MOODLE PLUG-INS FOR DESIGN AND DEVELOPMENT OF GAMIFIED COURSES

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Abstract

The current generation of learners desires fast, attractive, quality and effective training that utilizes the latest information and communication technologies and tools. This naturally leads to the need for new or reformed pedagogical methods, approaches and strategies. The article examines the use of serious games (in particular, gamification) as a suitable approach for attaining effective education for modern learners. The authors present how the implementation of games and game elements and techniques influences student motivation. This paper reviews software systems which use gaming and, in particular, existing gaming plug-ins in the Moodle e-learning environment.

This article explores the game elements that can be applied in training - story / history, level, badge, leader board, bonus, reward, combo, challenge / quest, hidden treasure, game rules, game progress, team and time frame. An appropriate interpretation of these game elements is offered in a learning context, as well as their possible implementation through elements of the Moodle environment, which is the main e-learning environment of the University of Plovdiv "Paisii Hilendarski", Bulgaria.

The authors' main goal is to design and develop software for implementing structural gamification of learning, which integrates game elements and techniques with the e-learning process, without any changes to the learning content of the courses. The article introduces the two plug-ins developed to assist the authors of the Moodle Middle School courses in the creation of gamified courses. The first plug-in changes the design of a new or already existing training course in a gamified way - based on game levels (open or locked with input requirements) and offers support for how to apply existing Moodle elements in a game context. The second plug-in allows for adding specific game elements to standard e-courses that do not exist in Moodle or cannot be implemented with standard Moodle elements. This plug-in implements the game elements leaderboard, avatar and game progress.

Keywords: Learning Gamification, Structural Gamification, Serious Games, Moodle Plug-in.

1 INTRODUCTION

The fast-paced development of technology has led to a drastic change in the modern learner's needs. The new generation of learners, the so-called Millennials or Generation Y, are very active learners who want fast, attractive, quality and effective learning that naturally leads to a change or at least an adaptation of pedagogical methods, approaches and strategies. Not only does the modern generation have no barriers to managing state-of-the-art information and communication technologies and tools, but it wants to use them in every field of life, including education.

One approach in training that has been gaining momentum lately is the use of so-called serious games - games that are used to achieve learning goals. Serious games come in different categories: Game-based learning (achievement of learning goals through the use of e-games), Gamification of learning (e-learning through integrated game elements and techniques in e-course), Organizational-dynamic games (training, related to dynamics and behaviour in organizations), Simulation games (mastering skills by playing in artificial environments that recreate real-world or unreal storylines), Edutainment (education through entertainment), etc.

Our study is related to the research and development of software for the implementation of gamification of learning, which integrates game elements and techniques with the e-learning process. Our efforts are primarily focused on structural gamification in Moodle, without any changes to the learning content of the courses.

The purpose of the article is to present the plug-ins developed for the implementation of game learning in the Moodle e-learning environment. Section 2 presents the methodology of the study. Section 3 examines the use of games as a training approach and the learners' attitude toward type of learning, as well as exemplary software systems offering gaming and existing gaming software plug-ins in

Moodle. The second part of Section 3 introduces two Moodle plug-ins, created to change the design of a traditional course into a gamified one and to incorporate game elements into an e-course. The article ends with a Conclusion outlining the authors' main contributions and the use of the developed plug-ins.

2 METHODOLOGY

Our main goal is to develop software tools for gamification and integrate them into the university Moodle system. We use the following methodology: review of previous works, design of software (plug-ins), development of prototypes, integration of plug-ins in Moodle, testing the software with real learners. The paper presents the first four steps, however, only one part or a summary of the results of the studies conducted are shown, since the authors have already published on the topic. Testing the software with real learners is being currently conducted and no data has been collected yet.

3 RESULTS

3.1 Previous works

Games motivate people to do things that they would not otherwise be willing to do or should practice a lot of effort and self-discipline. Everyone has participated in similar gaming approaches in everyday life: a loyalty card from a local discount store, a tourist book for collecting stamps from historical and cultural monuments or in order to receive a gold badge in the game "Pokémon Go!" for walking long distances to win a reward "high-level Pokémon". In fact, all of these examples represent gamification in various spheres of life: shopping, tourism, sport, etc.

