Gamification of courses in the e-learning environment

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Abstract. The paper presents a study in the field of gamification of learning, in particular – in structural gamification. The four-stages cyclic (Learning – Evaluation – Rewarding – Ranking) gamification learning model is proposed. The used gamified elements (level, story/history, challenge, team, time frame, game progress, status (avatar), bonus, badge, reward, hidden treasures, combo and leaderboard) with their impact to the learner’s motivation are explained. Two plug-ins are designed, developed and tested with real users. One of the plug-ins changes the design of the learning course in game-like view, while the other ranks the students in a leaderboard with their avatars, according to their course progress. The short explanation of the experiment with learners is done and part of the statistical results from the conducted survey in five areas (practical applicability; motivation; design and accessibility; interactivity and communication; and intelligibility) are shown.

1. Introduction
The main challenge in the learning process is how to motivate students better. One of the methodological approaches, that gathers speed in recent years – gamification of learning, uses the people passion of playing games. It is an indisputable fact that everyone, regardless of their age, play games. This approach is usually applied on two steps. On the first step, the user is rewarded for task completion and on the second step, the user is encouraged to strive for further improvement by the use of a leaderboard. Gamification relies on user desires for status, achievement, competition and to be part of an inclusive social community.

The paper aims to present the results of the study, conducted at the University of Plovdiv “Paisii Hilendarski”, in the field of structural gamification of learning. Section 2 points on some related research that influenced our work. Section 3 presents the study methodology. Section 4 proposes a model of a gamification learning process and two plug-ins for Learning Management System (LMS) Moodle, that add some gamified features. Section 5 briefly shows the impact of the developed software to the students’ learning process. The conclusion focuses on the obtained results and future objectives.

2. State of the art
The gamification as an approach has begun to be used in the early 20th century in the stores [1], although the name of the concept was given in 2002 by Nick Pelling. The gamification is part of a wide variety of serious games.

2.1. Definition of gamification
The most popular definition of gamification is “the use of game mechanics and experience design to digitally engage and motivate people to achieve their goals” [2]. [3] point in their definition the resulted perception of users – “gamification is about taking something that is not a game and applying game mechanics to increase user engagement, happiness and loyalty”. [4] emphasizes that gamification is a process – “a process of making activities more game-like with involving parts of games”.

Some authors, like [2] distinguish gamification from video games and loyalty programs, as gamification uses techniques from behavioral science to “nudge” people into achieving their goals. The others, like [5] describe gamification in broader context as: “incorporation of game-style incentives into every day or non-game activities to enhance customer and employee engagement, boost sales, and cut costs”.

Therefore, gamification techniques can be applied not only in learning (where students indeed achieve their goals) but in many different domains like a loyalty card for discounts in a shop, frequent flier programmes, a tourist book for collecting stamps, when visiting historical and cultural places, etc.

According to [6] the gamification of e-learning is two types: structural – the application of game elements to propel a learner through content with no changes to the content itself, the content does not become game-like, only the structure around the content; and content – the application of game elements and game thinking to alter content to make it more game-like. Our study is devoted to structural gamification.

[7] divided learners in four groups, depending on their specific behaviour and motivation for action: killers, who want to dominate other players by acting on people in the environment; achievers, who like acting and care about the assignments in the environment to win; explorers, who like interacting and exploring the environment and discovering new things there; and socializers, who like interacting with people in the environment and take advantage of the communication to socialize. We propose different elements in our model, motivating all these four groups of learners.

2.2. Gamification in e-learning environments

Some of the existing software systems which implement gamification of learning were investigated.

GENIE [8] is a web-based application, providing game templates or blank ones, where users can add their own game elements. GENIE uses the following game techniques: rewarding with badges and points for achieving learning goals; preparation of leaderboards for stimulating the competitive spirit; putting deadlines to tasks; and learning through gradually passing levels.

Academy LMS [9] is also a web-based system, available as a native application for Android and iOS and implemented with a very colourful design including cartoons and funny pictures. The system supports the following key game elements and techniques - earning badges, earning points after completing certain activities, adding levels, monitoring (by users) the progress of a course and a leaderboard.

TalentLMS [10] is a SAAS (Software as a Service) cloud-based e-learning platform, that implements the concept of serious games with; giving points for performed actions; collecting various badges for passed tests; receiving certificates and awards for course completion; re-certificate on certain time periods; Leaderboards - displayed by charts and diagrams; and passing the course by levels.

