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# Strategy to Implement Gamification in LMS

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## ABSTRACT

*The main goal of the chapter is to discuss implementation of the structural gamification in LMS. The overview of pedagogical approaches, theories, models and systems connected to the serious games and in particular for gamification is presented. The possibilities for using the game elements and techniques in e-learning (incl. possible realization with the standard elements of a non-gamified LMS) are presented. A four-stage cyclical gamified learning model is proposed. For the 4 categories of learners from the Bartle's classification, the appropriate game elements are determined. Two plugins for the application of structural gamification in Moodle have been designed and developed, which integrates game elements and techniques in the process of e-learning. The first plugin changes the design of the course into a game view. The second plugin allows adding specific game elements, which do not exist in Moodle. Different experiments of structural gamification has been done and presented.*

Keywords: Gamification of Learning, Game Element, Game Technique, Gamification Model, Structural Gamification, LMS, Gamification Plugin, Serious Game

## INTRODUCTION

The current generation in the education system has grown up with Internet access and early use of computers, mobile devices and gaming devices. This group of learners has a different pattern of behavior in media consumption, communication and therefore different expectations in the educational environments. Passive consumption of learning content and traditional pedagogical methods "face to face" and "distance learning" are no longer sufficient for the new generation of learners (Chang & Guetl, 2010).

The modern generation of learners are active, searching and demanding, they want fast, attractive, quality and effective training that uses the latest technologies and tools. Contemporary learning must change / adapt pedagogical methods, approaches and strategies to meet the needs of these learners, as well as to use the technologies of learners.

Recently, one of the most studied pedagogical approaches is the application of games in the implementation of learning and more precisely the so-called serious games. This is no coincidence,

because games are widespread in all age groups. Serious games are increasingly being integrated into school and university education and business learning.

Many scientists point to their strong motivating power. Moreover, not only the positive motivation (from success and receiving a reward), but also the negative one (from a bad result and not receiving a certain stimulus) are powerful triggers for the actions of the players.

Due to the large number of existing e-courses in the Learning Management Systems (LMS), the fastest and easiest way to apply the game methodology is by realizing the gamification of these e-courses.

The **main goal** of the chapter is to propose means (models, methods and tools) suitable for the organization of gamification of learning in LMSs for users of different types.

The study formulates and proves the following **hypothesis**: a possible approach to conducting gamified learning is the integration of modules (of the "plugin" type) to an appropriate LMS in which to create and use gamified learning e-courses.

In order to achieve the set goal of the research, the following four main tasks are planned and accomplished:

**Task 1:** Study of theories, models and systems related to the use of games in education and in particular its gamification;

**Task 2:** Creating a general model of the process for gamification of learning and methodology for developing gamified courses;

**Task 3:** Creating an approach for designing a system (module) to implement gamified learning in traditional LMS;

**Task 4:** Design, implementation and testing of software tools (module) for creating a gamified learning course, as well as for organizing and supporting gamified learning.

The second subchapter provides an overview in the following areas: serious games, in particular gamification of learning and examples of serious games in the LMSs, as well as pedagogical approaches, theories and models suitable for the gamification of learning. The possibilities for using the game elements and techniques in e-learning are presented in the third subchapter. The fourth subchapter proposes a four-stage cyclical learning model for structural gamification of learning. The implementation of structural gamification in a LMS is presented in the fifth subchapter, and the conducted gamification experiments are reflected in the sixth subchapter.

## BACKGROUND

### Serious games

The use of game elements and techniques in learning aims to make complex theoretical learning more accessible. The practical activities in the games and their repetition lead to a deeper understanding of the learning content (Connolly et al., 2012).

The games used in learning are known as oxymoron *serious games*. Serious games are aimed at achieving educational, learning and information goals (Abt, 1987). They do not belong to the category of "games" due to the fact that they are not intended for entertainment, pleasure and enjoyment (Michael & Chen, 2005).

Most serious games are simulations of real events or processes designed to reach solutions to problems. These games can also be fun, even though they are primarily aimed at learning or improving a practice. They focus mainly on learners who are not included in traditional education, although there are many examples from traditional school and university education. Serious games can be: educational games, advertising games, political games, etc. (Gachkova & Somova, 2016). According to Cruz-Chunha (2012), the first serious game is considered to be the Army Battlezone for military training from 1980.

There is currently no classification of serious games, but the following categories can be distinguished (Gachkova & Somova, 2016):

- **Gamed-based Learning** – uses video and electronic games to achieve learning goals;
- **Gamification of learning** – integrates game elements and techniques in the learning process;
- **Organizational-dynamic games** – train, reflecting the dynamics in organizations at three levels: individual behavior, group behavior and cultural dynamics;
- **Simulation games** – designed to learn different skills by playing in artificial environments that recreate both the real world and unreal plots;
- **Edutainment** – presents content designed to both educate and entertain (the term comes from the merging of the words education and entertainment).

## Gamification of learning

**Gamification** refers to the use of elements and techniques from games in activities outside the game context (e.g. shopping, sports or learning) to create a game-like activity (Langendahl et al., 2016). In gamification, it is not a question of turning an activity into a game, nor of developing a game, but only of changing the activity by integrating specific game approaches.

Examples of gamification can be found in various areas of application such as:

- predisposition to ecological behavior and higher sustainability (Gnauk et al., 2012) – the so-called green gamification;
- loyalty card from local shop for discounts;
- the game ‘Pokémon Go!’ from 2016 rewarded its users with high-level Pokémon for walking long distances – as example of the gamification of physical activity and sport;
- the Volkswagen-funded initiative called Fun Theory, where the Odenplan staircase in Stockholm was equipped with piano keys that make a piano-like sound when people step on them – example of the gamification of physical activity which encourage people to use the stairs instead of the escalator;
- tourist booklet for collecting stamps when visiting historical and cultural places and according to number of stamps, participants receive different type of badges;
- planning the resources of the institution, production and logistics (Herzig et al., 2012);
- supporting innovation processes (Scheiner et al., 2012), etc.

**Gamification of learning** is an educational approach to motivate learners to go through the learning content by means of additional game elements and techniques in the learning environment (Kapp, 2012). The aim of the approach is to increase learners' satisfaction and engagement by capturing their interest and inspiring them to continue studying learning resources (Huang & Soman, 2013).

