

A Multipurpose System for Gamified Experiences

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Abstract: Gamification is the application of game elements and game design techniques to non-gaming contexts, aiming to provide incentives to people overcome obstacles towards a desired engagement and behavior. Nowadays gamification is applied in different areas such as Education, Business, Human Resources, Health, and Entertainment. Generally, existent applications are tied to a specific context, making it hard to replicate ideas and to adapt to new scenarios. Here, we present a multipurpose system where users are responsible for creating their own gamified experiences. The system is based in a generalized gamification process and it allows customizations due to its platform with predefined game elements. We conducted an experiment where we confirmed the applicability of the proposed system by investigating aspects as potential to motivate users, flexibility to be applied in distinct contexts, and overall usability.

1 INTRODUCTION

Gamification is the use of game design elements in non-game contexts, aiming to engage users and increase productiveness. Gamification design adopts distinct game elements that address motivating factors, such as mastery, self-efficacy, challenge, social development and fun. The main idea is to reward users for their achievements (Deterding et al., 2011; Hanraths et al., 2016).

Gamification elements are generally applied in a way to create a gamification loop that considers the sequence: challenge, win condition, rewards, leaderboard, badges, and social network and status. When the user achieves a challenge driven by a specific condition or goal, some rewards are given accordingly to a point system. Based on the achievements' history, a leaderboard is established and badges are provided to users, which may result in changes of users' status or conditions in the related social network (Liu et al., 2011; Cechetti et al., 2017).

According to Marczewski (2015), the gamification design has to take into account the offering of elements to distinct player types, such as socialisers (who aim to make social connections), free spirits (who want to create and explore), achievers (who desire to overcome challenges), philanthropists (who want to enrich lives of others), and players (who aim to collect rewards). A special

attention is needed to the last type in the framework, the disruptors, who desire to disrupt the system, being not aligned to the system purpose.

Gamification has been used in distinct contexts. Aziz and Mushtaq (2017) investigate the use of gamification in enterprises, with the goal of enhancing productivity and motivation of employees, and also promoting engagement of employees with the new initiatives of company. Still in the organizations' context, benefits, challenges and applications of integrating gamification are outlined by Chow and Chapman (2013) and Schuldt and Friedemann (2017).

Syah (2016) describes a possible use of gamification in smart buildings to make employees contribute to energy saving using mobile applications, for instance by turning off unnecessary lamps. Other works regarding smart environments were proposed by Liu et al. (2011) and Papaioannou et al. (2017). Kazhamiakin et al. (2016) present a service-based gamification framework which can be used to develop games on top of existing services and systems within a smart city, in order to facilitate and foster positive voluntary changes of citizens.

Hanraths et al. (2016) developed a web-based platform for gamification of seminars and classes. They use game elements, such as avatars, levels, rankings, experience points, and achievements, in order to offer a versatile learning environment to engage students. Other works also consider

gamification in the education context, always seeking to provide a fun and challenging environment for students, for instance Morey et al. (2016), Schäfer (2017), Azmi et al. (2016), Heryadi and Muli Amin (2016).

In the area of Health, Alimanova et al. (2017) describe the use of gamification with virtual reality technology for hand rehabilitation, in a way to make the rehabilitation process more effective and motivating for patients. Aiming the promotion of healthy activities to treat obesity, Wen (2017) integrates gamification and social network features in a mobile application. Other work regarding obesity, by Adaji and Vassileva (2017), uses gamification to influence consumers to purchase healthier foods in e-commerce.

García et al. (2017) argue that the application of gamification in Software Engineering is promising. Software projects can be seen as a set of challenges that need to be fulfilled, for which some skills and collective effort are required. They propose a framework for gamification in software engineering development. The framework is composed of an ontology, a methodology guiding the process, and a support gamification engine. The gamification engine receives all the interactions of developers with their working tools; it then evaluates them to determine if they deserve a reward, according to the set of gamification rules specified by the designer of the gamified environment. The gamification engine stores a log of all the actions completed by each person, the gamification rules, and the rewards corresponding to each action. The framework provides a complete solution for applying gamification but it is specific to Software Engineering development.