Accord LMS [11] have upgraded their e-learning system with specific game elements: Leaderboard ranking, earning badges upon reaching the required criteria by students, and a points-based reputation system that shows the student’s progress together with other student’s progress.

Axonify [12] implements gamification as a basic training approach in the system by a very interesting methodology. The software includes game elements such as points, prizes, badges and charts, as well as a variety of up-to-date short games integrated into the application. These games are interrupted by questions triggered by certain game actions.

The most commonly downloaded Moodle gamified plug-ins [13] are LevelUp, Ranking block and Stash. LevelUp enables learners to earn points for various activities they have completed in the course.
The default algorithm is implemented for the progressive number of required points when passing to the upper level. Ranking block captures Moodle events in real-time and rewards points for them. The software offers a ranking of students with their points earned for completed activities. Stash proposes learners to find specific items placed in different Moodle activities or resources. Items can be opened one by one or several, gradually, so that students are encouraged to explore the whole learning material. Stash allows users to set items that can be collected in unlimited number of places.

3. Methodology of the study
The main goal of our study is to propose a model and software tools for carrying out gamified learning in the e-learning environment.

We use the following methodology: a literature review of previous works (learning methodologies and software systems and tools), prepare gamified learning model, design of software tools (plug-ins), development of prototypes, integration of plug-ins in the e-learning environment, and testing the software with real learners.

The paper presents all six steps, however, only one part or a summary of study results conducted are shown, since authors have already published on the topic. The focus is given to the outcomes of software testing, because this part of the research and some updates made, as a result of the testing has not been published yet.

4. Gamification in e-learning environment
We propose a learning model and software plug-ins for gamification in LMS Moodle.

4.1. Gamified learning model
The appropriate game elements from electronic games, which can be used in the gamified methodology of learning are found out in [14] and updated in [15].

We propose a four-stages cyclic gamified learning model (see Fig. 1), which uses all found out game elements, to motivate learners better: Learning – Evaluation – Rewarding – Ranking. Students learn using course resources and activities. After an assessment (test assessment, requirements fulfillment, etc.) of some ongoing learning goals, students are rewarded through different means (stimuli): bonus, badge, reward, hidden treasures and combo. As a result, they obtain points and/or new higher level, which directly reflect on the leaderboard ranking. After the processes of assessment, rewarding and ranking students naturally feel motivated to learn more, in order to receive more points, be on a better place in the ranking, obtain badges, receive additional extras, etc.

The learning process is organized in levels (locked or unlocked with entry requirements), presenting different learning sections with resources and activities that should be passed. The learning course is introduced with an interesting context (story/history) of activities, which have to be done. The learning rules are explained as game rules. At each level students have some challenges – all learning activities/tasks (reading text file, fulfilling test, writing/doing/solving assignment, etc.), that have to be done for achieving level’s learning goals. Some of the quests are individual, but the others are collaborative, where students work in teams. Some of the quests have time restrictions for completion of the activity – time frame.
For completion of some activities, students receive points/mark – **bonus**. For reaching a set of requirements, students obtain **badge** (Superstar, Adventurer, Explorer, Newbie, etc.). For excellent results or for doing something specific, students receive unexpected **reward** (additional interesting information, points/mark, etc.). For specific activity, students gain advantages as a **combo** (help, recommendations, more detailed examples, etc.). Some of the learning elements are locked (hidden **treasures**) and can be unlocked when students met certain requirements.

Based on collected points and current game level, students are ranking in the **leaderboard**, where leaders are seen. During the whole learning process, students have information about their learning progress as the **game progress**.

Students can choose their **status** in the gamified course as an **avatar** with some name and description.

The detailed diagram of the proposed four-stages learning model is presented in Fig. 2.

![Figure 2. Detailed model of the gamified learning process.](image)

For four user types of [7], the proper motivating game elements are proposed in the learning model [16]: for **killers** – leaderboard, points, course progress, status, combos; for **achievers** – badges, levels, course progress, bonuses; for **explorers** – quests (individual assignments), rewards, history; and for **socializers** – forums, quests (group assignments), history.

