ON THE DEVELOPMENT OF GAMIFIED ACTIVITIES IN THE CLASSROOM

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Abstract. *This paper presents a case study of developing gamified activities in the classroom, supported by simple web-based software tools. The followed gamification approach consists of the instantiation of a generic framework for the design and implementation of gamified activities in a given context, which aims to establish the appropriate player types and gamification mechanics for that context. Such instantiation of the framework is preliminary evaluated in a user study with Higher Education students, validating the approach and bringing ideas about how to develop effective gamified e-learning activities.*

Keywords: Gamification, Education, E-learning, Evaluation

1. INTRODUCTION

Gamification entails the application of game-design elements (a.k.a. mechanics) –such as challenges, badges, and leader boards– in non-game contexts with the intention of modifying behaviors and engaging people (Deterding et al. 2011), e.g., offering *rewards* in the form of product price discounts to customers of an e-commerce site if they suggest the site to certain number of their contacts.

Since people have their own personalities, interests and tastes, certain game elements that motivate a person may be irrelevant or non-engaging for others. Thus, it is needed to distinguish among different types of players (Bartle, 1996; Marczewski, 2013), according to how people interact and react when playing a game, and to the personal motivations that drive to take certain actions in a particular domain.

Previous work has shown the success of gamification approaches in different domains, such as education (Muntean 2011; Nahl & James, 2012; Iosup & Epema, 2014), health (Mulas et al., 2012), and government (Liyakasa, 2012), to name a few. To the best of our knowledge, however, rigorous validations of the effectiveness of player types and gamification mechanics have not been done yet. Moreover, some player types and associated mechanics may not be appropriate due to the particular actions that have to be performed in the domain of interest, which often is something that is not taken into account (Butler, 2014).

In this paper we start addressing the above issues, focusing on the educational domain. We first propose a generic, simple framework for the design and implementation of gamified activities in a given context, which aims to establish the appropriate player types and gamification mechanics the target context. Then, as a proof of concept, we instantiate the framework for an assignment solving lectures context, with the support of simple web-based software tools. Finally, we preliminary evaluate the above instantiation through a user study in the classroom with Higher Education

students. The results and conclusions achieved in the study not only validate the approach, but also bring ideas about how to develop effective gamified e-learning activities.

The remainder of the paper is structured as follows. In Section 2, we present the proposed generic gamification framework, and in Section 3, we describe the instantiation of the framework for the learning context of interest. Next, in Section 4 we briefly describe the user study conducted to evaluate the approach, reporting some of the achieved results. Finally, in Section, we end depicting some conclusions and future work.

2. A FRAMEWORK FOR THE IMPLEMENTATION OF GAMIFIED ACTIVITIES

Figure 1 shows our understanding of the main stages that have to be followed for developing gamified activities in a particular domain. We explain it next.

Gamification aims to increase people's motivation in non-game contexts for the purpose of changing behaviors and causing engagement in certain (usually tedious, boring, or undesirable) tasks, by means of gaming elements. Although each person has personal motivations that may be different to others', the consideration of "player types" has allowed enclosing general needs, desires and concerns. Hence, for example, based on the physiology Self-Determination Theory (Ryan & Deci, 2000) for human motivation, there are players who are motivated by their *social relatedness* and like gaming mechanics involving cooperation or team work, players who are motivated by their *mastery/competence* and like gaming mechanics based on challenges and competition, and players who are motivated by their *autonomy* and like gaming mechanics allowing the exploration, acquisition or creation of resources, hidden contents, etc.

According to the different human motivations, various models of player types have been proposed (Bartle, 1996; Marczewski, 2013). The selection or adaptation of one such models, or the proposal of new ones, represents the first stage of our framework. At this stage, we not only consider the definition and design of player types, but also the method to establish or infer the most appropriate player type for a particular person.

In existing models, for each personality type, a number of "gaming mechanics" are usually proposed. In general, these mechanics are intuitively assigned, without previous empirical evidences. For instance, in the Bartle's model (Bartle, 1996), *achievers*, who tend to concentrate on attaining observable measures of success, and need continuous feedback on how they are performing, may find mechanics such as leader boards useful, while *socializers*, who tend to concentrate more on interacting with other players than on game performance, may appreciate mechanics such as teams or group challenges. At this stage, one has to keep in mind that not all the mechanics defined for a player type may be relevant, or even feasible, for the context of interest. Moreover, some of such mechanics may better correspond to a distinct player type. In the proposed framework, further evaluation would allow redefining both player types and associated mechanics.