The gamification of learning, according to Kap (2012), is divided into two main types:

- **Structural** – learners go through the standard learning courses with included additional game elements and techniques. The content of conventional learning resources does not change, the content does not become game-like, only their structuring/organization in the learning course (e.g. awarding with badges for excellent completion of the test);
- **Content** – application of game elements and game thinking to alter the content to make it more game-like (e.g. adding story elements to a course or starting a course with a challenge instead of a list of objectives). Game techniques and abstract rules are used to change the conventional learning content.

Structural gamification is a very appropriate and useful approach because it can be integrated into already designed e-courses without changing their content, which we used in our study.

## Pedagogical approaches, theories and models

According to many authors, the key engine in gamification of learning is motivation. Kapp (2012) distinguishes between two types of motivation: **intrinsic (internal)** motivation derived from the learner and **extrinsic (external)** motivation driven by external factors (for example, the teacher sets a high score in fulfilling predefined learning objectives).

Games are a powerful motivation tool that is used in many learning methods and approaches. Some of them are considered (Gachkova & Somova, 2019), elements of which can be used to build a comprehensive gamification model of learning, suitable for computer implementation in an e-learning environment.

### ARCS model

John Keller (2010) presents the four-component ARCS educational model, which is an instructional design approach, with the following components: Attention, Relevance, Confidence and Satisfaction. **Attention** can be acquired in two ways: by perception (by using a surprise or an unexpected event to gain interest) or by asking (by stimulating curiosity through asking challenging questions or placing difficult problems that need to be solved). Keller proposes the following methods to attract learners' attention using:

- Active participation – using game strategies, role plays or other practical methods to attract the learners' attention to participate actively;
- Experience – using visual stimuli, illustrating teaching materials with real-world examples, etc.;
- Variability – using a variety of methods to present learning materials (e.g. short lectures, videos, mini-discussion groups) while taking into account the individual differences in the students' learning styles;
- Humour – using a small amount of humor;
- Mismatch and conflict – using the "devil's advocate" approach, which presents those who contradict previous experience;
- Inquiry – asking questions and problems that learners need to solve (e.g. brainstorming activities).

It is advisable to use terminology presented with concrete examples familiar to the learners in order to achieve **relevance**. Keller's possible strategies for achieving relevance are:

- Familiarity – shows how new knowledge is related to the learners' existing knowledge;
- Goal orientation – orientation of the learner about the importance of the learning objective, describing both the importance of achieving an objective and how it will help the learner in the present and in the future;
- Conformity – compliance of the learning motivation with the learner's motivation.

Methods for achieving learner's **confidence** can include the use of:

- Learners' growth – making small steps for growth during the learning process;
- Setting goals and prerequisites – the probability of success can be assessed more accurately if there are clear requirements for the learner's performance and assessment criteria;
- Helping learners understand the probability of success – learners' motivation will decrease if they think their goals are unachievable or the cost to achieve them (effort or time) is too high;
- Meaningful opportunities for learner success – the student must be explained what is the meaning of achieving specific learning objectives;

- Learning control – make learners believe that their success is a direct result of their efforts and provide them the ability to control learning and evaluation;
- Feedback – providing feedback and opportunities to acquire successes in the course for which feedback is received.

The possible strategies outlined by Keller for achieving learners' **satisfaction** can be:

- Rewarding – obtaining awards for achievements;
- Satisfaction – giving learners feedback about their progress and ensuring improvement of results;
- Usefulness – opportunity for learners to feel the usefulness of the learning by using newly acquired knowledge in a real task or a real environment;
- Avoiding underestimation - avoiding overly easy assignments.

### **Malone's theory of learning through intrinsic motivation**

Thomas Malone (1981) presents a model of game motivation analysis based on the motivating power of the games, focusing mainly on the elements of entertainment. The model has three key components: fantasy, challenge and curiosity.

Malone determines **fantasy** as an environment that "induces mental images of things that are not present within the real experience of the learner". Fantasies in games mostly satisfy the emotional needs of gamers. Using fantasy in the learning environment can make it more interesting and educational, because fantasy has both emotional and cognitive benefits.

The **challenge** depends on the set goals with unspecified results, because there is no certainty that the final goal will be achieved. Various levels of difficulty, discovery of hidden information, sets of level crossing objectives or game-based challenges can be used. The learning objectives should be learner relevant and easily attainable. According to Malone, to reinforce the challenge, it is desirable to provide feedback on learner's success in achieving the learning objectives.

Learning environments can arouse the **curiosity** of the learner if they provide an exciting environment and an optimal level of information complexity. According to Malone, curiosity is cognitive (provoked by the prospect of changing cognitive structures to a higher level, which can be achieved by making students to believe that their knowledge is incomplete or inconsistent, thus motivating them to learn more) and sensory (attracting attention by reflecting changes in light, sound or other sensory stimuli of the environment). To engage the learners' curiosity, it is suggested to use surprising and constructive feedback as well as hidden resources in the learning environment.

### **Motivational Active Learning (MAL)**

Pirker et al. (2016) propose a **strategy game-based approach** to design Motivational Active Learning (MAL) in traditional, blended and distance learning, mainly for implementation in primary and secondary education and to increase students' interest and engagement.

Typical MAL learning material is divided into small pieces of information (theoretical units) through which learners are introduced to key concepts. They then use the acquired knowledge to solve small assignments and problems, as well as apply theoretical knowledge in discussions or research. Most of the offered assignments are group (in groups of 2-4 students). Learners take an individual test before and after each learning material and compare their knowledge afterwards.

### **Kolb's Experiential Learning Model**

The Kolb's experiential learning model (A. Kolb & D. Kolb, 2005) explores one aspect of learning – the **learning style** (the way in which students most effectively perceive, process, store, and reproduce information) that is completely independent of the other components and is a relatively stable characteristic of the individual.

The model introduces the concept of "learning cycle", which distinguishes four phases of the learning process that require different skills:

- Feeling – gaining experience from personal experiences;

- Watching – based on a specific experience;
- Thinking – collecting observations and turning them into theoretical models;
- Doing – based on what has already been learned, new ideas and solutions are created, which are then tested in practice.