It is no coincidence that the definition given by Gartner [1] to gaming is not closely connected to learning: the use of game mechanics and experience design to digitally engage and motivate people to achieve their goals. Although the definition focuses on people's digital engagement, the examples above show that gaming is an even more general approach that can be implemented outside of any digital environment. An example of gamified learning which is not related to a digital environment is giving away bonus points to students for attendance, individual or group participation in learning activities, homework, a competition between groups, a completed self-assessment test, etc.

3.1.1 Games in the learning process

The use of games as a training approach, as well as their impact on student motivation, has been explored by many authors. In [2], students rate game rules as more interesting than conventional instructions (32% prefer game instructions, 5% conventional instructions, and 56% show no preference). [3] reported a better attitude towards learning and greater cognitive benefits for learners using interactive simulation games compared to traditional teaching methods.

According to Kapp [4], games, or even the application of only certain game elements, give a better attitude to learning than traditional teaching methods and increase motivation in different groups of learners and learning situations. E-courses designed with gamification provide effective training for diverse learners in areas of higher declarative knowledge and memorization levels.

Using games is not a way of entertaining learners, but an effective approach that uses games or techniques that meet and achieve specific learning goals [5] and is embedded in the curriculum in advance, along with game feedback.

A large-scale study of 89 research articles is provided in [6], which provides empirical data in 5 categories. 65 of the studies research in the field of: evaluating the effects of computer-based game on learning. As a result, 52% of these 65 studies clearly show the effectiveness of gaming use.

A number of authors have applied a gaming approach that has yielded better results compared to previously used conventional training methods - the use of business games in [7] has led to a significant increase in the level of knowledge, while gamification of e-courses in Moodle [8] showed an increase in the motivation and success of students compared to those of the traditional e-courses and others methods.

Gamification of the course presented by [8] was created using only the standard Moodle game elements (points, badges, time and conditional restrictions) and the standard Moodle non-game elements; their application is explained in a gamified context (section, group and course description (to

describe the plot)). [8] reported that 65.85% of the learners who chose to study through gamification had completed the course successfully during the first attempt, while only 44.44% of the other students who had been trained following the traditional methodology had achieved the same.

[9] emphasizes that student confidence increases by up to 20% when using game-based learning. In addition, simulation training increases the levels of: declarative knowledge by 11%, procedural knowledge by 14% and retention by 9% (source: [10]).

3.1.2 Game-based software systems

There are software systems that implement gamification of learning such as GENIE, The Knowledge Arcade, Academy Learning Management System (LMS), TalentLMS, Frog, Expertus One, Accord LMS, Axonify, etc.

Growth Engineering is a company with several developed gamification systems such as GENIE, Academy LMS and The Knowledge Arcade.

GENIE [11] is a web-based application in which courses can be created using pre-set questions, photos and video libraries, or even custom elements. Any course created in the web application can be downloaded in SCORM format. GENIE provides game templates or blank ones so that users can add their own game elements. The app also 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 [12] is also a web-based system that is available as a native application for Android and iOS. Academy LMS is designed specifically for the application of gamification in e-learning. The system supports the following key elements and techniques related to gaming - earning badges, earning points after completing certain activities, adding levels, monitoring (by users) the progress of a course and a leaderboard. The system is implemented with a very colorful design including cartoons and funny pictures suitable for games, which sets it apart from most other LMS systems implementing gamification elements. The system also has the option of exporting and importing in SCORM format and is suitable for both e-learning, mobile learning and blended learning.

TalentLMS [13] is a SAAS (Software as a Service) cloud-based e-learning platform that enables the creation of training courses through presentations, videos, web resources, wikis, etc., as well as imported from SCORM format. To implement the concept of serious games, TalentLMS uses: giving points for performed actions (going through learning resources for example); collecting various badges for passed tests; receiving certificates and awards for completion of the course; re-certificate on certain time periods; Leaderboards - displayed by charts and diagrams; and passing the course by levels.

Accord LMS [14] have upgraded their e-learning system with specific gaming elements implemented by the Evoq Social technology company. The gamification elements they apply include: Leaderboard ranking, badges that are earned immediately upon reaching the required criteria by the students, and a point-based reputation system that shows the student's progress, along with the progress of the other students. Instructors have access to analysis from various courses in which the student has participated, from which they receive information about how the student interacts with the gamified course.

Axonify [15] implements gamification as the basic training approach of the system, which is applied by a very interesting methodology. The software not only includes game elements such as points, prizes, badges and charts, but also a host of up-to-date short games integrated into the application itself. These games are interrupted by questions that are triggered by certain game actions. According to Axonify, this type of testing helps learners better retain their knowledge.