Herzig et al. (2012) present an architecture for gamification within enterprise systems. They reuse prior research on system architectures, e.g., service-oriented and event-driven architectures. They implemented the proposed architecture in a prototype to demonstrate its feasibility. The architecture is a useful model but it is limited to enterprise systems domain.

Böckle et al. (2017) have conducted a systematic literature review that identifies main issues and challenges in the literature on adaptive gamification. The performed analysis provides some contributions: a conceptual matrix of adaptive gamification design that identifies major dimensions of current approaches and classifies them accordingly; a thematic overview where the identified literature and their related studies are assigned to the designated areas; identification of

research challenges; and a proposal of a research agenda. The analysis is comprehensive and presents many related issues; however, adaptive gamification is not focus of our investigation.

Most applications of gamification are commonly systems specialized in a given goal or area. Therefore, those systems are hardly replicable outside them. Kazhamiakin et al. (2016) deal with the possibility of replication by proposing a way to design gamification in smart cities. However there is a lack of a multipurpose system that can be applied to many contexts.

In this paper, we present 4DWin, a system that allows customization of distinct gamified experiences. The system has a set of predefined game elements, giving the users the ability to create their own gamified experiences from scratch in an easy manner. This approach is especially interesting to informal groups (Counts, 2007; Schuler et al., 2014; Ferreira et al., 2017), which come together online to perform work or social activities, fostering engagement, commitment and participation through gamification. Here, we also validate the proposed system by applying it in different contexts in an experiment to analyze its usability and flexibility.

Section 2 describes the multipurpose system for designing gamified experiences. Section 3 describes how we evaluated the proposed system. Section 4 presents conclusions and future work.

2 TOWARDS A MULTIPURPOSE SYSTEM TO SUPPORT GAMIFICATION

In this section we explain the characteristics of a generalized gamification that, together with a process to customize gamified experiences, are the foundation for the development of the 4DWin system to support gamification in contexts defined by users.

2.1 Generalized Gamification

The concept of generalized gamification is a way to create gamified experiences that is not particularly tied to any particular context. It gives the users the ability to create the content of their own specific experience by using a predefined system. Below we characterize the differences between a generalized gamification system and the usual applications of gamification, which are going to be referred to as specialized. We focus on the following topics: roles,

context, feedback, content, game elements, setup, and size.

In a specialized gamification, there are two main roles: designers and users. Designers define and manage the gamified experience, whereas users in fact experience the system. In a generalized gamification, there is no formal separation between these roles: regular users are prone to act as designers by contributing to the gamification configuration in distinct levels according to their own involvement with the gamified experience. When explaining specialized generalized gamification, we differentiate designers and users. When describing generalized gamification, we use only the term users due to their empowerment in the gamified experience.

Context represents the environment in which the gamified experience is going to be applied. A specialized gamified system is built from the ground up in a way the creator thinks it best suits the specific goals being addressed. This may be made by choosing a set of game elements and techniques that match the intrinsic motivations of the users. A generalized gamification system has such elements and techniques almost totally predefined, leaving the users with the task of customization necessary for the goals to be achieved.

Feedback means how the system interacts with its users. A specialized system is prone to be automatic in a way users receive instant feedback for their actions. On the other hand, as generalized gamification is not specifically attached to any context, it is hard to define automatic hooks between users' actions and the tasks defined.

The content of a gamified experience built on top a generalized gamification platform is defined by its own users. On a specialized gamified system, the designers behind it usually come up with the content themselves. Even though it is theoretically possible to allow the contribution of users with content design in a specialized system, this feature is not usually used, especially because these systems have content policies that are hard to be adopted by most users.

The game elements present on a specialized gamified application are basically chosen and implemented by the same agents that define the gamified experience's content. In a gamified experience that uses a generalized tool, the game elements are already defined, leaving the user responsible for the content creation.

