

Gamification After Almost a Decade: Is it Still Relevant? A Case of Non-STEM Hybrid E-learning University Course

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Abstract: Gamification is a common and familiar term so far and it can be seen in almost every part of human activity. It's been nine years since the terminology first appeared in Gartner's Hype Cycle Report in 2011, however, higher education institutions still do not apply computer game elements to online Learning Management Systems (LMS). The problems encountered are related either to the administrators of the LMS system or to teachers who, for various reasons (lack of time, authority, knowledge, motivation, etc.) reject the changes. Objective of this paper is to determine if there is statistical significant difference between experimental and control groups. Experimental group will be using gamified Moodle online course while control will use classical Moodle online course. Research is made on a sample of 46 graduate students from the Faculty of Organization and Informatics within the course Computer Mediated Communication. Experiment lasted for 14 days after which testing the students' motivation to use the teaching materials as well as the lessons learned after the experimental period took place. The results indicate 7 times higher activity in the experimental group of students, as well as 33.23% better results (using t-test) in the experimental group of students in the final knowledge test, thus accepting both hypotheses of this research.

Keywords: Achievements, Computer Mediated Communication, Hybrid, E-learning, Gamification, Non-STEM, Moodle

Introduction

The analysis of the scientific literature relating to gamification, computer games and their use within educational games (Viamonte and Figueiredo, 2019; Hasan *et al.*, 2019; Petroulis *et al.*, 2019; Anatolievna and Anatolievna, 2019; Anatolievna, 2018), leads to the conclusion that educational systems have room to implement elements from computer games and implementation is necessary, primarily because of the z generation needs. The problem is that the elements found in computer games which contribute to the fun of e-learning, users hardly ever use, no matter that the first occurrence of this phenomenon has been documented in Gartner's Hype Cycle chart of new and upcoming technologies of 2011 (Muntean, 2011). The following text mentions three major factors associated with e-learning. Educational institutions administrators set up a system that is at some point the most stable considering other program and hardware factors. Administrators are technicians or engineers who have no insight into the

pedagogical and psychological requirements of e-course users or the supporting documentation of intrinsic or extrinsic motivation. Teachers are provided with virtual space where they can create content for an e-course that accompanies the course units, independently or with the help of an assistant. Each virtual space within an LMS system has an identical structure, where the teacher can only modify the elements he adds through predefined modules. Major changes to external plugins are not possible unless administrators decide that external plugins are a necessary part of the overall eLearning system. Students often use the LMS system as the primary source of information to learn and prepare for upcoming examination tests. The e-course changes daily in terms of various information, communication activities, work records, credits, etc. The student has to monitor the enrolled e-course constantly and use its functionality. The limitations which can be observed among teaching staff are a serious problem for the implementation of new teaching methods and technological solutions in the educational field and are as follows:

- Lack of time for preparation the quality materials
- Lack of authority to modify secured virtual space
- Lack of knowledge to modify secured virtual space
- Negligence of the idea of lifelong learning and vocational training
- Negligence of positive effects and influence on e-course user motivation
- Unclear vision of the teacher while setting the course learning outcomes
- The traditional approach to educational methods for knowledge transfer and assessment of knowledge

Due to the aforementioned disadvantages, the created e-course is often inconsistent, nontransparent or unintuitive to use. In the case of daily use, it causes frustration, demotivation and boredom among the students. E-courses are not aligned or interesting to users and they retain almost the same design, with minimal changes, for more than a 15 years. Computer games, as the second part cited as the basis for research in this work, along with education, are extremely important industry. On a sample of 625 respondents (Lopez-Fernandez *et al.*, 2019) show that 33.9% of the student population are permanent players, while 37.9% of those who are full time employees and these computer games are a daily pleasure. Also interesting to note is that 55.6% of respondents have completed college (Bachelor, Master and PhD). The point is that the perception of the average player needs to change, because when it comes to players, he does not mean primary and secondary school age players. Gough (2019), in its survey of 4,000 respondents, states that computer games have gone beyond the hobby phase, that the most common age of computer game users is between 18 and 35 years (40%) and that players over 50 represent the proportion which equals to the share of players under the age of 18 (21%). 46% of players in America are women. Average playing time on weekends or holidays is 90 min. Wijman (2019) reports results showing 9% increase in the global computer gaming market and for 2019 it is \$ 152.1 Bn, while for 2020 it is \$ 178.2 Bn. The largest share of this amount is games made for smart devices which could be a good indicator of the approach to higher education activities. The BYOD movement (Bring Your Own Device) that researchers are talking about (Aguboshim and Udobi, 2019; Kurniawan *et al.*, 2020; Tu *et al.*, 2019) also benefits. From the above it could be concluded that the implementation of computer game elements into the daily activities of a user in as many areas as possible, is a logical step. It affects individual motivation, facilitates daily activities and makes a user more productive.