All the systems studied above are not freely available because they are paid software.

3.1.3 Game-based plug-ins for Moodle

Three of the most commonly downloaded Moodle plug-ins [16] that self-identify as gamification plug-ins are LevelUp, Ranking block and Stash.

LevelUp is a block type plug-in. It enables learners to earn points for various activities they have completed in the course. Course authors / administrators have the ability to adjust the number of levels globally for the system and the points needed to reach the levels. The default algorithm is

implemented for the progressive number of required points when passing to the upper level. The plug-in was developed in 2 versions - free and paid.

Ranking block is also a block type plug-in. The plug-in 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. Graphs are also displayed for group assignments.

The third block plug-in for Moodle is Stash, in which learners can find specific items placed in different Moodle activities or resources. Course authors can place items and set them up differently - items can be opened one by one for a Moodle item or several, gradually, so that students are encouraged to explore all the learning material. It is also possible to set an item that can be collected in an unlimited number of places. This approach will encourage students to return to specific training units to collect more such items.

3.2 Two plug-ins for gamification in moodle

Gamification is so successful because of the user's desire for status, achievement, competition and being part of an inclusive social community. The common approach in gamification is: first to reward the user for completing the desired task, and second using the leaderboard to make the user strive for further improvement.

Successful gamification is built using different game elements and techniques matching the needs of different personalities, as Bartle [17] defines four types of personalities (killer, achiever, socializer and explorer). For example, a top leaderboard position could motivate a killer personality type, rewarding with points and badges could satisfy achievers' desires, forums and group challenges are preferred for socializer and hidden treasures inspire the explorer.

Table 1. Game elements in gamification.

Game element	*Usage for gamification*
Story/history	Interesting context of the activities to be done
Level	Different learning parts that should be passed
Badge	Obtaining for reaching a set of requirements (Champion, The best designer)
Leader board	Ordered list of participants, leaders to be seen
Bonus	Receiving points/mark for completion of some activity
Reward	Receiving unexpectedly something for excellent results/doing something (additional interesting information, points/mark, …)
Combo	Gaining advantages (help, recommendations, detailed examples, …)
Challenge/Quest	Tasks/Activities to be done
Hidden treasure	Locked interesting resource with some requirements (activities to be done, results to be achieved, …)
Game Rules	Learning rules
Game progress	Current status of the learner (learning progress and achieved level)
Team	Group of participants learning together
Time frame	Time restrictions for completion of some task/activity

After analysing e-games, the existing game elements have been identified that can be used in the educational context shown in Table 1. Training can be implemented at levels (learning parts) that contain different game elements that increase motivation and learner engagement such as hidden treasures, challenges and time frames for some activities. The trainees will participate in both individual and group activities (teamwork). Learning content (learning resources and activities) can be put into game context - in game story / history. The learning objectives will be presented as game rules, which students generally prefer to follow. To complete certain learning activities (under certain criteria), trainees will receive various incentives: bonuses, badges, rewards or combos. To enhance the competitive spirit, student outcomes will be displayed on the Leaderboard. Learning progress statistics will be presented as game progress. Students will have the opportunity to change their avatar.

Our goal is to implement plug-ins that support the work of administrators and creators of Moodle training courses who want to create playable courses. On the one hand, Moodle authors can create e-courses in which almost every methodology is implemented, due to the great abundance of elements and settings in the system. On the other hand, the system is a free Open Source software package. These arguments, as well as the benefits for the students (including all activities, individual and group work, ways of communication with the teacher and students, etc.) make Moodle a widely used e-learning platform.

Moodle offers a great variety of learning resources and activities that can be used in a gamified context. For example, when playing a history course in Moodle, the Glossary resource (containing a list of famous personalities with their images) can be used as a Hidden Treasure with the following input restrictions: the current self-assessment test be solved by at least 60 points and the current assignment to be passed.

To implement gamification of learning in Moodle, the authors created two plug-ins: Gamified course view and We play. Moodle has a library of over 50 different types of plug-ins, with plug-ins: block and course format types selected for authors' purposes. One plug-in is implemented in type course format (Gamified course view) and the other is type block (WePlay). Course format plug-ins can only be course specific, while block type plug-ins can be both global and course specific. The plug-ins created are implemented as course specific.

