Abstract

When studying in traditional environment can be boring and not efficient, introducing game features into learning routine can lead to high increase in motivation and engagement in learners. This technique of involving game modules into process called gamification.

Even though the gamification tends to provide good results on learning outcomes, the research in the area has some limitations. Many of these systems were not evaluated within in-class environment, to identify if they really help to learn subject or not. On the other hand, if there was experiments within course, the number of samples are and time frames of experiment are small.

The following study was conducted to understand the result of gamified learning platform on student performance. Also to identify in which cases external learning systems are usable. The study shows that learning platform become more engaging after introducing gamification techniques and it helps to improve overall student learning performance. Also we notice some correlation between effectiveness of professor and platform usage. Used testing system.
1 Introduction

With a fascinating growth of technology, educational system also faces drastic changes. With a huge interest in MOOC systems, e-learning becomes one of the best examples of advances in education. But on the other hand with a great portion of online classes and online learning tools the need to engage and motivate students is of great importance. It is very hard to identify external impulses that will force student to learn a subject. But while for some students solving math or programming moderate problem can be cumbersome, they can spend hours and hours playing hard strategical games. This kind of observation gives an idea of incorporating game features into learning environment. This technique, called gamification.

Gamification is used in a wide range of domains, such as marketing, sport, health and so on. One of the example of such system is Swarm or former foursquare which was one of the early systems that uses badges to motivate users to check-in in places using that software. Memrise and Duolingo are other examples of successful commercial products for learning languages. The world’s leading business gamification solution for enterprises is known to be badgeville, which provides means to increase employee engagement.

The problem with motivation and engagement arises in any domain, but when technology grows so rapidly, the need of students in technical areas grows exponentially. Consequently the problem of engagement in the courses of those technical subjects become very crucial. In particular student find challenging learning programming languages. To overcome this problems, many web-based gamified systems were created. The gamification of technical courses not only plus-able for university students, but also for employees and employers. The costs on employee trainings are reduced by e-learning, moreover gamification can provide more motivated professional training.

Even though the gamification tends to provide good results on learning outcomes, the research in the area has some limitations. Many of these systems were not evaluated within courses, to identify if they really help to learn subject or not. On the other hand, if there was experiments within course, then the limitations are in number of samples.

In the following work, we present how gamification can improve the engagement of students and their overall course score. The experimental results are acquired on significantly more samples than the similar studies. The experiment time frame is also considerably more, about one year long.
2 Literature Review

While gamification is used to motivate and engage student in learning activity, it can also have opposite actions, such as 'Overjustification effect' or addiction [13]. But those side effects must be eliminated in the phase of system design. For example making the rewards achievable or tangible, by limiting the time between takes, can help to solve some of this problems.

To prevent gamification from becoming just a "pointification" Cheong at al. tackle problem by using design science research to create and evaluate and instantiation of a Quick Quiz tool [6]. The Quick Quiz software is a multiple choice quiz, which was tested in IT-related undergraduate course over four weeks. Tool was iteratively improved based on the data collected from the system. The effectiveness(effect on student learning, future use, and effect of specific features) of the tool was measured based on the questionnaire. The number of usable answers was 76, and about 76% on each evaluation metrics was positive.

Most extensively used gamification techniques are points, levels, badges, leader boards, prizes and rewards, progress bars, storyline, feedback. A review by Nah at al. [18] shows the impact of those elements on the learners’s outcomes, in a sense of motivation, enjoyment or productivity. In particular the badges and prizes boost motivation, or goals and visual elements enhance performance and so on.

The mechanism of earning badges was shown to have a positive impact on students’ motivation [9] in an educational platform like PeerWise [4], which is used by more than 300 institutions worldwide. PeerWise is a system that provides course assessment content creation environment for learners, and has a significant impact on students’ learning. But as tests are generated by users, there is need again of motivating them for generating content. The experimental results acquired from more than 1000 student class, indicated the group of the students who used the PeerWise system with badge-based achievement system increased the number of answered questions by 22%, compared to badge-off group [9]. On the other hand there was no any different between the size of content generation between two groups.

Gamification is widely used in learning almost any subject. With the advances of science and technology, there is a need of motivating and encouraging students to take and succeed in technical classes. And in this case gamification again shows positive effects [7]. There are also attempts of adapting gamification in software development procedure [11] [19].
One of the early systems is the QuizPACK platform, that provides questions that check the students knowledge of language semantics \[5\]. That is given a fragment of code, student is asked to predict the output of the program. The evaluation is done based on three measures: in class quizzes, final exam grade, final course grade. Number of students enrolled in classes for 2 semesters is 39 and 42 respectively, but only 22 of them used system actively.

A study conducted by Domínguez et al. \[10\] developed a plug-in for ”Blackboard” e-learning platform, that gamifies learning of ” using Information and computer technology” university class. The system is a layered learning environment, which provides as an emotional assessment - achievements or badges. The experimental results were acquired from about 200 students for a one semester. Finding showed that the group of students who practised with a gamified plug-in increased their final scores, but on the other hand they performed poorly on writing assignments.

In the research paper authored by Kumar et al. \[17\], gamification methodology is described to motivate students learn programming in C++. Student engagement and motivation to learn programming was measured using a survey based on a questionnaire in which 207 students of post graduate programme participated. Esper et al. \[12\] tried to recreate learning experience by developing CodeSpell system \[3\], for learning JAVA language. The objective of the study is to enable students to continue learn even outside of the classes. The system designed mostly for introductory level learners and represents video game.

The most recent and successful research projects conducted by Microsoft research is Codehunt \[2\], which helps to learn programming on Java or C#. This platform used by more than 140,000 students and enthusiasts around the globe. It consist of worlds and many levels, user have to discover hidden code segment and fill it. Based on the Codehunt database the data mining is performed to identify a set of hints (automated feedback) that can be given to the player, in order to made playing more engaging with instant feedbacks \[20\]. Authors highlight as a future work the identification if gamification helps students to learn more effectively or not. There is a data collected over Pex4Fun during 6 months, and the same thing is planned to be done for CodeHunt \[21\].

Beside the gamification mechanism, the other approaches are used to design educational systems. As learning is very individual activity, machine learning techniques can provide significant information for the individual educational material creation. In that sense many intelligent tutoring sys-
tems show high positive impact on learning engineering courses, particularly programming languages [22] [16] [14]. The other approaches are learning outcome visualization, but not in a way of displaying achievements and rewards, but as an analysis of the overall learning data [23].

Even though the gamification of education seems to have a positive impact on the learning [15], up until 2014 only 14% of research work in gamification were addressed to gamification in education [8]. Moreover some of pair-reviewed works have couple of limitations, such as small sample size, limited experimental time-frame or usage of only questionnaires in evaluating the impact of system [15]. Literature review shows that the existing works in gamified learning of programming are limited by the number of students, which is at most 230. The other significant lack of the studies is that most of the successful systems such as Codehunt [2], was not tested in a real course settings, to identify the learning results of the system. Moreover, described systems have very narrowed learning objectives, such as debugging skills, guessing code structure, learning language semantics and so on.

The objective of this paper is to present the outcomes of gamified web-based platform for learning c++ programming language, in the real class environment. The experimental results are gathered in a scale of one year, during undergraduate programming course, with 600 students??
References