Research Plan and Procedure

In order to define the research direction more precisely, the following hypotheses were made: H1.

Computer games elements included in the experimental e-course, have a positive effect on enhanced use of teaching materials when compared to the classical e-course containing identical teaching materials, without computer game elements. H2. An e-course which has implemented computer game elements enables students to achieve better results than traditional ones, acknowledging the level of gained knowledge of the particular teaching content. To test hypotheses H1 and H2, general scientific methods such as observation, description, comparison methods, synthesis and content analysis methods and in particular statistical methods of empirically collected data (*t*-test), were used. *T*-test was used since the results had normal distribution.

To confirm hypothesis H1, objective indicators of the Moodle system were used in the form of student activity logs over teaching and bonus materials. Log records were recorded over a 14-day period for both groups of subjects. The results are in tabular and graphical form.

In order to confirm the hypothesis H2, it is necessary to provide the conditions for testing the level of acquired knowledge of specific teaching content, which is achieved through three steps:

- In the first step, students are divided into two groups according to the group attendance records (experimental group G1 and control group G2)
- In the second step, the statistical difference between the groups was tested. After testing the statistical significance of the difference by the *t*-test method between the test scores of the experimental (G1; N = 23) and control (G2; N = 23) groups, it was determined that there was no statistically significant difference with respect to the average test scores and indicated to the possibility of reaching statistically significant differences in the experimental system. The calculation is visible in Table 3
- In the third step, the students of both e-courses studied the course materials exclusively through the e-course. The calculation is visible in Table 3. The topics of the course were not mentioned in the lectures or in the laboratory exercises. The use of e-courses lasted for a minimum of 14 days, followed by testing the acquired knowledge by applying post-test knowledge testing. Calculation is visible below in Table 3

Pre-test is a test which is used for getting to know the subjects, their initial knowledge and for examining statistically significant differences between the groups.

Based on the results, groups of respondents were created to ensure to equality and meet initial research requirements. The post-test is a test of acquired knowledge used to test knowledge after the experiment is conducted and is used to determine statistically significant differences between the subjects involved.

The pre-test in this research contains 32 questions (26 questions with 5 offered answers and 6 questions with space for typing answers yourself). The questions covered general concepts in the field of multimedia, such as questions about basic elements of multimedia, hypertext, video, colors, formats, etc. The post-test in this research contains 31 questions (25 questions with 5 offered answers and 6 questions with space for typing answers yourself). The structure of the questions is the same as in the previous test. The questions covered specific concepts in the field of multimedia, such as questions about frequency sampling, MIDI and WAV files, data compression, animation formats, etc.

The contents of the *experimental* course "Multimedia" of the course "Computer Mediated Communication" (CMC) are shown below:

- Text - describes the concept of text, embedding text into your computer, using text in multimedia, text design, selecting fonts, using colors and navigation menus
- Graphics - defines the concept of graphics, the division into vector and raster graphics, formats of records and storage of graphics and includes a table view of the formats mentioned
- Sound - deals with the concept of sound, frequencies and their limits of audibility, MIDI files, waveform files, MPEG audio compression and more
- Bonus - Color - defines the RGB and CMYK color system on a practical example, palettes and color depth and problems with color transitions and rendering of colors in HTML
- Bonus - Other terms - chapter describes the following terms: Visual communication, graphic design, digital competence and key elements. Both bonus chapters are only available to customers if they meet the previously defined e-course criteria. The criteria are explained to the student in an e-course within the Welcome to the System > Criteria and Opportunities for Progress
- Video - deals with the concept of video, analogue and digital video, NTSC and PAL standards, video compression, formats like MPEG, AVI, WMV, DivX
- Animation - chapter defines the concept of animation, its use in multimedia, the types and principles of animation, the techniques of different animation styles and the formats of animation files
- Hypermedia and hypertext - deals with concepts such as hypertext, hypermedia and interactivity and describes the levels of interactivity, navigation structure and more
- Bonus - Applying Text to the Web - describes the HTML format and relationship to fonts, with the recommendations given in tabular format

- Bonus - Graphics for the Web describes PNG, SVG and GIF formats, provides plotting speed and quality and GIF and JPEG comparison
- Bonus - Applying Audio to the Web - chapter addresses three concepts: Audio download, web site audio and streaming audio
- Bonus - Applying Video to the Web - chapter describes the processes of storing videos, turning on videos, streaming videos and highlighting a tabular format view of the Web
- Bonus - Applying Animation to the Web - describes Flash animation, animated GIFs and provides some recommendations when applying animation to the Web. The above bonus chapters are only available after meeting predefined criteria