A. Kolb & D. Kolb (2005) distinguish four learning styles resulting from a combination of each of the two phases in the learning cycle:

- The dreamer – specific experience, observation and reflection;
- The thinker – observation, reflection and abstract thinking;
- The decision maker - abstract thinking and active experimentation;
- The performer - active experimentation and specific experience.

### **A learning model based on Bloom's revised taxonomy**

Gloria et al. (2014) identify Bloom's revised taxonomy model as the most popular **cognitive approach** used in serious games (including their assessment). The Bloom's revised taxonomy, based on the Bloom's taxonomy for classification of educational goals (Anderson & Krathwohl, 2001), provides a more dynamic concept for classification and distinguishes six cognitive levels of learners' knowledge. Bloom defines educational goals for different cognitive levels through certain actions (through verbs) and objects (through nouns), while the revised taxonomy uses actions – categories and subcategories (through verbs and gerunds).

Anderson and Krathwohl (2001) further develop the idea by identifying 19 specific cognitive subtasks that complement the six basic categories. According to (Gloria et al., 2014) the two pedagogical models of Kolb and Bloom complement each other and can be easily applied together.

### **Serious games in Learning Management Systems**

Some learning management systems have integrated concepts and approaches from serious games and especially from game-based learning and gamification. Such systems are GENIE, The Knowledge Arcade, TalentLMS, Frog, Expertus One, Moodle, Academy LMS, Axonify and Accord LMS, as some of them are described below.

The application of elements of serious games in the web-based application GENIE (Growth Engineering GENIE) by Growth Engineering is made by means of:

- Rewarding with points and badges for certain learning goals achieved;
- Ranking in leaderboards for stimulating the competitive spirit;
- Setting time goals (deadlines of tasks);
- Learning through gradually passing through levels.

To add game functionality, the users can custom elements or use the already created templates, provided by GENIE.

Software as a Service cloud-based platform TalentLMS (TalentLMS) implements gamification through :

- Rewarding with points for performed learning actions;
- Obtaining various badges for completed tests;
- Receiving awards and certificates upon completion of a course;
- Participation in re-certification of a certain time period;
- Ranking of learners in leaderboards – they are realized in the form of charts and diagrams;
- Learning the course by levels.

The web-based system Academy LMS (Growth Engineering Academy), which is also available for Android and iOS, is designed specifically for the application of gamification in learning and is suitable for e-learning, mobile learning and blended learning. The system supports the following key elements and techniques related to gamification:

- Earning badges and points after performing certain activities;
- Learning on the base of levels,
- Monitoring by users the progress of the learning process in a course;
- Ranking of participants;
- Colorful design, including cartoons and funny pictures, which distinguishes it from other similar LMS.

Accord LMS (Accord LMS) has been upgraded with the following specific elements for gamification realized by Evoq Social:

- Ranking of the leaders;
- Receiving badges when reaching the necessary criteria;
- Point-based reputation system that shows the learner's progress relative to the progress of the other learners;
- Analyzes for teachers about interaction of learners with the game courses.

Axonify (Axonify) implements gamification as a basic learning approach, which is applied by a special methodology. In addition to game elements, such as points, awards, badges and rankings, the system also includes a number of short games integrated into the application itself. These games are interrupted by questions that are triggered by certain game actions.

Three of the most frequently downloaded Moodle modules (Moodle Plugins) that self-identify as gamification modules are: LevelUp, Ranking block and Stash. All three modules are of the block type.

Level up provides gamification of learning with the following features:

- Automatically captures and attributes experience points to students' actions;
- Block that displays current level and progress towards next level;
- Report for teachers to get an overview of their students' levels;
- Notifications to congratulate students as they level up;
- A ladder to display the rankings of the students;
- Ability to set the number of levels and the experience required to get to them;
- Images can be uploaded to customize the appearance of the levels.

The plugin Ranking block proposes the following opportunities:

- Captures Moodle events in real time and awards points for them;
- Offers a ranking of the learners with their points obtained for the completed activities;
- Displays performance graphs for group assignments.

In the third plugin Stash, learners have to find certain items placed in different Moodle activities or resources. Course authors can place such items that encourage learners to explore all learning materials. It is also possible to collect an unlimited number of items from one place, which will encourage learners to return to certain learning parts to collect more such items.

## GAME ELEMENTS, TECHNIQUES AND ACTIONS

The appropriate game elements and actions that can be applied in gamification of e-learning are selected. The possibilities for using the game elements and techniques in the learning are presented in Table 1 and Table 2. The list of selected game elements (see Table 1) contains: avatar, bonus, badge, combination / combo, reward, leaderboard, level, progress, status, team, time, resource, message and various learning elements, and the list of game techniques (see Table 2): change of identity, reward system, progress tracking, current status tracking, teamwork, time constraint, game rules, feedback, communication, challenge, mission, adventure, hidden treasure and story/plot.

*Table 1. Using game elements in gamification of learning*

<b>Element</b>	<b>Description / Usage in learning</b>
Avatar	The avatar element represents the role of the player during the participation into the game. Avatars have different names, images and may have different skills depending on the game. The avatar presents the different roles of the learners that can be used in missions and other learning activities.
Level	The level of the game is a section or part of the game. Most games are so large that they are divided into levels, so only one part of the game needs to be loaded at a time. To advance to a higher level, the player usually has to achieve specific goals or perform a specific task. The levels represent the sequence of execution. The different levels of the learning process can be considered as game levels.
Bonus	The results in the games are reported by an abstract quantity (most often through acquired bonuses) related to a player or team. Bonuses are expected gains from different types of abstract units (points, virtual objects or resources). Bonuses are usually collected in the game and their amount is an indicator of a successful game play. The events in the game, related to the activities, can increase or decrease the results of the participants. Bonuses represent the receipt of the expected remuneration for completed learning activities.
Badge	Badges are a reward given for a particular success that sets a participant apart from others. There are clearly defined criteria for receiving a badge. Badges are usually digital images that symbolize the success achieved. Badges are a distinctive mark of achievement in various learning activities.
Combo	A combo (combination) is a set of actions performed sequentially, usually with strict time constraints, that give a significant benefit or advantage. It is usually given to the player as a kind of reward for the achieved goal. Combos are used to show an aggressive style of play. The combo is a prize that gives an advantage over the other learners. It can be realized by means of additional hints or learning materials, contributing to the solution of a certain task for a shorter period of time, etc.
Reward	The reward is an unexpected prize (under certain conditions) from various stimuli in the game (such as points, rising the levels, receiving special objects, etc.), which inspire, involve and motivate the player. Rewards are received unexpectedly for certain learning successes and can be resources with interesting facts, certificates, virtual objects or other types of virtual prizes.
Leaderboard	Players can be ranked relative to other players based on achievements (e.g. points earned, levels reached, progress, time used, etc.). Leaderboards can provide an incentive for players to improve as they give a sense of superiority or achievement. This element provokes competition between players (Antin & Churchill, 2011). The leaderboard shows the learners ranked by current success, and sometimes the ranking shows only the first by success, for example the first ten.
Team	Cooperation is an act of teamwork with other players to achieve a mutually desired and useful result. This is the social aspect of the games that many players enjoy. In team games, the more players work together, the more they are able to achieve (Kapp, 2012). Teams are used for group learning activities and reporting on the ability of participants to work in a team.
Resource	Game resources can be a variety of items that are used for achieving the game's objectives.