Once selected, the gamification mechanics have to be implemented for the application context, which belongs to certain domain. This represents the third stage of our framework. Specifically, we propose mechanics have to be implemented in the form of domain-dependent "actions." For example, in an e-commerce site, *achievers* may be motivated by the publication of *leader boards* with the customers whose product reviews has been the most appreciated by others in the last month, and the achievement

of *rewards* in the form of price discounts depending on their ranking positions in such boards. In this case, "writing a product review" and "rating others' product reviews." As before, empirical evaluation would allow redefining the action-based mechanic implementations.

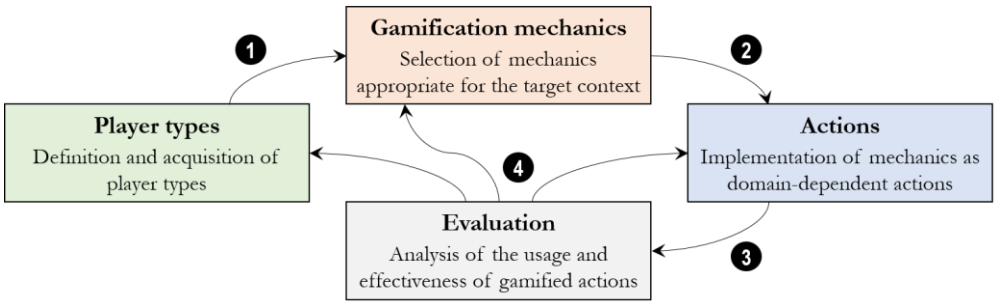

Figure 1.Schematic view of the proposed gamification framework.

3. INSTANTIATION OF THE FRAMEWORK IN A LEARNING CONTEXT

As a proof of concept, we instantiated the proposed gamification framework for the educational domain, and preliminary evaluated it through a user study with students attending assignment solving lectures of a Higher Education subject. We believe, nonetheless, that our instantiation can be performed or adapted in other learning contexts.

Moreover, in this first instantiation, we support the involved processes by means of a simple e-learning environment composed of web forms. Specifically, we made use of the Google Forms tool[1] to build and publish online forms where the students and the teacher recorded the actions performed during the activity. We also created a form aimed to establish the students' player types, and a form to gather the students' opinion about the activity. Due to the easy use of such tool, we also believe that teachers, not necessarily of Computer Science studies, would be able to follow our approach in their subjects.

In the next subsections, we detail how we addressed the stages of the framework for the above mentioned context.

3.1. Defining the player types and gamification mechanics

Among the player type models existing in the gamification literature, we decided to follow that proposed by Marczewski (2013), which is based on Bartle's taxonomy of player types (Bartle, 1996) and the psychology of motivation. To define the player types, Marczewski distinguishes between extrinsic and intrinsic motivations. An extrinsic motivation comes from an action aimed to achieve a result derived from completing a task, e.g., studying to pass an exam, but not for the fact of finding such task interesting or important. An intrinsic motivation, in contrast, comes from a task done for the satisfaction of doing it. In our educational context, we believe that intrinsic motivations are those which have to be pursued, since students have to see their learning as the benefit of doing a subject activities, regardless explicit results, such a passing the subject or obtaining high grades.

Thus, the player types we consider in our framework instantiation are the intrinsic player types of Marczewski's model, namely: *achievers*, who are motivated by mastery and rewards, *explorers* or *free spirits*, who are motivated by autonomy and self-

[1] Google Forms, https://www.google.com/forms

expression, *socializers*, who are motivated by social relatedness and status, and *philanthropists*, who are motivated by altruism and care-taking. For each of these player types, particular gamification mechanics have been proposed (Marczewski, 2013). Hence, for example, mechanics that may suit an achiever's motivations are the accomplishment of certain challenges and levels, and the gain of points and badges. Because of lack of space, we do not describe all available mechanics. In Section 3.3 we just list the mechanics we chose for the framework instantiation, and explain how we implemented them.