The users of a generalized gamified system have a low cost way of creating their gamified experiences, if they have an available infrastructure

to build upon. The issue here is how the infrastructure is flexible and how difficult is to create the gamified experience. An equivalent specialized system, created from the scratch, would demand development and so be more expensive.

Specialized gamification can be designed and implemented to scale up to a huge user base. The dynamic content generation present in generalized systems makes them harder to scale up. In addition to possible resource limitations, generalized gamification are meant for small groups since there is a need for trust between group members in order to assure valuable content creation.

2.2 Steps of a Gamified Experience

We propose a process, shown in Figure 1, to allow the implementation of generalized gamified experiences. The simplicity of the process is derived by the ideal of having a system that is replicable in many scenarios.

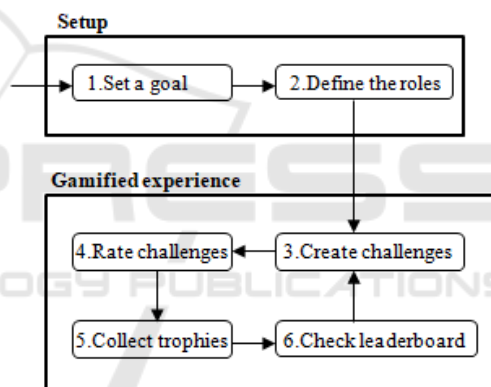


Figure 1: A process to create gamified experiences.

In the first step of the process, the creator of the group is responsible for choosing the group's name and writing down its goal description. The way the group is defined should be an agreement among its users. This simple step sets the ground for the next steps. An example of group can be "Fit in", whose objective is collaboratively help each other to have a healthier life.

In step 2, the group's creator customizes the permissions each user has on the group's content creation. He defines who is capable of performing the tasks proposed in the "gamified experience" part of the diagram. The roles are related to the creation of challenges, the rating of challenges, and the assignment of trophies. Basically there are two options to assign roles: "all the users" or "only the designers". The essence of a generalized gamification is aligned to allow all users to

contribute in the same way. Selecting “only the designers” means that only some users with the role of ‘designer’ are in charge of the gamification configuration, being a way to restrict the number of contributors in large groups. The best configuration for each group depends on the group’s setup. For instance, the “Fit In” group can be defined as a completely collaborative group, where every user has the full access to content creation, being able to create challenges, rating and assigning trophies on free will.

Challenges, described in step 3, are the core game element of the system mechanics. They represent tasks designed to help the user to do his part on the group’s goal. The goal of a challenge creation is to define it in a way it motivates the users (or a set of target users) to perform the underlying task. For instance, in the “Fit in” group a challenge could be “No chocolate: Resisting chocolate for two months”.

Rating, in step 4, represents the action of giving an evaluation to a challenge. The exact criteria for the rating value given to a challenge should be an agreement between the users, but the recommended design is to rate the challenges based on a compromise between its perceived difficulty and its importance for the group’s goal. Here, the average rating of a challenge is used to define the final score value associated with it.

Trophies are the representation of achievement inside the system’s gamified experience. They are tokens intended to be collected by the group’s players. Once a user performs the task proposed on a challenge, he is able to “win” the respective trophy, as expected in step 5, adding the correspondent score to his own total.

The leaderboard, mentioned in step 6, is basically an area of the system that socializes the users’ data. It is intended to make public to the group the users’ information, in especial, their total score and the trophies they have won. This part of the system was thought to create an environment of competition inside the group. The gamified experience continues to step 3 in a cyclic way, allways aligned to group goal.

2.3 The 4DWin System

The 4DWin system is a web application that implements the proposed process, in order to provide the infrastructure to users create collaborative gamified experiences. The application has the following features: create a group; edit a group; leave a group; add members; change

members’ privileges; remove members; add a challenge; view a challenge; edit a challenge; rate a challenge; remove a challenge; add a trophy (win a challenge); remove a trophy; check challenges tab; check trophies tab; and check leaderboard tab.