	Game resources can be considered as different types of learning resources that are used to implement some game techniques and achieve some learning goals.
Time	According to Kapp (2012), time can be used as a motivating element for the activity and actions of the player. For example, when a timer appears on the video game screen and starts counting down, it increases stress levels and motivates actions. Time is used to set time limits for learning activities in order to control the learning process.
Progress	The progress of the game is used to show the advancement of the player in the game, i.e. how far the player has reached in relation to the whole game. Some games offer the ability to keep the current progress so that once the game is over, the players can start again from the recorded position to improve their final score. Progress usually represents the percentage of objectives achieved in relation to all learning objectives.
Status	The status is used to represent the player's current achievements (e.g. chosen avatar, points earned, level reached, badges received and available resources). The status in the learning considers the current state of the learner – current avatar, learning goals achieved, assessments of the learner, completed learning activity, etc.

Table 2. Using game techniques in gamification of learning

Technique	Description / Usage in learning
Game rules	The rules of the game are one of the main components of any game. The rules are designed specifically to limit the player's actions and keep the game manageable (Kapp, 2012). The rules of the learning process can be considered as rules of the game.
Time limit	Time limits are a technique used to provoke players. They focus and begin to perform the tasks needed to achieve the level or the current goal. Time limits are an additional but essential part of the learning rules and connected to the determining of the reward system. They can be used for both learning activities and learning resources.
Communication	Communication is used to send messages between two or more players in order to exchange information related to the game and to stimulate the desire for socialization between participants. Communication is an important factor in learning, through it students can share ideas and problems, to collaborate and work on group learning activities and to implement social communication.
Feedback	Feedback is received from the competent party for the actions performed by the player. It can also be used as a type of prompt/ motivation. Feedback in learning is usually used by the teacher to give the learners an opinion or recommendation on their work.
Mission/ challenge/ adventure	The fulfillment of the assigned missions in the games stimulate the satisfaction of the players. Many games use this technique to achieve various goals, most often described with story and supplemented by time constraints. Missions can represent all the learning activities that the learner has to carry out within the learning course. For more complete gamification, a game story can be added to these learning activities to describe the purpose of the mission.
Hidden treasure	Players should meet certain conditions to unlock hidden treasures. Hidden treasures are a technique for unlocking the discovery spirit of the players. Hidden treasures are hidden learning resources (like interesting fact or examples) that can only be discovered/ opened when certain learning conditions are met (e.g. when completing a certain mission).
Reward System	The reward system is a schedule with a quantitative description of the various reward elements (badges, rewards, bonuses, and combos) and the effort required to obtain them. For example, the most effective reward system, is one in which the rewards have a variable ratio of quantity, time interval and effort to receive. The reward system gives additional benefits and incentives to students under different rules and in different forms, which motivate them to carry out more learning activities.

Story / History	The story includes the ongoing plot of the game (e.g. a description of specific sub-scenes for role-playing games). The story gives an interesting context to the learning process. It can describe a story with different missions to complete.
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Also in Table 3 (Sharkova et al., 2020), the interrelation between game element, game technique and game action is made.

Table 3. The relationship between game element, technique and action

Game element	Game technique	Game action
Avatar	Changing Identity	Role Playing
Bonus	Reward System	Receiving a bonus
Badge	Reward system	Receiving an award
Combo	Reward System	Gaining an advantage
Reward	Reward System	Rewarding
Resource	Reward System	Gaining resources, exchanging resources
Leaderboard	Reward system	Participation in a competition
Level	Tracking progress	Going to the next level, repeating a level
Progress	Tracking progress	Getting information about the progress in the game
Status	Current status tracking	Receiving current status information
Team	Team work	Participation in group activities
Time	Time limit	Carrying out activity for a certain time
	Rules of the game	Following the rules
Resource, Message	Feedback	Obtaining an opinion from a competent party
Message	Communication	Sending a message, receiving a message
Various Elements	Challenge / Mission / Adventure	Completing a mission
Resource, Combo	Hidden Treasure	Treasure hunt
	Story / History	Creating and entering a different reality

## MODEL FOR STRUCTURAL GAMIFICATION OF LEARNING

Based on the research, a four-stage cyclical gamified learning model is proposed with the following stages (see Figure 1):

- **Learning** – Students learn using the learning resources – and activities of the gamified course;
- **Assessment** – Some of the learning activities are assessed to determine if some current learning objectives have been achieved, such as assessment of a test or assignment, fulfillment of input requirements, etc.;
- **Rewarding** – On the basis of assessment, learners are rewarded through various incentives: bonuses, badges, awards, combos and hidden treasures;
- **Ranking** – As a result of rewarding, students receive points or some virtual objects, and/or a new higher game level, which directly affect the position of the participant in the ranking.

After the assessment, awarding and ranking stages, learners feel motivated to learn more or do more learning activities to get more points, to be higher in the rankings, to be awarded with badges, to receive additional bonuses, etc. , which rotates the cyclically gamified learning process, as illustrated in Figure 1. The learning model is built on levels with learning materials and activities as well as with gamification elements and techniques. After the assessment stage, where some of current learning goals are assessed, students are rewarded through different means (stimuli): bonus, badge, reward and combo. As a result, they obtain points and/or new higher level, which directly reflect to the Ranking stage – learners move 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. Therefore a four-stage cyclical gamified learning model is a motivation learning model. The detailed model of a gamified learning process is given in Figure 2.

