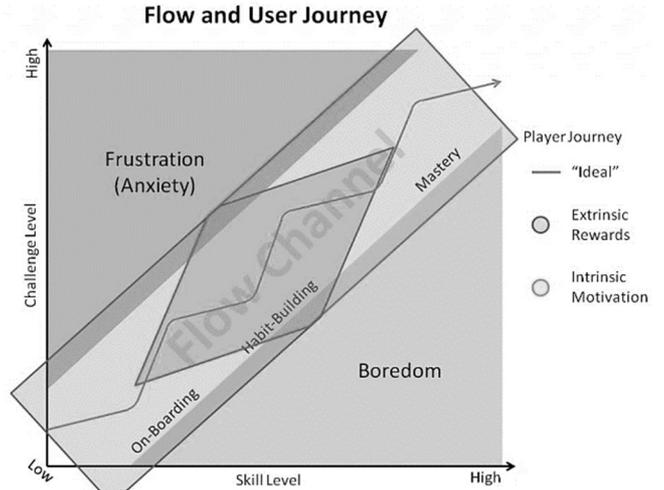


Fig. 2. The Flow and Players Path [11]

III. THE INFLUENCE OF GAMIFICATION ON THEACHERS

Parreno and associates investigate the influence of the gamified system on teachers. The survey was conducted through an online survey involving a total of 98 teachers, an average age of 44 years. Male gender was 56.25% of teachers. The analysis and results of the research are listed below in Table 1. In Table 1, it is seen how the teachers in the research had a positive attitude about the use of Gamification in teaching, but only 18 out of 98 teachers (11.30%) applied the practice in their classes. It is stated and expected, given that the term is quite new and insufficiently documented in professional and scientific literature. [20]

TABLE I. INFLUENCE AND APPLICATION OF GAMIFICATION IN HIGHER EDUCATION [20]

1. Do teachers in higher education show a positive attitude towards Gamification?		
	Average value	Standard deviation
Yes, they like the idea	4.42 out of 5 points	0.807
Yes, they have a positive attitude	4.35 out of 5 points	0.808
2. Do teachers in higher education use Gamification in their colleges?		
	Percentage	
No, never	38.10	
Sometimes	50.60	
Yes, always	11.30	

On the third question: "Does the gender impact on teachers' attitudes on the application of gamification in higher education?", as well as for the fourth question:

"Does the gender of teachers influence the application of gamification in higher education?" The answer was negative. The answers were based on the analysis and calculation of the t-test in which there was no statistically significant difference between the subjects mentioned. The fifth question: "Does the age of teachers influence the usage of Gamification in higher education?" The answer was negative. The age is not related to the views or the usage of the Gamification. In the analysis, Parreno did not find any significant positive correlation with age of respondents. In the sixth question: "Does the type of educational institution influence teachers' attitudes about applying Gamification in higher education?" The answer was positive. It has been shown that teachers of private higher education institutions have a more positive attitude towards applying Gamification, as opposed to teachers of public higher education institutions. In the case of the last question that we'll address here: "Does the type of educational institution influence the usage of Gamification in higher education?" The answer was negative. The results point to the lack of statistically significant differences in responses between private and public educational institutions.

IV. BASIC PRINCIPLES OF TEACHING WITH THE USAGE OF COMPUTER GAMER ELEMENTS

Lovett and associates from the Carnegie Mellon's Eberly Center for Educational Excellence cited four principles that describe how we learn in traditional terms as opposed to computer-based learning. [21]

- Principle 1: Using visual aids to streamline, trigger the desired activity, but also warn and correct otherwise, through instant feedback systems.
- Principle 2: Using iterative activities in which students return through the system after a previously successfully resolved chapter in order to obtain the maximum number of points, thus ensuring long-term knowledge.
- Principle 3: Ensuring the dynamic speed of the passage through the system, which is satisfied with the fun and motivational factor of keeping the attention of students who learn faster, and students who need significantly more time to master the same amount of teaching content.
- Principle 4: The system in which students learn should be consistent, transparent and clear in many issues - from learning objectives, feedback on the success of student activities, advancement, testing of knowledge, to navigation between teaching units.