Participants and Groups

Respondents in this study were students of the Faculty of Organization and Informatics in Varaždin who attended earlier abbreviated course named CMC, at the graduate study program in Informatics. The total number of respondents who volunteered to participate in the survey was 53. The respondents were divided into two groups of 25 students per group. Out of the total number of respondents, 13 or 24.53% were female and 40 or 75.47% were male. The average age of the respondents was 23 years and older. The pre- and post-test were completely completed by 46 subjects. Respondents were enrolled in self-selected groups during the study semester. The existing distribution was accepted and students of one group in laboratory exercises from a particular course were also one group in the research (experimental group G1 and control group G2). Another additional grouping was not used during the experiment. Based on the pre-test scores, the average value, standard deviation and statistical significance between the groups were calculated.

Results

The following section lists student activity reports that were generated based on log files from the Moodle system and also represents the final section to consider when making a decision to accept or reject hypothesis H1. The assumptions made by the authors cited within this research (Ismail, 2019; Bernik *et al.*, 2019; Adeel, 2014; Kovacova and Vackova, 2015; etc.) suggest that elements of computer games have a positive effect on student motivation, accordingly, summarized research results will be presented below.

Table 1: Comparison of computer game elements used in the research for the experimental group (E) and control group (C)

Computer game (gamification) element	Research e-course	
	E	C
Simplified graphical interface	+	
Dynamic graphical interface	+	
The story as an introduction to the e-course	+	
Epic meaning	+	
Avatar and personal information	+	+
Social networks and web services	+	
Visualization of all obligations	+	
Tasks and challenges	+	
Collecting points	+	
Advancements within the e-course	+	
Collecting of badges	+	
E-course completion status	+	
Synchronous communication chat	+	
Asynchronous communication forum	+	+
Nonlinear use of teaching materials	+	+
Collaboration	+	
Interactive repetition and assessment	+	
Top listing and ranking of students	+	
Detection of systems and teaching materials	+	
Elements of surprises within e-module	+	
Conditional access to teaching materials	+	
Countdown of time	+	
Feedback	+	
Educational games/GBL	+	

Table 2: Comparison of the use of teaching and bonus materials in the course CMC

Course syllabus	E	C
1. Text	142	25
2. Graphic	141	22
3. Sound	94	14
4. Bonus: Color	111	16
5. Bonus: Other terms	109	19
6. Video	125	13
7. Animation	122	18
8. Hypermedia and hypertext	155	13
9. Bonus: Applying Text to the Web	102	18
10. Bonus: Graphic for the Web	103	21
11. Bonus: Applying sound to the Web	106	13
12. Bonus: Applying video to the Web	112	11
13. Bonus: Applying animation to the Web	187	14
Total activity	1609	217

Table 3: Comparative test of the statistical significance of the difference by *t*-test between pre-test and post-test of results

Test	Group	N	Mean	*SD	t	p
Pre-test	G _E	23	21,91	2,70	1,04	0,3029
	G _K	23	20,91	3,73		
Post-test	G _E	23	22,13	4,55	4,57	0,0001
	G _K	23	16,61	3,59		

*SD = standard deviation

In the research conducted within the course "Computer Mediated Communication", a total of 13 teaching and bonus materials were used, which were available to students for at least 14 days. The experimental e-course contains elements of computer games (Table 1) and served as support for the teaching materials listed in Table 1. Separate teaching materials only, are listed in Table 2.

Student activity is greatest in the chapters entitled "Hypermedia and Hypertext" and "Application of Animation on the Web". The overall activity of the experimental group of respondents can be explained by a high degree of interest in teaching materials and a high degree of interest in a different approach to educational content. A similar indicator has already been seen in Bernik *et al.* (2018; 2019). The biggest difference between the control and the experimental group of subjects was observed at the end of the second section within the chapter titled: "Applying Animation to the Web". The difference in activity is 13 times greater in favor of the experimental group of subjects. The interest in teaching materials is greater in the experimental group of subjects, as is the case with previous studies. The explanation for these results is attributed to the more visually appealing design of the e-course, which is complemented by the aforementioned elements of computer games.

The control e-course was designed as in the previous two surveys and contains the possibility of using avatars, forums and the possibility of non-linear access to teaching materials. Graphical display of log results is shown in Fig. 1.