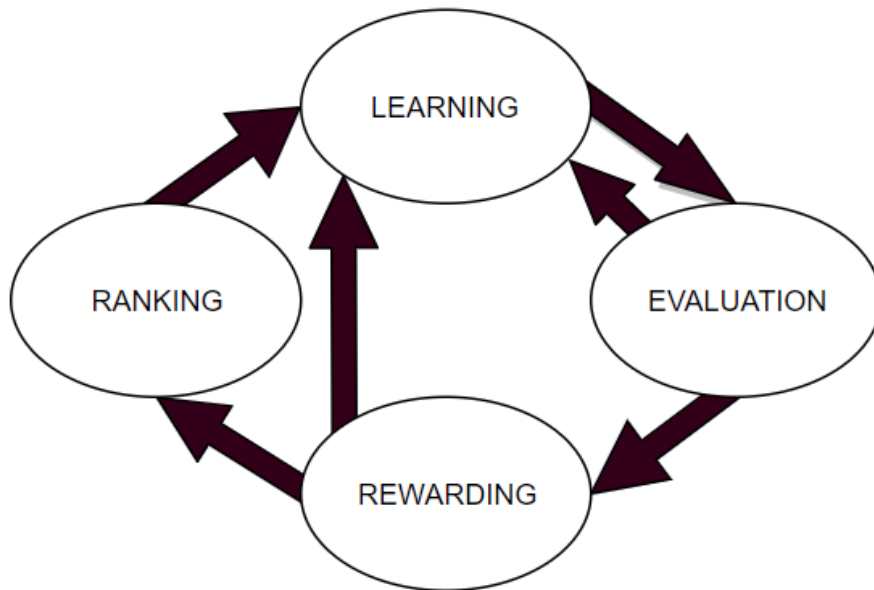


Figure 1. Four-stage cyclical gamified learning model

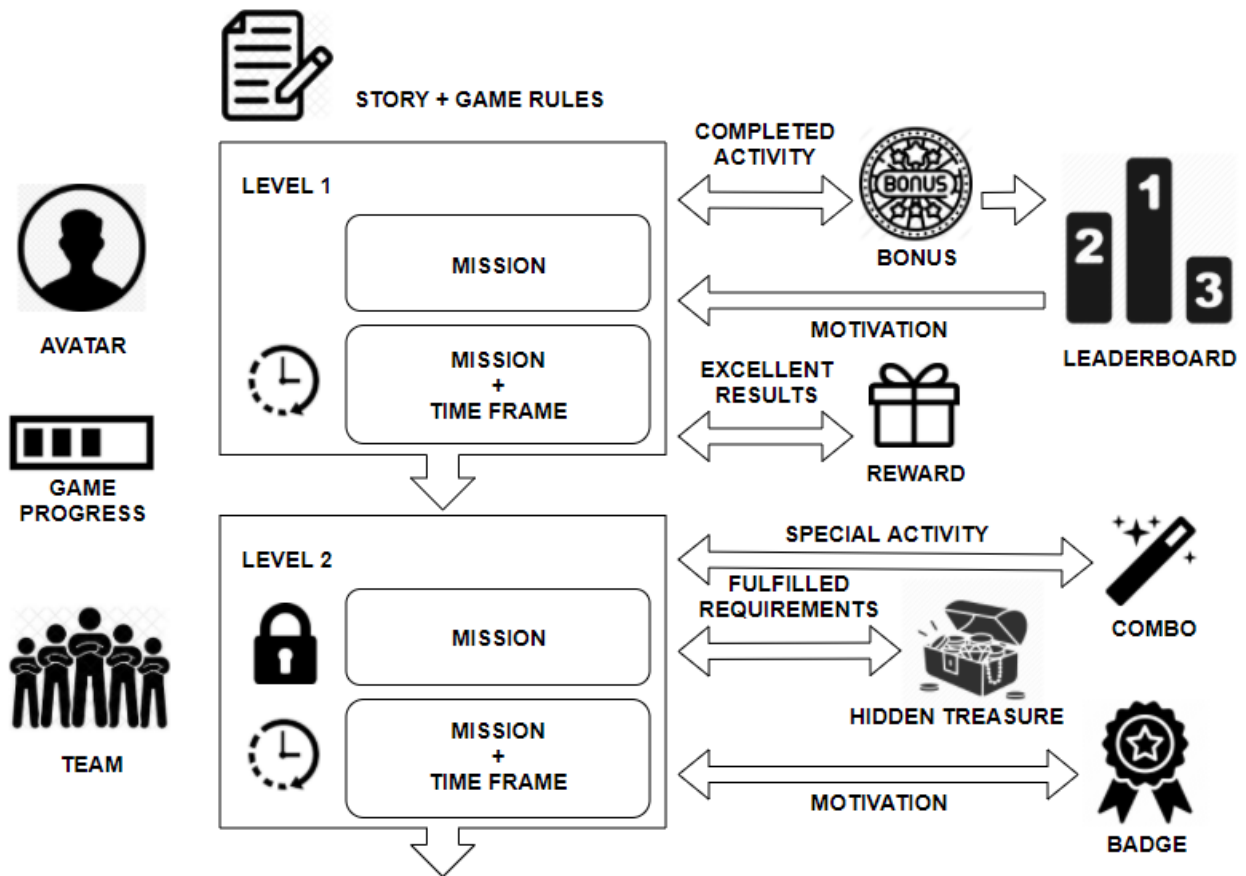


Figure 2. Detailed model of a gamified learning process

According to Bartle's classification (Bartle, 1996), game players are of 4 types: killers, achievers, explorers and socializers. For these 4 categories of learners, the appropriate game elements and techniques in the model are determined as follows in Table 4.

It is unlikely to find a learner, a representative of exactly one type. Most learners are usually a combination of more than one type and are therefore motivated by a different variety of game elements.