3.2. Acquiring the students' player types

Table 1 shows the 16-item questionnaire proposed to infer the students' player types. Its questions are adaptations of those in Marczewski's questionnaire (Marczewski, 2013). Marczewski's questions were oriented to the games and video-games domains. Ours, in contrast, aim to be generic, domain-independent, and matching with the payer types in different ways. Specifically, we defined 4 questions aimed to estimate the closeness of a target person to each player type. Questions 1-4 were intended to infer the philanthropist closeness, 5-8, the achiever closeness, 9-12, the socializer closeness, and 13-16, the free spirit closeness. The allowed answers for each question were "I strongly disagree", "I disagree", "I neither agree nor disagree", "I agree", and "I strongly disagree."

	Questionnaire item	**Player type**
1	I usually help people (even if they are unknown to me).	***Philanthropist***
2	I spend part of my time helping people (even if they are unknown to me). For example, I collaborate with a humanitarian aid organization, contribute on internet forums, etc.	
3	I uninterestedly provide information to people (even if they are unknown to me). For example, I write posts in blogs, lend my class notes, etc.	
4	I do not like sharing my knowledge with others.	
5	I tend to attend a course for the sake of learning, not for getting a degree or certificate.	***Achiever***
6	I tend to repeat tasks until I do them perfectly.	
7	For me, the way to achieve something is as important as the goal itself.	
8	I tend to give up if something gets too difficult or hard.	
9	I participate in social networks (Facebook, Twitter, etc.) regularly.	***Socializer***
10	I prefer to relate/interact with people (e.g., in social networks) rather than listen to them, follow or watch what content they upload, etc.	
11	For me, the number of friends/followers is one of the most important measure of success.	
12	I like sharing personal experiences with my friends/followers, e.g., in social networks, blogs, etc.	
13	Self-expression –i.e., expressing own originality and autonomy, and showing myself as a person who has a unique personality and is distinct from those around me– is very important to me.	***Free spirit***
14	I enjoy more a game/videogame/book with a guided story and a fixed route, than other that lets me explore and have a more open story.	
15	I do not like being confined by too many rules, e.g. in a game or videogame.	
16	I often try to find hidden messages, unexpected issues, or uncommon ideas in books, movies, videogames, etc.	

Table 1. Proposed personality questionnaire to infer player types.

Each possible answer for each question was set a weight. The greater the weight of the answer, the higher its influence for assigning the corresponding player type to the subject. Specifically, the closeness score $clo(s,p) \in [0,1]$ of subject s to player type p is computed as the average value of the weights $w(p_q)$ set to the answers of the four

questions p_q, with $q \in [1,4]$, corresponding to p, i.e.:

$$clo(s,p) = \frac{\sum_{q=1}^{4} w(p_q)}{4}$$

For questions 1-3, 5-7, 9-10, 12-13 and 15-16, the "I strongly disagree" (analogously "I strongly agree") answer means having a null (maximum) closeness with the corresponding player type, i.e., it had $w = 0$ ($w = 1$). The "I disagree" ("I agree") answer had $w = 0.25$ ($w = 0.75$), and the "I neither agree nor disagree" answer had $w = 0.5$. For questions 4, 8, 11 and 14, the weight order of the possible answers was the inverse, i.e., $w = 1$ for strongly disagreement, $w = 0$ for strongly agreement, and so on.

3.3. Implementing the gamification mechanics

In the classroom and during several lectures (sessions), the students were requested to solve a number of assignments related to topics of a subject, working in different ways (alone, in pairs, or in teams) and performing various actions, which were related to certain gamification mechanics and player types. All the actions were supported and recorded by a web form-based system, accessible via web through the students' mobile devices and laptops. As shown in Table 1, a total of 21 actions were considered, which were specific implementations of existing gamification mechanics for our particular learning scenario. At the beginning of each session, the students were presented with the description of the different activities, and they were allowed to freely choose and perform (record) any of them during the activity. The students had publicly available a summary of all their achievements and awards after each session.

