

gamification

by WINANTI WINANTI

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Gamification Framework for Programming Course in Higher Education

¹ Winanti^{1,2}

Scholar of Doctor of Computer Science,
BINUS Graduate Program, Bina Nusantara
University, Jakarta, Indonesia 11480
Information System Departement, STMIK Insan
Pembangunan, Tangerang, Indonesia 15810
winanti@binus.ac.id; winanti12@ipem.ac.id

Yaya Heryadi³

Computer Science Departement, BINUS
Graduate Program – Doctor of Computer
Science, Bina Nusantara University, Jakarta,
Indonesia 11480
yayaheryadi@gmail.com

³ Bahtiar Saleh Abbas⁴

Computer Science Departement, BINUS
Graduate Program – Doctor of Computer
Science, Bina Nusantara University, Jakarta,
Indonesia 11480
bahtiars@binus.edu

¹ Agung Trisetiyarso⁵

Computer Science Departement, BINUS
Graduate Program – Doctor of Computer
Science, Bina Nusantara University, Jakarta,
Indonesia 11480
atrisetiyarso@binus.edu

Wayan Suparta⁶

Civil Engineering Department
University of Technology Yogyakarta,
Yogyakarta, Indonesia
drwaynesparta@gmail.com

Ford L. Gaol⁷

Computer Science Departement, BINUS
Graduate Program – Doctor of Computer Science,
Bina Nusantara University, Indonesia 11480
fgaol@binus.edu

Francisca Sestri Goestjahjanti⁸
STIE Insan Pembangunan, Indonesia
sestri@ipem.ac.id

Abstract – This paper presents a gamification framework for higher education, especially for programming language courses to increase user motivation, pleasure, and satisfaction so that learning objectives can be achieved. Although student and lecturer motivation, pleasure, and satisfaction tend to increase compared to conventional techniques, gamification is not a panacea. The success of its application depends on the skill of the lecturer in choosing a game mechanic to give a sense of playing to the learning process more interestingly. The technique is done by dividing the class into two parts where one class uses the conventional method and one class uses the gamification method and the results will be evaluated through the assessment results before using the gamification method and after using the gamification method. The framework in this paper adds to the existing framework activities, namely adding in the field of baseline analysis, learning materials, and tools used in gamification, where previous papers from three activities have not been discussed in detail. The results obtained turned out that using the gamification technique of student learning outcomes on average 15 to 25 better than using conventional techniques.

Keywords: gamification, education, introductory programming

I. INTRODUCTION

Gamification of education is a trend that is currently developing because using the gamification method in learning will be more interesting when compared to using conventional methods. Lots of advantages gained by the gamification method starting from the formation of a positive behavior towards the learning outcomes of programming language courses because students will be directly involved and significantly increase students' learning interest in programming language courses that play numbers, symbols, and coding on average. Also, students will also be more energetic, motivated and the success level or learning success will be better shown in the study results card

Gamification was defined as “the process of game-thinking and game mechanics to engage users and solve problems.” [1]. Gamification as “the use of game design elements in non-game contexts.” [2]. Gamification is different from game-based learning (GBL). Whilst, the former only used several game elements such as badges, point system, difficulty levels, quests, and avatars; GBL asks students playing particular games into which the predefined learning outcomes were embedded.

Gamification there are often several movements that can improve the ability or capability of students while attending programming language courses. Students will be more communicative and better language skills. Also, in gamification students are helped especially in the learning process. Students will be more imaginative because they are more likely to exchange ideas or even exchange roles in collaboration with other students in certain themes. This is very important in building the skills needed by students in terms of understanding academically.

Regardless of the functions and benefits of relieving stress, the game can be used as a tool that is used to increase the enthusiasm of the students involved in learning. Using elements like those in the game is how gamification works. The use of these elements such as points, rewards, badges, leaderboards and achievements that can lure students in interaction with each other and finally the competition to be the best and the foremost becomes a priority for students.

In the past ten years, gamification techniques have attracted educators and teachers to adopt this technique to achieve the following main objectives: a). increase student engagement [3], [4] and b). personalization of student learning process [5], [6]. The strength of gamification in education is its remarkable power to encourage and motivate students' engagement for their enjoyment. It is expected these power will help students to achieve learning outcomes Interestingly, in a study conducted it can be concluded that computer science / IT since the beginning of

learning educators have applied gamification in the learning process [7]

Despite many studies reported many evidence on successful gamification in education, study findings [7], [8] concluded gamification in education is still a challenging problem. The study has validated several key success factors for successful adoption of gamification in education namely: the course material and learning objectives, the holistic structure of the learning experience, specific elements and mechanisms to guide the student achieving learning experience.

This study aims to develop a gamification framework for teaching a programming courses in colleges to increase student's learning engagement and participation. The framework was planned to be tested to students taking a programming courses in their first year at Higher Education.