Two interfaces of 4DWin are shown in Figures 2 and 3. In Figure 2, on the left, there is the list of groups to which the user belongs. There are three tabs: challenges, trophies and leaderboard. The challenge tab is in evidence with the challenges of group “Top Coders” (a group to enhance programming abilities). Each challenge has a name, an icon and a number (points to conquer if the user “wins” the challenge).

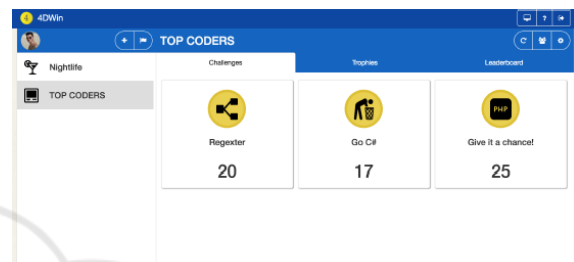


Figure 2: Challenges tab.

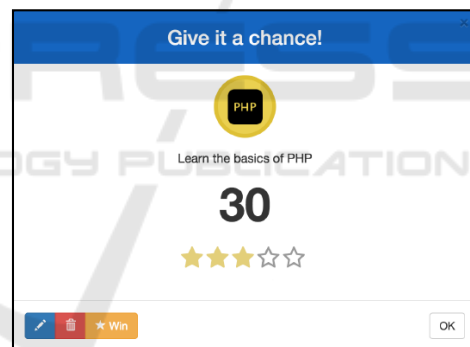


Figure 3: Challenge view.

Figure 3 shows a specific challenge called “Give it a chance!”, whose goal is to “Learn the basics of PHP”. The stars represent the assessment of the challenge by the user. If the user accomplishes such challenge, he clicks on “Win” and receives a trophy associated to it. All trophies are accessed in the respective task. The points associated to the challenge are added in the user score, which can be accessed in the leaderboard tab in Figure 2.

4DWin uses the client-server architecture. The server side was written in JavaScript running on a Node.js environment. It was developed as a RESTful API. In this single page application implementation, the server is only responsible for exchanging raw JSON data with the client, leaving all the view

rendering for the client side code. The server also communicates with external services, such as Facebook for user login, and Outlook for sending user email notifications of new content.

The client side was developed as a single page web application to be run on modern browsers. This decision was made to maximize user coverage: since most current platforms have access to a web browser, the application can virtually be accessed by any device. The single page application pattern was chosen because it minimizes the need of page reloading, therefore simulating the behavior of a native application. Besides common technologies such as HTML, CSS and JavaScript, the React.js library is the main constituent backing up the whole client side.

3 EVALUATION

We conducted an experiment to evaluate 4DWin system in terms of motivation, flexibility and usability. With respect to motivation, we aim to identify the motivating features that the system offers to the chosen gamified experience. Flexibility refers to the possibility to use the system in different contexts. Usability is associated to the easiness for users to perform tasks in the system.

3.1 Design of Experiment

Fourteen voluntary participants took part in the experiment. They were undergraduate students in a computing engineering course. They had to perform a set of tasks and later to respond an evaluation. Firstly, participants should execute some offline tasks: choose a group (including context and goal) to create a gamified experience; and propose 5 to 10 challenges that are aligned with the chosen gamification goal. The challenges should be comprehensive enough to achieve the goal. Participants should then access the system, log in with Facebook account, and read the “Getting Started” tutorial. Finally, participants should perform core tasks in the system: create a new group based on context and goal that they defined previously; define the group settings to best match the group’s context by allowing all users or a set of users to contribute to gamification configuration; add each challenge they defined previously; rate each challenge they created based on their difficulty; win (add it to their trophies) one of the available challenges; check up their trophies; and check up the leaderboard.

Participants classified the created group in a given category, which reveals the contexts used in the gamified experiences. As result we have: 1 group in “entertainment” context, 1 group in “hobby and leisure” context, 2 groups in “business” context, 2 groups in “health and fitness” context, 2 groups in “games” context, 6 groups in “school and education” context, 0 group in “travel and places” context. Participants evaluated sentences related to motivation (M1 to M7), flexibility (F1 to F3), and usability (U1 to U4). They used a five-point Likert scale: 1 (strongly disagree), 2 (disagree), 3 (neutral), 4 (agree), and 5 (strongly agree). Sentences are shown in Table 1 and Table 2, with the related results.