### 4.1.1. Plug-ins for gamification

Moodle platform has a rich variety of learning resources and activities that can be used in the gamification process [17] to realize different gamified elements: **Story/History** – Label, Page, File; **Game Rules** – Label, Page, File; **Challenge** – Page, File, Folder, URL, Book, Lesson, Assignment, Choice, Quiz, Glossary, Workshop, Wiki, Database, Forum, Chat, External tool, Survey; **Hidden Treasure** – Page, File, Folder, URL, Book, Lesson, Glossary, Forum, External tool; **Reward** – Page, File, Folder, URL, Book, Lesson, Glossary, Forum, External tool; **Combo** – Label, Page, File, Folder, Glossary, Database, Book, Lesson, Chat, External tool; **Badge** – Badge; and **Socializing** – Forum,
Chat. Only an avatar and a leader board are missing and can’t be realized from the existing Moodle elements. Two plug-ins are designed and developed to cover these missing game elements.

**Plug-in for playful design.** The first plug-in provides a gamified view of learning courses and changes automatically the design of a standard Moodle course. The course design follows the concept of game levels. User who have a system role Author can use the plug-in to create a new course or to re-design the existing course in a playful design. The software also proposes help for gamified usage of standard Moodle resources and activities (see previous paragraph). If the author follows these recommendations, design a course in multiple section format (like levels) and add some Moodle settings to restrict section/resource/activity access, the developed course will be fully gamified. The plug-in is created in Moodle type course format and implemented as course specific.

![Leaderboard](image)

**Figure 3.** View of the Leader Board ranking with avatars.

**Plug-in for specific game elements.** The second plug-in proposes for usage game elements that do not exist in Moodle: leader board and avatar. The plug-in can be used in creation of a new course or be added to an existing non-gamified e-course. The software gives the following opportunities for the students:

- To choose an avatar (image), a title (Mr., Mrs. or Prof.), a special name and a short description (the screen in Fig. 3 is taken from account with name Bugs Bunny);
- To see the current LeaderBoard learner ranking (with achieved level and obtained points);
- To see own place in the LeaderBoard learner ranking (Bugs Bunny is on 3rd position);
- To see the reached current level in the course for all learner;
- To see earned points of all learner;
- To see their own current Game Progress;
- To see the logs of her/him actions – actions for which the student has earned the points.

In order to comply with EU laws on concealing sensitive information, each learner participates in the Leaderboard ranking instead of personal name and photo, with a special name and avatar, which may be different for each course.

During the learning process, students collect points (the number of points for each possible learner action is configurated by the teacher) for each activity they have done (entering to read a text learning document, filling in a test, completing an assignment, etc.). They are ranked at the Leaderboard on the
basis of current points, despite the fact that everyone moves at their own pace and are currently at a different level.

The plug-in is created in Moodle type block format and implemented as course specific. For the development of both plug-ins are used the following programming languages and tools: PHP, JavaScript, HTML, CSS, Font awesome 4 (for icons) and Bootstrap 4 (for design basis). They are integrated into the Moodle e-learning platform of the University of Plovdiv “Paisii Hilendarski” (http://pdu.uni-plovdiv.bg). Additional tables have been added to the Moodle database via XMLDB. The plug-ins have been implemented with multilingual support in English and Bulgarian.

5. Experiment

The developed plugin has experimented from 38 students studying at the University of Plovdiv “Paisii Hilendarski” during the course “Object-oriented design and programming (C++)”. Students had the opportunity to evaluate the developed plugin by taking part in a survey. For the collection of primary data about students’ satisfaction a questionnaire was developed. The questionnaire has been prepared in such a way that without being time-consuming to complete to give a clear picture of students’ opinion about the plug-ins. The questionnaire contains 19 questions divided into five sections (see Table 1):

**Section 1.** Practical applicability (Q1-Q4).
**Section 2.** Motivation (Q5-Q9).
**Section 3.** Design and accessibility (Q10-Q13).
**Section 4.** Interactivity and communication (Q14-Q16).
**Section 5.** Intelligibility (Q16-Q18).

Most of the questions are multiple choice. Students should state how far they agree with the statements on the 5-point Likert-type scale, where 1 means Strongly Disagree (SD), 2 is Disagree (D), 3 is Neutral (N), 4 is Agree (A) and 5 is Strongly Agree (SA). There is an open-ended question at the end of the questionnaire which allow students to make recommendations for enhancing and extending functionalities of the plugin.