3.2.1 Plug-in for playful design

The first plug-in [18] (Fig. 1, middle section of the page) automatically changes the course design to a game-based view and offers, for help, the authors of the training courses a game interpretation of the already existing Moodle elements. The plug-in can be used for both a new course as well as an existing one. The design of the course follows the concept of game levels. Each level of the course can be locked (not accessible, in Fig. 1 in light gray) with input starting conditions or open (accessible, in Fig. 1 in black). The entry-level entry requirements for a given level are Moodle's standard restrictions that can be applied to the elements (e.g. mandatory completion of certain activities for passing a level or obtaining a certain number of points from the completion of a test, etc.).

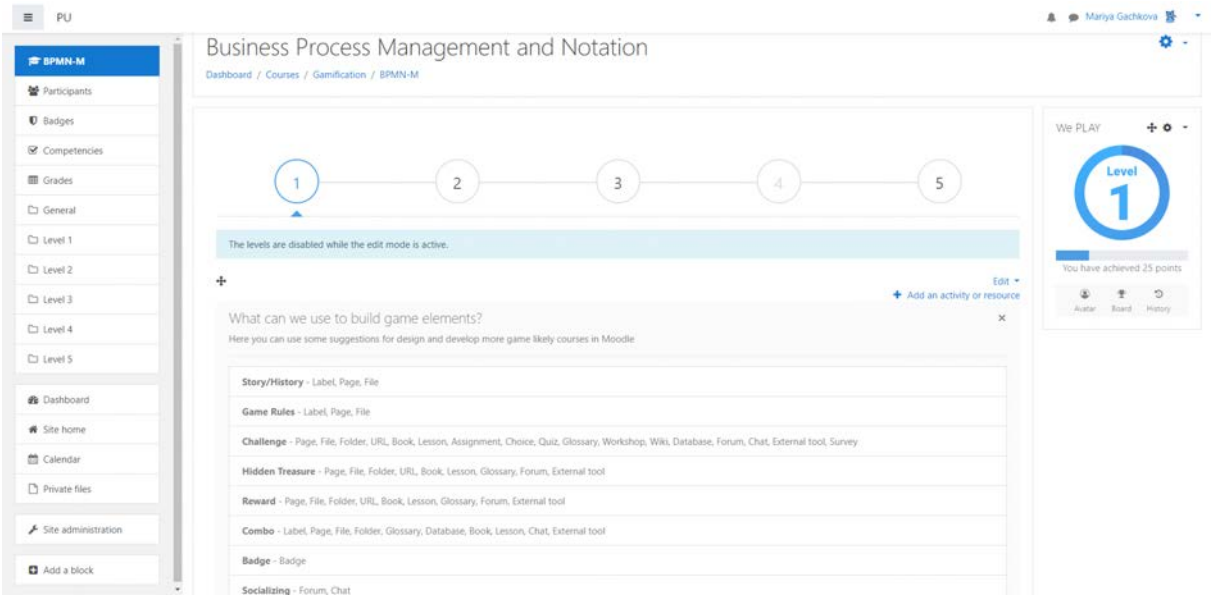

Figure 1. Plug-in "Gamified course view".

The plug-in also offers recommendations on how standard Moodle elements can be used in a gamified context. For each game element, a list of possible Moodle elements [16] is provided, through which it can be realized as follows:

- **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;
- **Socializing** – Forum, Chat.

Following these recommendations, as well as Moodle's standard settings, especially regarding accessibility of resources and activities, the authors can create a fully playable course.

3.2.2 Plug-in to create a course with specific game elements

A second plug-in was designed and implemented to include game elements in a training course that do not exist in Moodle. The implemented software can be used both to create a new course and to modify an existing standard e-course to become more gamified.

The plug-in lets you see the LeaderBoard learner rankings. Each student's name is on the LeaderBoard which shows the place he / she occupies in the ranking, the points earned so far, and the current level he / she has reached in the course. In order to comply with EU laws on concealing sensitive information, each learner participates in the ranking instead of his / her own name and picture, with a special name and avatar, which may be different for each course. Thus, each learner can see the points of the other students, the entire ranking system and most importantly his/ her own place among them, without knowing any real names - only the results achieved. According to the authors, the opportunity for the learner to be able to see how he / she is ranked at any time in the course of his / her learning will lead to a natural aspiration to climb the ranking, which will increase his/ her motivation for learning.