*Table 4. Appropriate game elements and techniques according to the game type of the learner*

User's type	Game elements	Game techniques
Killer	leaderboard, bonus, combo, progress, status, time	reward system, progress tracking, current status tracking, time constraint
Achiever	level, badge, bonus, reward, resource, progress	reward system, feedback, challenge/ mission/adventure, progress tracking
Explorer	avatar, reward, resource	challenge/mission/adventure, hidden treasure, story/plot, reward system, feedback, change of identity, game rules
Socializer	team, avatar, message	teamwork, communication, change of identity

## IMPLEMENTATION OF STRUCTURAL GAMIFICATION IN LMS

The main purpose of the research is to design and developed a structural gamification of e-learning courses in non-gamified LMS. Two approaches can be used to achieve this goal:

1. Conversion of a standard e-course into a gamified one;
2. Creating a new gamified e-course from „scratch“.

Due to the rapid development of e-learning in recent years, as well as the even more widespread blended learning, there are many e-learning environments in which a huge number of already created e-courses are located. That is why the research uses the first approach, in which the already existing traditional e-courses can be used, which can be automatically or with little intervention transformed into gamified ones.

For the implementation of the proposed model and approach, Moodle was chosen as one of the most popular and used LMS in the world, which is a flexible and free open source system with over 250 million users, over 34 million courses, over 173000 installations on the platform in over 240 countries (Moodle). An important reason for the choice is its wide application in University of Plovdiv, where we do our experiments and where a number of e-courses in various subject areas have already been created. Although Moodle is not a platform for game-based learning, it can easily use game elements and techniques. There is even a special name for the gamification in Moodle – "gamooification", proposed by Henrick (2013).

The LMS Moodle has been researched to discover its gamification capabilities and shortcomings. Table 5 shows the implementation in Moodle of the game elements and techniques from previous section. Most game elements have a full or partial implementation in Moodle or can be presented with other suitable elements.

*Table 5. Implementation of game elements and techniques in Moodle*

Game element/technique	Implementation in Moodle
Avatar	No implementation
Bonus	No exact implementation, but points of activity assessment can be used as one type of bonus
Badge	Implemented, badges can be created and set to be manually or automatically distributed to learners
Combo	No exact implementation, but can be simulated

Reward	No exact implementation, but the awards can easily be realized with other Moodle elements
Resource	Implemented, various learning resources can be added for learning or as a resource for carrying out a learning activity
Rewarding system	Partially, bagges and bonus points are fully realized, other awards can be simulated
Ranking	No implementation
Level	No exact implementation, but it is very similar to course section
Progress	No exact implementation of the gamification progress, although there are some statistics in Moodle on learning activities and student assessments
Status	No exact implementation
Team	Implemented, It is possible to create groups of learners to which group assignments/ resources can be assigned
Time	Implemented, it can be used to set a limited period for learning activities and a course
Time limit	Implemented, time limits can be set for submitting assignments and solving tests, as well as for each learning resource and activity in Moodle
Game rules	No exact implementation, but they can be interpreted as learning rules
Feedback	Implemented, there is a functionality for sending feedback from the teacher when assessing learning activities
Communication	Implemented, there is a forum and a chat in Moodle
Mission / Challenge / Adventure	No exact implementation, any learning resource and activity or set of them, possibly with time constraints and including story, can be interpreted as mission
Hidden treasure	No exact implementation, in Moodle, a hidden treasure can be easily simulated by placing various conditional locks on learning resources/activities, and the desire to unlock them by satisfying the set conditions can be interpreted as a search for a hidden treasure
Story/History	No exact implementation, but can be easily created with existing Moodle elements

To implement the model, software (Gachkova & Somova, 2020) for the application of structural gamification of learning in Moodle has been designed and developed, which integrates game elements and techniques in the process of e-learning, without any changes in the learning content of the courses. For this purpose, two plugins have been developed to help the authors of the Moodle courses in creating gamified courses.

We have implemented the missing gamification functionality in Moodle as modules of the "plugin" type so that they can be easily integrated into the environment. For the other game elements that have "partial" implementation, we offer recommendations (see Table 6.) with which existing Moodle elements to be realized. Conditions for a fuller application of gamification are also given.

*Table 6. Recommendations for Moodle implementation of game element/techniques*

<b>Game element/technique</b>	<b>Possible Moodle Elements</b>	<b>Additional Conditions</b>
Bonus	every Moodle resource, points	conditions for obtaining
Badge	Badge	conditions for obtaining
Combo	Label, Page, File, Folder, Glossary, Database, Book, Lesson, Chat, External tool	conditions for obtaining, visible disabled element, time constraint
Reward	Page, File, Folder, URL, Book, Lesson, Glossary, Forum, External tool	conditions for obtaining
Resource	every Moodle resource	conditions for obtaining
Level	Course section	conditional entry restrictions
Team	Group	–
Time	time	–
Message	message from Forum or Chat	–
Communication	Forum, Chat	–
Game Rules	Label, Page, File	–
Feedback	feedback of Moodle learning resources and activities	depending on student's progress

Mission	Page, File, Folder, URL, Book, Lesson, Assignment, Quiz, Glossary, Workshop, Wiki, Database, Forum, Chat, External tool, Survey	possible entry or time constraints
Hidden Treasure	Page, File, Folder, URL, Book, Lesson, Glossary, Forum, External tool	conditional entry restrictions, visible disabled element
Story/History	Label, Page, File	–

The first plugin for creating gamified e-courses in the Moodle environment can be used to automatically transform a standard e-course into a gamified one or to initially create a gamified course. This plugin changes the design of the course into a game view – based on game levels (open or locked with input requirements) and offers help on how to implement game elements with standard Moodle elements (on the basis of recommendations in Table 6). Course authors can create a fully gamified course only following recommendations in the plugin and using the familiar Moodle elements, but in the game context. Figure 3 presents an example of a sample course for a specific learner in game design, containing three (visible) levels of play where the learning has reached level 3. The panel on the right shows information about the participant’s current level, progress and menu options: status, leaderboard and rewards. Moodle supports several basic types of plugins (modules), this module is created by type "course format" and implemented as a specific format for each course.