Table 1 presents summarized results of the survey. For each statement in the table, the number of responses and their percentage are presented (see Column 2 - Column 6).

| Statement                                                                 | 5=SA | 4=A | 3=N | 2=D | 1=SD |
|---------------------------------------------------------------------------|------|-----|-----|-----|------|
| Q1. Training through gamification is more enjoyable than using a standard e-course. | 18   | 18  | 2   | 0   | 0    |
| (47%)                                                                     | (47%)| (6%)| (0%)| (0%)|      |
| Q2. Gamification is suitable for higher education training                 | 18   | 12  | 8   | 0   | 0    |
| (47%)                                                                     | (32%)| (21%)| (0%)| (0%)|      |
| Q3. Game elements do not overburden or hinder the learning process.       | 14   | 16  | 8   | 0   | 0    |
| (37%)                                                                     | (42%)| (21%)| (0%)| (0%)|      |
| Q4. Gamification helps me to achieve educational goals effectively.        | 14   | 16  | 8   | 0   | 0    |
| (37%)                                                                     | (42%)| (21%)| (0%)| (0%)|      |
| Q5. Gamification training is more motivating than training through a standard e-course. | 12   | 16  | 10  | 0   | 0    |
| (32%)                                                                     | (42%)| (26%)| (0%)| (0%)|      |
| Q6. Getting points for each learning activity leads to using more learning resources. | 14   | 14  | 10  | 0   | 0    |
| (37%)                                                                     | (37%)| (26%)| (0%)| (0%)|      |
| Q7. The LeaderBoard element encourages me to get better grades.           | 16   | 14  | 8   | 0   | 0    |
| (42%)                                                                     | (37%)| (21%)| (0%)| (0%)|      |
| Q8. The LeaderBoard element encourages me to learn faster.                | 10   | 20  | 8   | 0   | 0    |
| (26%)                                                                     | (53%)| (21%)| (0%)| (0%)|      |
| Q9. The Avatar element encourages me to be more active during training.   | 10   | 12  | 16  | 0   | 0    |
| (26%)                                                                     | (32%)| (42%)| (0%)| (0%)|      |
| Q10. The proposed gamification design is good.                            | 18   | 12  | 8   | 0   | 0    |
| (47%)                                                                     | (32%)| (21%)| (0%)| (0%)|      |
Q11. The use of a gamification design makes the course more accessible than a standard course. 8 20 10 0 0 (21%) (53%) (26%) (0%) (0%)
Q12. Game elements have enough intuitive design for their easily using. 12 24 2 0 0 (32%) (63%) (5%) (0%) (0%)
Q13. I had no difficulty with navigation in the gamification course. 14 14 10 0 0 (37%) (37%) (26%) (0%) (0%)
Q14. I use more interactive learning resources (incl. communication) in the gamification course than in the standard course. 10 18 8 2 0 (26%) (47%) (21%) (5%) (0%)
Q15. The gamification course encourages communication and collaboration with other students. 16 12 6 4 0 (42%) (32%) (15%) (11%) (0%)
Q16. Game elements are presented in an understandable way and I have a clear idea of what is expected from me. 18 20 0 0 0 (47%) (53%) (0%) (0%) (0%)
Q17. The way the training is delivered meets my educational needs. 8 18 12 0 0 (21%) (47%) (32%) (0%) (0%)
Q18. The gamification course develops my learning skills. 12 18 8 0 0 (32%) (47%) (21%) (0%) (0%)