3.2 Results

The results of the conducted evaluation are shown in Table 1 (regarding motivation) and Table 2 (regarding flexibility and usability).

Table 1: System evaluation regarding motivation.

Id	Sentence	Mean	Std
M1	It is motivating to create new groups	4.1	1.0
M2	It is motivating to add new challenges	4.4	0.6
M3	It is motivating to rate the challenges	3.8	1.2
M4	It is motivating to see my trophies	4.6	0.6
M5	It is motivating to see the leaderboard	4.7	0.6
M6	It is motivating to have challenges added by other members	4.3	0.9
M7	It is motivating to see the trophies won by other members	4.1	0.9

Regarding motivation, we observed that the main stimulating features for the contexts used in the experiment were trophies (M4) and leaderboard (M5). These results were expected since in a gamified experience, users are moved to conquer points and see their results for personal pleasure (by acquiring trophies) or for comparison with other users (by checking status in leaderboard). Other important and well evaluated aspects are the possibility to create challenges (M2) and to have challenges created by others (M6). These results demonstrate the essential aspect of the generalized

gamification, where users are up to develop content in a self-organizing structure.

The creation of groups (M1) was well evaluated, but it is important to mention that it is a single step moved by the need in a given context. A not so well evaluated aspect was to see trophies of others (M7), which is interesting because users are interested in their ranking but not in the others' achievements. The lowest evaluation was assigned to rating challenges (M3), which needs further investigation: in the current system, all users should evaluate challenges before "Win" them, but maybe we could consider sufficient the rating of the challenge's creator.

Table 2: System evaluation regarding flexibility and usability.

Id	Sentence	Mean	Std
F1	The system is adequate to the created group	4.2	0.9
F2	The system can increase members' engagement in the created group	4.4	0.6
F3	The system can be applied to other groups	4.7	0.6
U1	It is possible to execute all tasks that the application is supposed to support	4.2	1.1
U2	The proposed tasks can be performed in a timely manner	4.6	0.6
U3	I feel satisfied with the application	4.3	0.6
U4	The application is easy to use and understand	4.3	0.7

The system was considered flexible in supporting distinct contexts in the experiment, since it was adequate to groups (F1) and it has a potential in increasing engagement (F2). Moreover, participants believe that the system can be employed to other groups (F3). Regarding usability, the system was considered effective since it allowed the execution of desired tasks (U1), efficient as tasks are performed in a timely manner (U2), satisfactory (U3), and easy to use and understand (U4). However, participants reported some obstacles related to usability, especially due to screen sizes where the application was not fully responsive.

4 CONCLUSIONS

Gamification is a technique that is based on the games effectiveness on producing engagement. It aims to increase group productivity in a given context. This technique is based on the proposal of motivational incentives to tasks that are aligned with the group's goal. In successful applications of gamification, incentives are generated from a careful choice of game elements and game design techniques, taking into consideration the peculiarities of each context. So applications of gamification are built on top of systems usually tied to specific scenarios.

We proposed a system that provides a set of tools for creating gamified experiences in diverse contexts. We created a system that is context agnostic. It has predefined game elements that together with a specified customization process enable groups to define their own gamified experiences. The goal is to help make gamification a technique that is easy to apply by anyone. We conducted an experiment, which confirmed positive aspects of the system, including its motivating potential, its flexibility to cope with distinct contexts, and its usability.

It is interesting to notice that the system can be improved and expanded in many ways. Interesting modifications, specifically related to usability, were proposed by participants in the experiment that deserve further inspection, for instance the way data are displayed in leaderboard. The addition of new game elements available for the creation of groups is likely to represent an effective approach to increase the system's overall usage. The field of generalized gamification has still much to develop, but 4DWin surely represents an innovative step towards the spreading of usable gamification.

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