The rest of this paper is organized as follows. Part 2 will describe several related works. Part 3 will explain the research method followed by research findings and discussion in part 4. Finally, Part 5 will conclude this paper. Learning by using media gamification in some literature can improve student achievement. In the case of a

learning programming language in college if the learning is still using the traditional way to make students saturated and the atmosphere becomes boring. To create fun learning, open, creative and independent one of them by using media learning gamification.

Although the method of learning is very much but the method of gamification is preferred by students and according to some research literature on gamification able to improve student achievement and facilitate lecturers in delivering learning materials so that gamification is widely used in various sectors including in education. In gamification students can be themselves for being directly involved, learning to be fun, social skills being trained, being more sporty, improving learning and no less important learning achievement for the better.

II. RELATED WORKS

In the last decade, a plethora of reports on gamification research resulted in several proposed frameworks available in the literature. For example, it proposed a social gamification framework to improve the learning of K-6 students. [9].

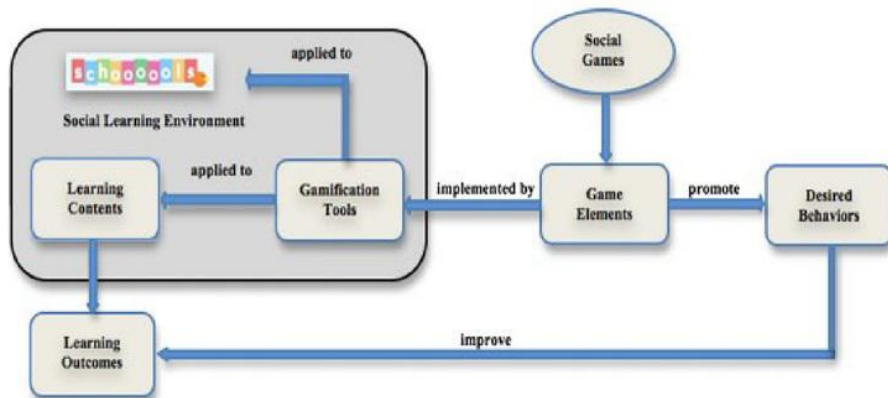


Fig.1. Gamification framework for K-6 education (Source: Simões, Redondo & Vilas, 2013) [9]

This gamification framework was later revised (see Fig. 2). Unlike the previous one, the proposed framework clearly defined the key factors that affect the change in terms of students' behaviors, immersion, emotions and mechanic (psychomotor). [10].



Fig.2. Gamification framework (Source: Tondello, Wehbe, Diamond, Busch, Marczewski & Nacke, 2016) [10]

From the implementation side, [7] showed some evidence that some design techniques contributed to the achievement of gamification objectives in education context such as a) visual status, b) social engagement, c) freedom of choice, d) freedom to fail, and f) rapid feedback. The authors also noted that, unlike entertainment game, gamification less exploit the following game design elements such as goals, personalization, unlocking content, storyline, onboarding and time restriction.

The learning system with gamification, especially basic programming learning requires precision and perseverance that emphasizes the quality of learning and lecturer motivation, attractiveness and relevance of learning, the effectiveness of learning methods, management of lectures, student responses or responses, student capture capacity or students' understanding of the contents of the material lecture.

III. GAMIFICATION FRAMEWORK DEVELOPMENT METHOD

The proposed gamification framework for the education context comprises the following activities (see Fig. 3). The main activities are : [11]

- 1) Participant identification to identify all actors involved in the teaching-learning process.
- 2) Objective identification aims to identify the main objective of gamification in education and to select the main objective as main priorities due to the predicted impact on a learning outcome and student learning satisfaction.
- 3) The implementation aims to use various game mechanics necessary to improve students' participation and engagement in delivering learning materials.
- 4) Learning evaluation to measure the effectiveness of learning in terms of learning achievement, playability, and satisfaction.

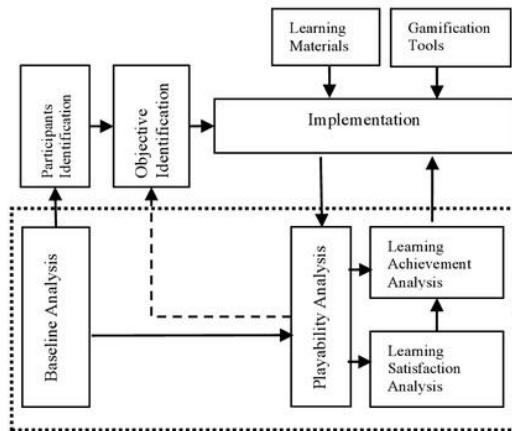


Fig. 3. Gamification Framework for Education

The proposed framework has additional components, namely: baseline analysis, learning material, and gamification tools. Baseline analysis as basic information is arranged before a program starts and as a comparison tool in estimating the impact of the program before and after the program is implemented. Learning materials to assist lecturers in the activities of the teaching and learning process are arranged systematically according to the competency standards set to achieve learning objectives. While the gamification tool can help lecturers and students in the learning process and be able to maximize motivation, feelings of enjoyment and engagement towards the learning process.