The hypothesis H1 is confirmed. The decision is based on a table and graphical analysis of the objective indicators that were generated using log files from the Moodle system. Also, the greater interest in bonus and teaching materials is almost constant in the experimental group of subjects, as is the very low interest in the control group of respondents. From the indicators above it can be concluded that motivation of the experimental group was significantly higher, which is evident due to the higher activity within the Moodle e-course according to the use of available teaching and non-teaching materials.

Testing the statistical significance of the difference by *t*-test between the post-test results of experimental and control group of respondents, where the calculated *p* value is 0.0001 according to which it can be deduced, with the possibility of an error of 1%, as there is between the experimental group and control group subjects statistically significant difference according to average post-test scores. The experimental group achieved a better result by 33.23%, thus accepting the hypothesis H2.

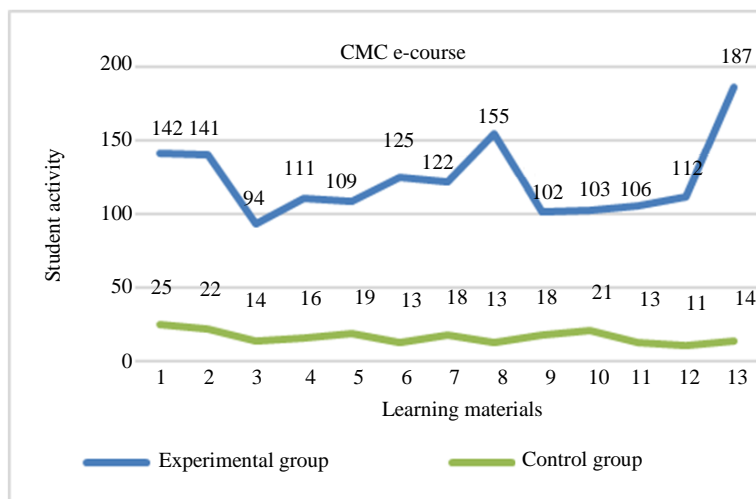


Fig. 1: Graphic display of the use of teaching and bonus materials in the course CMC

Conclusion and Future Work

This experiment put to the test two groups enrolled in non-STEAM university course, since authors of this article already tested statistical significant difference in STEAM course in their early work (Bernik *et al.*, 2018; 2019). The focus in this research was put on Multimedia and from the results shown in this study it can be seen that in non-STEAM experiment, the results were even better compared to earlier findings. This is important to note since there are a lot of fields which do not belong to STEAM grouping and could rely on our results. Considering the objective results generated from the log of activity on the teaching and bonus materials from the Moodle system used in this research, it can be concluded that the elements of computer games implemented in the experimental e-course enhances the use of teaching materials.

Average number of points before the experiment for the experimental group was 21.91, while for the control group it was 20.91. The experimental group achieved a better result of 4.78%.

Using pre-tests of test knowledge and indicators obtained, *p* values were calculated, which shows that there is no statistically significant difference between the groups. The experimental group joined the experiment followed by a post-test knowledge test.

Average number of points after the experiment for the experimental group increased by 1% to 22.13 points, while for the control group it decreased by 25.88% to 16.61 points. The intermediate value of *t* is 4.57. The calculated *p* value is 0.0001, which leads to the conclusion, with the possibility of an error of 1%, that there is a statistically significant difference between the subjects of the experimental group and the control group according to the average post-test

results. The experimental group achieved a better result for 33.23%.

As both hypotheses were confirmed it is clear that gamification is relevant to this date. Management of various institutions (University, etc.) should be aware of it and implement gamification to their strategic plan of online systems such as Moodle. It should be noted that expert should be hire for this job, not the teaching staff, because we are suggesting one standardized approach where user experience is positive and user interface is similar between two courses. The importance of this topic is huge, even now with the Covid-19 situation in the world, where most if not all of the students are finishing their semesters via online educational systems (Moodle, Claroline, etc.).

Our future work is orientated towards creation of gamified model which could be applied to both STEAM and non-STEAM courses inside Moodle environment since Moodle is open source and largely accepted by the student community. The model will be tested on several experiments and on different institutions and hopefully will give some good insights how to approach to the creation of gamified learning course.

Author's Contributions

Andrija Bernik: The main responsible author for research design, design of gamified e-courses and implementation of pre-research. Contributed in design, writing, data collection and analysis of the results.

Danijel Radošević: The main responsible author for implementation of the research. Contributed in design, planning, data collection and analysis of the results.

Jasmina Dvorski: The main responsible author for literature review and writing. Contributed in literature review, writing, translation and analysis of the results.

Ethics

This article is original and contains unpublished material. The corresponding author confirms that all of the other authors have read and approved the manuscript and no ethical issues involved.

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