Student action	**Mechanic**	**Player type**
P1 Receiving a "gentleman badge" from a student I helped on solving an assignment	*Meaning / Purpose*	***Philanthropist*** (working in pairs)
P2 Helping a student to solve an assignment	*Care taking*	
P3 Presenting an assignment solution on the blackboard	*Sharing knowledge*	
P4 Asking (the teacher/system) for an assignment solution	*Access*	
P5 Interchanging a "ring" with other student	*Collecting & Trading*	
P6 Giving one of my rings to a student	*Gifting*	
A1 Choosing to work alone for solving the assignments	*Challenge*	***Achiever*** (working individually)
A2 Receiving a "victory badge" for being the first student who solved certain assignment		
A3 Receiving a "quest badge" for solving certain number of assignments	*Quest*	
A4 Receiving a "level-X expertise badge" for solving certain number of assignments with difficulty level X	*Level / Progression*	
A5 Receiving a "mastery certificate" for obtaining certain number of victory, quest and/or expertise badges	*Certificate*	
S1 Choosing to work in a team for solving the assignments	*Team / Guild*	***Socializer*** (working in teams)
S2 Receiving points for the competition ranking by solving assignments	*Competition*	
S3 Receiving a "colleague badge" (from a member of my team) for being very participative and cooperative	*Social status*	
S4 Creating a "twinning link" with a student I enjoyed working with	*Social networking*	
S5 Giving a "gentleman badge" to a student to whom I asked for help on solving an assignment	*Social discovery*	
F1 Choosing to work alone for solving the assignments	*Exploration*	***Free spirit*** (working individually)
F2 Receiving an "explorer badge" for asking (the teacher/system) and solving hidden assignments of high difficulty		
F3 Receiving an "adventurer badge" for asking (the teacher/system) and solving assignments out of the study topics	*Unlockable / Rare Content*	
F4 Receiving a "customizer badge" for proposing and solving adaptations or modifications of an assignment	*Customization*	

Student action	Mechanic	Player type
P1 Receiving a "gentleman badge" from a student I helped on solving an assignment	*Meaning / Purpose*	***Philanthropist*** (working in pairs)
P2 Helping a student to solve an assignment	*Care taking*	
P3 Presenting an assignment solution on the blackboard	*Sharing knowledge*	
P4 Asking (the teacher/system) for an assignment solution	*Access*	
P5 Interchanging a "ring" with other student	*Collecting & Trading*	
F5 Receiving a "creator badge" for proposing and solving new assignments	*Creativity*	

Table 2. Considered student actions, gamification mechanics, and assumed player types.

4. EVALUATION OF THE IMPLEMENTED LEARNING GAMIFIED FRAMEWORK

To validate the proposed framework and evaluate its implementation for the considered learning context, we conducted a user study in a subject belonging to a 1st-year Computer Science course, which consists of an introduction to programming and Abstract Data Types. It was done in the classroom and took five 1-hour lectures, in which students were presented with a large number of assignments of different (marked) difficulty degrees, and were asked to freely choose and solve any of them. They were also requested to freely perform and record online available actions (Table 2). A week before the starting of the study, they filled the questionnaire (Table 1) with which their assumed player types were established. In the subsequent subsections we summarize the evaluation done.

4.1. Assessing the inference of player types

Once a student s filled on-line the player type questionnaire, her closeness score $clo(s,p)$ for each player type p was computed as described in Section 3.1. The player type with the highest score was considered as the student's primary player type.

A total of 32 students participated in the study, filling the player type questionnaire and recording some actions into the online system during the gamified activity. More specifically, 21 students recorded actions in the all the sessions; they were 6 philanthropists, 6 achievers, 7 socializers, and 2 free spirits, according to their inferred primary player type. Since only two students were associated to *free spirits*, the results for this player type may not be significant, so we cannot obtain reliable conclusions from their actions.

Assigning [1,5] values to the possible answers to the questionnaire items in terms of increasing closeness of the questions to their player types (i.e., 1 to "I strongly disagree", 2 to "I disagree", 3 to "I neither agree nor disagree", 4 to "I agree", and 5 to "I strongly agree"), we computed the mean and standard deviation values of the answers received for each student and inferred player type. For lack of space, we do not report the obtained values. We just outline some main conclusions based on such values. Specifically, we observed that questions 8 (*achiever*) and 15 (*free spirit*) did not correspond with the player types to which they were intended, because of their low mean values with respect to other types. We also observed that questions 7 (*achiever*), 10 (*socializer*) and 13 (*free spirit*) did not clearly correspond with their player types due to high standard deviation values.