The results clearly show that students have positive opinions about the developed plugin. An analysis of the answers show that most students think that training through gamification is more enjoyable than using a standard e-course (84% of the students answered SA or A, and no one student answered D or SD to statement Q1). The percentage of students who think that this teaching approach is suitable for higher education, game elements do not overburden the learning process and that gamification helps them to achieve educational goals effectively is also high (79% answered SA or A to statements Q2, Q6 and Q4 and no one student answered D or SD to these statements). Most students agree that gamification training is motivating and getting points for each activity encourage them to be more active in the learning process (74% answered SA or A to statements Q5 and Q6). The LeaderBoard element encourages students to learn faster and get better grades (79% answered SA or A to statements Q7 and Q8). The lower but relatively high is the percentage of students who agree that Avatar element encourages them to be more active during training (58% answered SA or A to statement Q9). Students approve the proposed design (79% answered SA or A to statement Q10 and 95% answered SA or A to statement Q12) and agreed that the use of a gamification design makes the course more accessible than a standard designed course (74% answered SA or A to statement Q11). 26% of students stated that they sometimes have difficulty when navigating in the gamification course, but the other students stated that they have not such problems (see answers of statement Q13). Most students shared that they use more interactive learning resources in the gamification course than in the standard course (73% answered A or SA to statement Q14) and a small part of them use less interactive learning resources in the gamification course than in the standard course (5% answered D to statement Q14). The lowest degree of agreement students gave to the statements that the
gamification course encourages communication and collaboration with other students (11% answered D to statement Q15), but as a whole the percentage of students who agreed with this statement is high (74% answered SA or A to statement Q15). All students think that game elements are presented in an understandable way and have a clear idea of what is expected from them (all answers to statement Q16 are A or SA). When students are asked to agree that this way of training meets their educational needs 33% of them answered N. The percentage of students who cannot judge whether a gamification course develops their learning skills is also high – 21% (see answers to statement Q18).

As a whole, the students are satisfied by the functionalities of the developed plug-ins and think they are useful for them - the average scores on all sections is above 4 (see Fig. 4) and the average score on all statements of the questionnaire is 4.12. According to the students, the functionality of the developed plug-ins can be improved and expanded through adding hints and more badges, removing the fusion of colours in the Level chart (because they associate it with the Progress bar), merging the Progress bar and Level circle functionalities and improving the point accumulation algorithm.

6. Conclusion

The paper presented the study in the field of structural gamification, where the authors aimed to design and develop a system for conducting gamification training in an e-learning environment. The used approach is to integrate a system (plug-ins), that creates and uses a gamified e-course for learning, with an existing suitable learning management system.

In achieving the objective of the study, the following five results were obtained:

- Investigation of game techniques and elements used in gamification and also of existing gamified systems.
- Design of a model of gamified e-learning course.
- Creation of an approach for designing a software system for the implementation of gamified learning in an e-learning environment.
- Software realization of plug-ins for creation and usage of a gamified course.
- Conducted experiment – developed and experimented a gamified course with real users.

References

[1] Christians G 2018 The Origins and Future of Gamification Senior Theses 254 University of South Carolina
[2] Gartner https://www.gartner.com/en/marketing/glossary/gamification
[3] What is the definition of gamification? 2018 Growth Engineering https://www.growthengineering.co.uk/definition-of-gamification/
[4] Werbach K 2014 (Re) defining gamification: A process approach. In International conference on persuasive technology Lecture Notes in Computer Science vol 8462 (Springer, Cham) p 266
[5] Chappelow J 2019 Gamification https://www.investopedia.com/terms/g/gamification.asp
[6] Kapp K M 2012 The gamification of learning and instruction: Game-based methods for training and education (San Francisco: Pfeiffer)
[7] Bartle R 1996 Hearts, clubs, diamonds, spades: Players who suit MUDs Journal of MUD research vol 1 n 1 pp 19-58
[8] GENIE http://www.growthengineering.co.uk/genre-content-authoring-tool/
[9] Academy LMS http://www.growthengineering.co.uk
[10] TalentLMS http://www.talentlms.com/
[11] Accord LMS https://evaluate.accordlms.com/learning-management-system/
[12] Axonify https://axonify.com/
[13] Moodle plugins database https://moodle.org/plugins
[14] Somova E and Gachkova M 2016 An Attempt for Gamification of Learning in Moodle, International Conference on e-Learning (e-Learning’16) Bratislava, Slovakia pp 201-207
[15] Gachkova M and Somova E 2020 Moodle plug-ins for design and development of gamified
courses 14th annual International Technology, Education and Development Conference – INTED’2020 Valencia, Spain

[16] Gachkova M Takev M and Somova E 2018 Learning and Assessment Based on Gamified e-Course in Moodle Mathematics and Informatics vol 61 n 5 pp 444-454

[17] Gachkova M and Somova E 2019 Plug-in for creation of gamified courses in the e-learning environment Moodle IOP Conference Series: Materials Science and Engineering vol 618