IV. STUDY RESULTS AND DISCUSSION

1) Existing Teaching and Learning Problem Analysis

From our observations in the last 2 semesters, there are several main problems in providing learning in higher education, namely :

- a) Students find it difficult to understand the basic concept of teaching materials delivered by lecturers.
- b) Students tend to be less creative in trying new approaches to solve problems given (just follow the example of lecturers given in the classroom without being creative).
- c) Low participation in class discussion.
- d) Low collaboration: students tend to work individually.
- e) Low motivation: lecturers hesitate to change learning modules.
- f) Low engagement: students tend to easily get bored with lecturer teaching styles.
- g) Low rate of student's learning achievement.

2) Participant Identification

In the teaching-learning process, the main actors are students, lecturers, and teaching assistants. Although this framework will be tested fully to a class in one-semester duration, some partial testing to the framework is being progressed.

In the initial test, several students enrolled in the class were divided into two groups. Each group has 20 students with the same proportion of females and males. It is assumed that the student profiles in each group are homogeneous. Study material in each group will be delivered as follows:

- (1) Group 1 uses a conventional technique, and (2) group 2 uses gamification techniques. Before the experiment begins, to obtain baseline data, each participant is required to fill out a self-administered questionnaire and brief interview conducted by lecturers.

1) Objective Identification

In general, the gamification main objectives in Introductory programming are to improve students learning achievement in the following topics:

- a) The basic concept of the program, program structure, and program execution
- b) Variables and data types
- c) Control structures
- d) The basic concept of algorithm and implement algorithm in the program
- e) Functions
- f) Strings
- g) File Input and Output

The gamification technique, in particular, focuses on improving student's mastery of basic syntax of the given programming language and reducing programming error in a fun way. In basic learning, programming languages are often found errors in inputting syntax, where the syntax becomes very important in programming. Wrong writing of syntax results in programs that cannot run and finally the output cannot be accounted for. Mastery of the syntax based on student programming is focused on this gamification method to obtain maximum learning outcomes.

(3) Implementation

Implementation steps can be divided into preparation, main process, closing steps. In the first steps, member of lecturers who participate in this activity was informed on objectives, research procedures, expected outcomes, a set of game mechanics, and learning achievement measurement metric. It is assumed that the learning types to be supported by the gamification for education are individual and collaborative (group) learning. Each learning objective is mapped to each of the selected game mechanics. Several gamification elements can be adopted such as game leaderboard to acknowledge the top learning achiever, social engagement or collaboration media, freedom of choices (allowing the student to choose learning material or exercise), freedom to fail (allowing a student to reread learning material or repeat solving the exercise) and rapid feedback from lecturers.

Table 1. Implementation of gamification

Game mechanic	Implementation
Completing quest	Lecturers use the concept of the quest, students can submit their work that can strengthen the norms or rules in learning
Point	Students who can answer are given certain points/values to be more challenged and motivated
Badges	Students answer correctly will be given badges so students are challenged to answer the next question
Level	Every student activity in programming language learning is given a value that can affect the level and the lecturer separates the material into different levels and tiered to see how far the level of student mastery
Challenges	Students who succeed through one stage will be given a challenge so that their confidence increases. If students experience difficulties, the lecturer does not reduce the level of difficulty but helps students solve the challenge.
Leaderboard	Lecturers display leaderboard (standings board) to show the performance of all students so that students have the spirit of competition and collaboration in learning the language learning
Rewards	Every student can answer so the Lecturer will give rewards (badges, certificates, achievements) that can be displayed on student social media or internal campus websites.
Onboarding	The lecturer explained that each material was adjusted to daily activities to provide consistent, fair and transparent assessment and feedback for students so that students were able to take responsibility for themselves.

(4) Learning Evaluation

Learning achievement the results of the evaluation of student learning processes to measure latent variables as follows: playback/enjoyment, motivation, and student satisfaction. Correlations between variables and causal relationships between variables will be analyzed using statistical methods. With statistics, it can be seen how much the results of the teaching and learning process increase each semester.

Student learning outcomes will be seen, how much the increase in the results of lectures can improve the performance of lecturers' success. Lecturers are considered to be more maximal and succeed in providing lecture material. In each semester can be evaluated how effective the lecturer provides lecture material and the ability to teach lecturers at stake.

V. CONCLUSION

Gamification techniques for learning show promising results from conventional techniques. Some qualitative measurements use a small sample with two classes of groups in which one learning class with conventional methods and one class using gamification shows learning outcomes with the gamification method in one-semester student have an average score of 15 to 25 higher than learning to use conventional methods. Interestingly, learning with gamification techniques in the classroom not only affects students but also affects the lecturers because lecturers will be more innovative in creating gamification techniques. So that proved that gamification is very effective in improving student learning outcomes and not only improves student achievement but also motivation, pleasure, and learning satisfaction are fulfilled. Thus the learning objectives can be maximized with direct and interactive involvement of students and lecturers. Finally, the gamification method can encourage students to get better, higher and satisfying grades for students and lecturers so that learning objectives can be achieved.

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