V. AN EXAMPLE OF GOOD PRACTICE: DUOLINGO, E-LEARNING SYSTEM FOR FOREIGN LANGUAGES

DuoLingo is a combination of a massive online collaborative platform for free foreign language learning combined with a paid (crowdsourced) translation system. The system is designed to support students in learning a foreign language, where it helps in translating web pages and specific documents. The weight of the word and the weight of the required translation increase dynamically as the accuracy of the solution increases, whereby students can give their voice, ie, assess the quality of another student by providing feedback

on the accuracy of the translation. Top rated translators are exposed to the public, as well as their translations. Each task accomplished collects points and time bonuses that can be later used in new tasks. Student involvement is ensured by content from the Web because it is more interesting than translating random sentences. DuoLingo system is shown in the figure 3. The system contains logical visual elements that are changed by user actions. The user interface is comfortable and consistent with just a few levels for navigation. The system offers a statistical (weekly) view of user activities, with constant reminders of other options, ensures the collection of virtual currency, and the purchase of virtual products. It also shows the status of friends with whom we are connected through the DuoLingo system itself or through the social network.

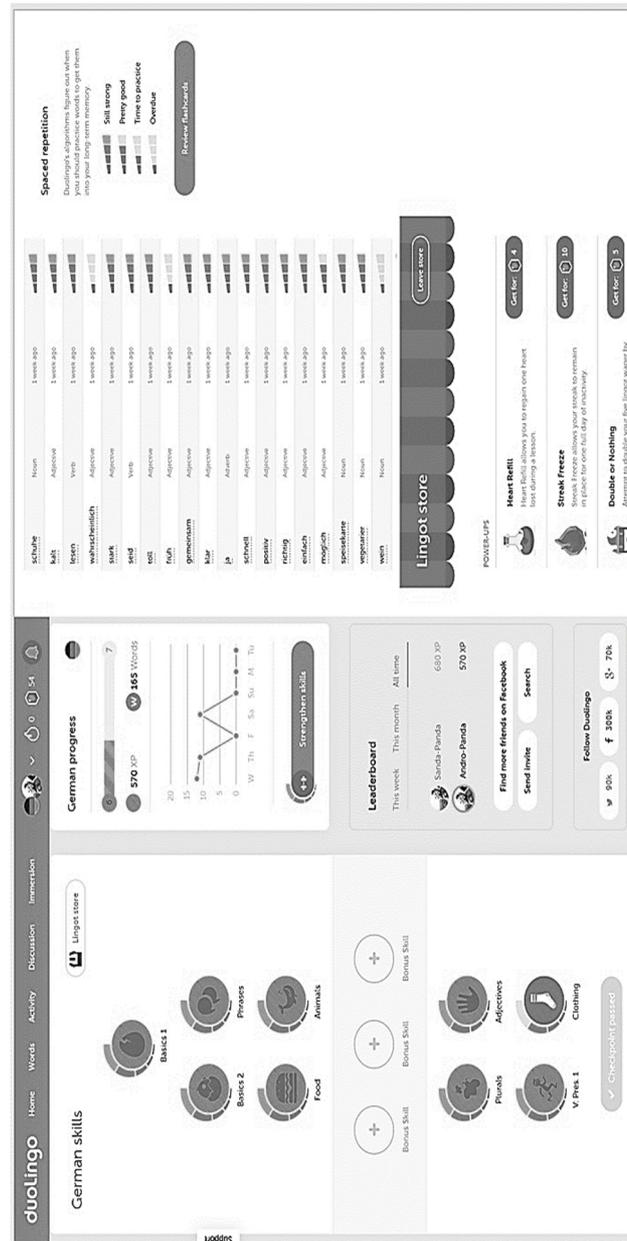


Fig. 3. The Structure and Visuals of DuoLingo System

VI. CONCLUSION

This work, besides the definition and basic elements itself, covers the most important parts of the Gamification approach as a method for teaching in higher education.

Through the graphic presentation of Gartner's innovation technology indicators, it is evident that Gamification in the final stage of enlightenment enters the level of productivity, which would mean that the application of the above method will be even more present in all areas, from education, health care and fitness, to task management, sustainability of the environment and science. An outstanding incentive for research activities is also visible through the call for proposals by the European Union on two occasions in 2014 and 2016 through the Horizon 2020 project

It is important to note that Gamification as a term should not be associated with a specific content, purpose or scenario, but rather use mechanics, dynamics and aesthetics from computer games to enhance productivity, motivation, and overall sense of system users. The paper also shows the positive attitude of teachers in higher education who have a positive attitude towards the use of Gamification in teaching, but only 11.3% of them actually use it

The paper concludes with four basic principles that should be followed when using Gamification in educational systems, and illustrates the example of one of the most successful foreign language learning systems called DuoLingo.

The authors of this paper believe that the higher education system will in the near future pass through a visual and conceptual transformation regarding the design and method of interaction between the student and the system itself, which is also a direct consequence of the trends in the ICT field.

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