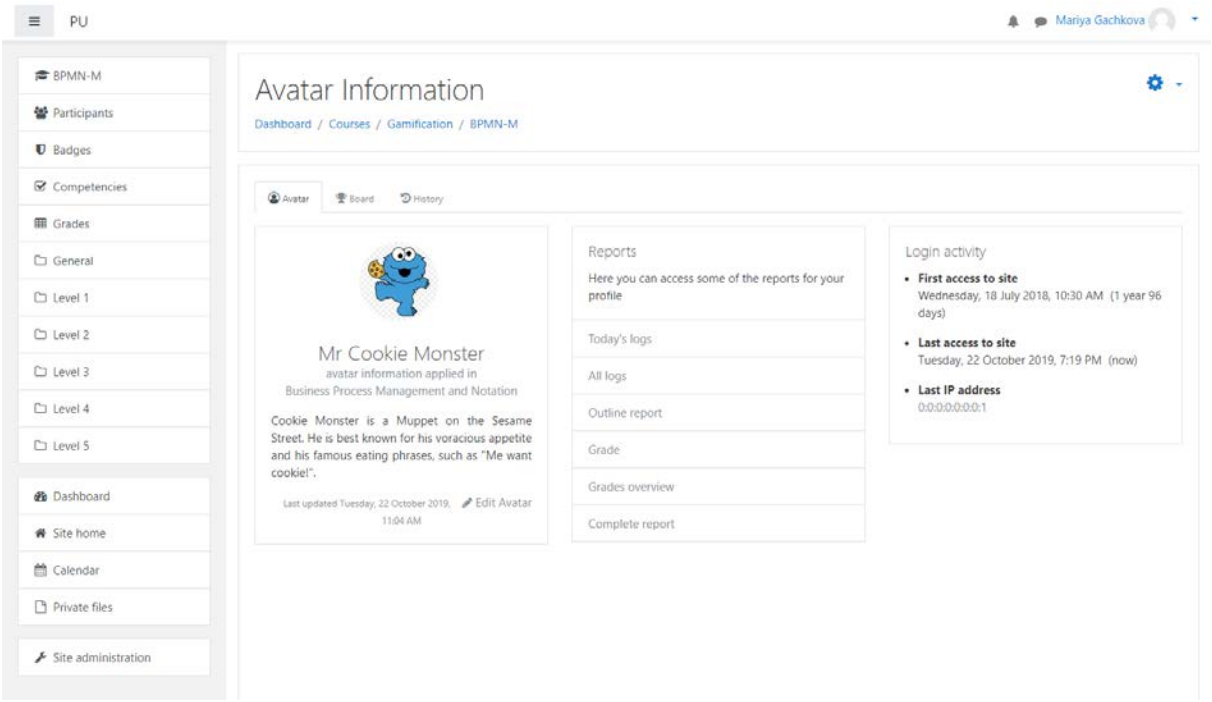

Figure 2. Avatar menu option in plug-in "WePlay".

The plug-in also shows the Game Progress of the learner so far. For example, in FIG. 1 (on the right side of the page) you can see the plug-in block preview with information that the learner has received 25 points so far and is still at level 1 of the course.

The plug-in has a menu with four options (see Figures 2 and 3) that can be accessed from the embedded block itself - Avatar, Leaderboard, History and Settings.

The first option Avatar of the menu introduces the learner to adding a title (Mr., Mrs. or Prof.), a name, short description, and a photo of their avatar, as they wish to appear in the current course. With the picture and name entered, the learner will appear in the Leaderboard. FIG. 2 shows a view from this menu option of the student's profile with the avatar "Mr Cookie Monster".

The second menu option called Leaderboard leads to the page with the current student rankings. The Leaderboard is a gaming element that doesn't come standard in Moodle, so it was implemented. FIG. 3 shows three avatars, levels and points achieved so far. The students are ranked on the basis of points at the moment, despite the fact that everyone moves at their own pace and at that moment are in a different level.

The third menu option History shows the logs of the logged-in user actions. It shows the last actions that it takes on the system, such as reading a lesson, completing assignments, and more. Actions can be easily tracked thanks to which the points of the user have been earned.

The fourth menu option Settings allows for plug-in configuration. The plug-in settings can be modified by three default Moodle user roles - manager, course creator and teacher. Therefore, this menu option is not visible from the learner's profile. These settings apply only to the specific instance of the plug-in, because each block (plug-in element) added to a course is a separate instance in the system.