The screenshot shows a Moodle course interface in 'Game' view. At the top, there's a navigation bar with 'ФМИ' and 'Български (bg)'. The main header says 'Game' with a settings gear icon. Below the header, there's a breadcrumb: 'Моето табло / Моите курсове / Game'. The main content area is divided into two columns. The left column shows a progress bar with three levels (1, 2, 3), where level 3 is highlighted. Below the progress bar, there's a list of activities: 'Обявления', 'Анкета за игрово-базирано обучение' (with a checkbox), 'COLLES анкета' (with a checkbox), and a section 'Ограничено Available from 30 януари 2020' containing 'Език за програмиране PHP' (with a checkbox), 'Това е тест за оценяване на познанията за език за програмиране PHP', 'Какви са предимствата на PHP' (with a checkbox), and 'Тест за история на PHP' (with a checkbox). The right column shows a 'Влез в ИГРАТА!' panel with a large green circle containing 'Level 3', a progress bar, and the text 'Ти си спечелил 114 точки'. Below this are icons for 'Статус', 'Класация', and 'Награди'.

Figure 3. Game view of the course

The second plugin allows adding specific game elements to the standard e-courses, which do not exist in Moodle and cannot be implemented with the standard Moodle elements. This plugin realizes the ranking of learners (leaderboard) depending on the achieved levels and progress, history of the awarded game elements, avatar and game progress.

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.

The plugin can be used both to create a new course and to modify an existing standard e-course to become gamified. It is designed as a Moodle plugin of the "block" type and is implemented as a separate instance for each course.

The plugin has a menu bar containing three options: status, leaderboard of learners and a diary with awarded activities of the learner, which give the following opportunities to users:

- To choose an avatar with an image, a special name and a short additional information about the learner;
- To overview the current ranking of learners with the achieved levels and the obtained points (see Figure 4);
- To identify one's own place in the ranking of students;
- To view one's own current status and progress in the game;
- To examine the reports of personal actions – actions for which the learner has earned points;
- To view the current level reached in the course for all learners;
- To view the current points earned by all learners.

During the learning process, learners collect points for each activity they have performed (opening a text document to study it, completing a test, completing an assignment, etc.). The number of points for each possible action of the learner is configured by the teacher. Students are ranked in the leaderboard based on current points, despite the fact that everyone is moving at their own pace and are currently at a different level.

The learner's progress shows the percentage of points earned in the current level to the total number of points in the level. For example, in Figure 4, the first participant in the ranking ("Angry Bird") has achieved only 2% of the points needed to reach the next level (level 6), and the other learner "Jerry" – 67% of the points needed, to move to level 5.

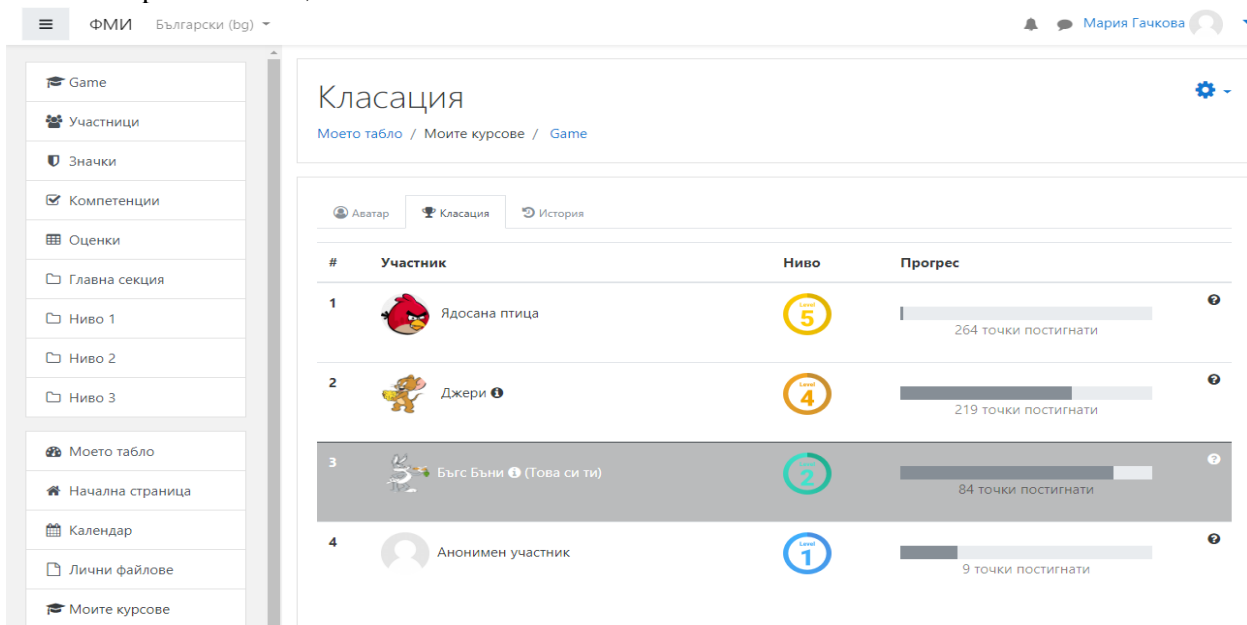


Figure 4. Leaderboard of learners

## CONDUCTED EXPERIMENTS

Different experiments (four) of gamification of learning at the University of Plovdiv “Paisii Hilendarski”, Bulgaria have been done. The results of the experiments generally prove the thesis that gamified learning is more attractive for learners, students are more motivated to learn and learning outcomes are comparable to standard e-learning, and sometimes higher.

### First Example

An example methodology for designing a gamified course based on levels, using rewards, bonus points, badges and a social component (forum or chat) has been experimented (Somova & Gachkova, 2016). The experiment was conducted during traditional learning process of the bachelor course “Web programming”, where students use an e-course as addition to face-to-face lectures.

Each learning week, in the e-course, is transformed into a game level. Each course level includes learning resources for study, assessment tests and/or individual or group assignments of different types for implementation, covering certain learning objectives. After the assessment of each assignment, test and some communication activities, students receive points. Based on the points received, students then receive badges and the final grade. If the points received from one assignment are more than 70%, they also receive a reward (additional interesting resource).

The conducted training is compared with the training in the same subject from the previous year. The results (final grades) of the students from the two years are comparable, but the students from the second year have shown a greater desire to get involved in the learning activities of the e-course and motivation to solve the tests and assignments.