Specific settings have been added to the plug-in in three categories: block settings (to change the title and description / block presentation), points earning configuration (settings for configuration of points that could be achieved for every CRUD operation), appearance of the block (on which pages to display the position on the screen) and on current page (additional settings specific page).

PHP and JavaScript programming languages have been used to develop the plug-ins. The plug-in was created using software tools: HTML, CSS, Font awesome 4 (for icons) and Bootstrap 4 (for design basis). Additional tables have been added to the Moodle database via XMLDB in the install.xml file. The plug-ins have been implemented with multilingual support in English and Bulgarian. Functionality for automatic update of plug-ins has been added after admin approval.

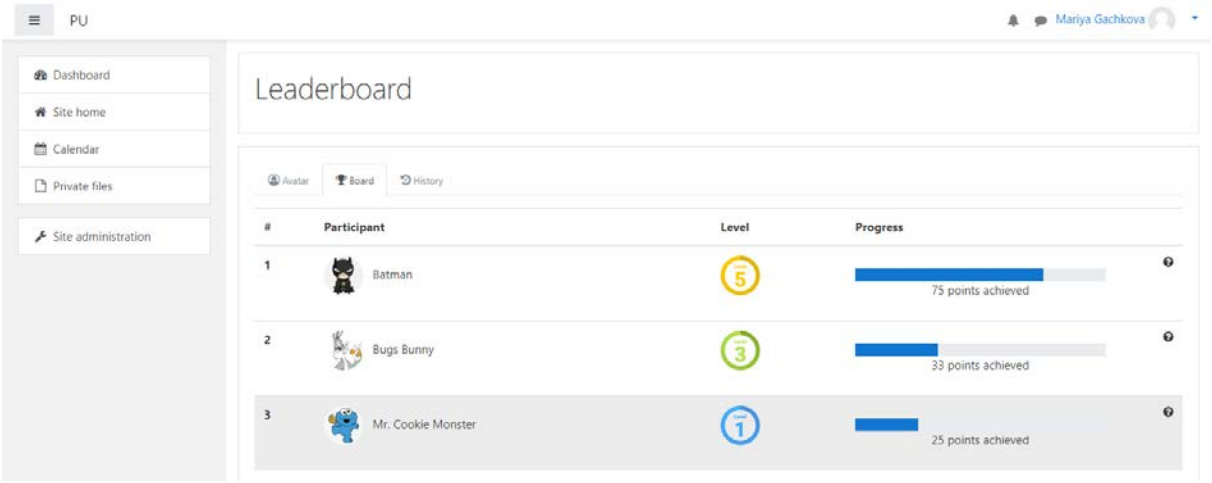

Figure 3. Leaderboard in plug-in "WePlay".

The plug-ins are integrated into the Plovdiv University of "Paisii Hilendarski" e-learning environment (http://pdu.uni-plovdiv.bg), which is also used in traditional face-to-face training (such as blended learning) to support the learning process. The e-learning environment uses the Moodle platform. The first tests of the developed software will be conducted with game-based versions of some of the traditional courses of the Faculty of Mathematics and Informatics of the Plovdiv University.

4 CONCLUSIONS

The article introduces work oriented towards offering game-based learning in the Moodle e-learning environment. Arguments have been presented to defend the thesis that education through serious games, or even through the use of game elements and techniques, leads to more motivated learning and, hence, to more effective learning outcomes.

Two plug-ins have been developed to support the authors' work on the creation of gamified courses, as well as providing training through game elements and techniques. One plug-in is aimed at changing only the e-course design into "game-type" based on levels. The other plug-in overcomes the lack of some game elements in Moodle - the avatar of the learner (with name and picture) Leaderboard (wall of champions with current points and elapsed rankings) and Game Progress (current learning status).

The Moodle e-learning environment (installed with two plug-ins developed) will be integrated with the mobile application - Mobile LAP [19] that allows students to track their activity and success rate on their mobile devices during the training and compare them with the average level of activity and success rate of other students, in order to increase their success, as well as track whether they adhere to the learning schedule wherever they are.

The developed software solutions are used both in the electronic and in the traditional face-to-face training of the Plovdiv University “Paisii Hilendarski”, as an alternative to the lecture hall courses, which the students use for self-preparation and self-assessment.

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