### Second Example

Second attempt (Gachkova et al., 2018) for structural gamification of the learning have been made on the basis of existing standard e-learning course in Moodle “Modeling and management of business processes”, only by using the Moodle resources and activities in gamified context, with which the training has been conducted. A second example of designing a gamified e-learning course has been done, where to the game elements of the first example have been added: input requirements for certain levels, individual or group assignments of different types, combos, leaderboard (as a published list), story/history, status and course progress.

Some of the levels have input restrictions based on the previous assignments (the assignment is completed and submitted, the assignment is assessed with a minimum number of required points and the time limit is met). If the points are not enough for them to go to the next level, they can send the revised assignment again (this is one of the moments when the gamification cycle is triggered).

For encouragement, students can win badges: First Finished, High Score and Best Team (for group assignments). They can also receive combos (additional instructions and help for the next assignment) or unexpected awards such as additional resources with interesting facts, etc.

113 students participated in the experiment, and students were given a choice between a standard or a gamified e-course. 41 students choose to participate in the gamified e-course and 27 of them successfully completed all levels of the course. These students who failed during the training continued their education with the standard e-course (as most dropouts were during the first two levels).

The results of the two approaches were compared in the final exam, where the students from the gamified course have 7.13% higher grades than the students from the traditional e-course.

A COLLES (the Constructive On-Line Learning Environment Survey) survey was conducted at the beginning and end of the gamified e-course with the same questions to provide feedback on the effectiveness of some aspects of gamification of learning. First survey find out learner's expectations and the second survey – learner’s satisfaction. The COLLES survey is divided into six categories: Practical importance, Self-criticism, Dialogic, Teaching help, Mutual assistance and Understandability, where students answer using the Lycart five-point scale.



The results of this survey can be summarized in the following: students who participate in the gamified e-course spend more time on assignments in the learning environment than students who prefer the standard e-course; students in the gamified e-course have higher grades of assignments than students using the standard e-course; students in the gamified e-course seek fewer explanations than students in the standard e-course; the average understandability of the students in the gamified course is equal to their preferences, expressed before the training, and is higher than 75%.

### **Third Example**

Both created gamification plugins have been tested with real users in third experiment (Gachkova et al., 2020). A total of 50 participants took part in the experiment with bachelor courses "Object-Oriented Design and Programming (C++)", of which 38 were learners and 12 were teachers.

Two surveys, one for students (with 20 questions) and one for teachers (with 24 questions), have been conducted and analyzed in five areas (practical applicability; motivation; design and accessibility; interactivity and communication; comprehensibility). In general, both students and teachers rate the potential of gamification with very high marks.

The category "Practical applicability" was rated with the highest arithmetic mean of the surveys of teachers and students - 4.49, followed by the categories "Comprehensibility" and "Design and accessibility" - 4.47, "Motivation" - 4,41 and "Interactivity and communication" - 4.26.

The total average grade of all answers of the surveyed students is 4.15 out of a maximum of 5 (the Lycart five-point scale is used). The category "Practical applicability" is rated by students with the highest average grade – 4.25, followed by the categories "Interactivity and communication", "Comprehensibility", "Design and accessibility" and "Motivation" with the lowest score – 4,09.

The total average grade of all answers of the surveyed teachers is 4,71 out of a maximum of 5. The category "Design and accessibility" is rated by students with the highest average grade – 4,79, followed by the categories "Comprehensibility", "Practical applicability", "Motivation" and "Interactivity and communication" with the lowest score – 4,26.

### **Forth Example**

Forth experiment (Sharkova et al., 2020) with real students has studied the gamification approach in face-to-face collaborative learning, supported by a cloud environment. The experiment is conducted with two consecutive university level English courses for IT students, "English for ICT: Lifelong writing in the Cloud" and "English for ICT: Learner autonomy in the Cloud". The courses includes the following game elements and techniques: mission, reward, bonus, badge, leaderboard, hidden treasure, team work, avatar, story, progress, status, time limit, team, feedback and communication. The courses are delivered on Google cloud.

Used gamified learning methodology has been proved by conducted survey with 93 participants. Students gave their attitudes towards the different aspects of gamification in descending order, ranging between 97% to 72%: overall effectiveness, game rules awards, research and problem based tasks and leaderboard.

## **CONCLUSION**

The great motivating role of games and their widespread distribution has naturally led to the increasing use of game methodology for educational purposes and especially in e-learning or blended learning. In the chapter, the concept of serious games has been discussed and the attempt for their classification has been made with the following categories: game-based learning, gamification of learning, organizational-dynamic games, simulation games and edutainment. Examples of existing LMSs that apply concepts from serious games have been shown.

Gamification, as a motivator of human activities, has been presented in a more general context, with examples in different areas, paying special attention to the gamification of learning and its two types: structural and content.

Pedagogical approaches, theories and models suitable for the design and construction of gamified e-courses have been analyzed: Keller's ARCS model, Kapp's two types of motivation, Malone's theory of learning through intrinsic motivation, an approach for motivated active learning from Pirker et al., Kolb's experimental learning model, and Gloria et al. and Anderson and Krathwohl learning models based on Bloom's revised taxonomy.

The possibilities for using the game elements and techniques in the gamification of learning have been discussed.

Based on the research, a four-stage cyclical gamified learning model has been proposed with the following stages: Learning, Assessment, Rewarding and Ranking, as well as a detailed model of a gamified learning process. For the four categories of learners, from Bartle's classification, the appropriate game elements in the model have been determined.

The game elements and activities and their possible realization with the standard elements of a non-gamified e-learning environment have been discussed – a specific interpretation of the Moodle LMS has been proposed.

To fully implement the model, two plugins for the application of structural gamification of learning in Moodle have been designed and developed, which integrates game elements and techniques in the process of e-learning, without any changes in the learning content of the courses.

Various experiments for gamification of learning have been performed and presented.

The following directions can be suggested as possible future perspectives for the development of this research: creation of a gamified interactive textbook (based on the EPUB standard) for mobile learning, usage of the gamification methodology in other (non-learning) university activities and systems (e.g. for administrative activities of students, teachers and staff), creation of a specialized gamified environment for e-learning, in the field of green gamification for training users in ecological behavior, etc. These are just a small part of the rich possibilities for using gamification in every field.

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