4.2. Assessing the relationships between player types and gamification mechanics

At the beginning of each session, the students were presented with all the assignments statements and difficulty degrees, as well as with short introductions of the player roles, and descriptions of the gamified actions. At any time, they were free to choose which role (player type) to play and which action (gamification mechanic) to perform. The only requirement was that all performed actions had to be recorded in the online system. Some of these actions were recorded by the students themselves through their mobile devices and laptops, and others were recorded by the teacher from the students' requests, such as recording the achieved awards. In a complete implementation of the system, all the actions may be recorded from the students, some of them in an automatic, implicit way. Again, we do not show all the details and analysis, but summarize the main results.

Achievers and *socializers* recorded all the mechanics that were assumed for them. *Philanthropists* recorded all their mechanics except *Collecting & Trading* (P5), so its correspondence is doubtful. *Free spirits* only recorded one of their mechanics, *Exploration* (F1, F2). Members of all player types did not show interest in mechanics associated to free spirits. Hence, without taken the free spirits into account, *Level/Progression* (A4) for achievers, *Social Status* (S3), *Social Networking* (S4) and *Competition* (S2) for socializers, and *Meaning/Purpose* (P1) and *Access* (P4) for philanthropists, were the most representative and discriminative mechanics. *Challenge* (A1, A2), *Quest* (A3) and *Certificate* (A5), assumed for achievers, were recorded by all player types, showing to be the most versatile mechanics.

4.3. Evaluating the effectiveness of the gamification mechanics

After completing the sessions, the students were asked to freely fill an online questionnaire aimed to gather their opinion about the proposed activity. 22 students responded; they were asked to mark their favorite mechanics. Based on their preferences, we identified 5 achievers, 3 free spirits, 7 socializers, and 7 philanthropists.

Then, to find out which were the most effective mechanics, we performed an analytical comparison between the numbers of students who performed each action, grouped by *inferred* player type, and the numbers of students who marked each action in the questionnaire, grouped by *preferred* player type. We obtained the following conclusions.

The students' preferences for mechanics associated to *achievers* and *socializers* matched with the most performed mechanics inferred for such player types. A similar match also applied to *philanthropists*' mechanics, but in this case, some of such mechanics, *Care taking* (P2) and *Access* (P4), did not were effective. We believe, nonetheless, they can be successful in a complete e-learning system. The *free spirit* player type was not effective at all. We would be in favour of not considering it the proposed e-learning context. *Level/Progression* (A4) and *Competition* (S2) were not very effective, but could be successful in a complete system used for a long period of time. We notice that a large percentage of the students indicated their preference for such mechanics. Despite the students showed preferences for *Unlockable/Rare Content* (F3), they did not perform this mechanic. This may be due to the fact that the students had already access to the assignment solutions (P4), so we see here a redundancy that should be avoided in the future. Finally, *Collecting & Trading* (P5) and *Gifting* (P6) were not positively appreciated by the students. In our opinion, these mechanics could

be effective in a context more oriented to games and fun, but not in an e-learning environment where the main goal is (and has to be) the students' learning process and goals.

4.4. Analyzing the students' opinion about the gamified learning activity

To complement the effectiveness analysis of the studied player types and gamification mechanics, after finishing the gamified assignment solving lectures, we asked the students to fill an online questionnaire to known about their opinions about the activity. Specifically, we obtained average opinions about the following aspects of the activity: its general acceptance/like, the students' enjoy, the effectiveness for the students' learning process and goals, its preference over conventional lectures, and the students' engagement.

In general, the level of appreciation for the activity was positive (average values greater than 2.5 in a [1,5] scale) in terms of *acceptance* and *enjoy*. The activity was considered effective for the students' *learning process and goals*, and preferred to *conventional lectures*. The success of the *engagement* aspect was not so clear, except for the philanthropists, who expressed they really enjoyed the activity and declared they were in favour of continuing it. The explanation for this may be the fact that philanthropists worked in pairs, instead of individually, as achievers and free spirits did. The students who preferred the socializer player type were the ones than less accept, enjoy, and found effective the gamified activity. We believe this may be due to the fact that the teams were too big (with 4-6 people), which could make a student feeling she did not contribute enough.

Students were asked about how easy was to understand and take into practice the corresponding mechanics, their level of stress, and the achieved level of fun. In general, despite the fact that actions had to be recorded explicitly, the students found the activity and its mechanics easy to understand and perform. The students who preferred the *achiever* player type were the ones that found the activity easier to understand, but suffered a higher level of stress. They worked alone and were motivated by the achievement of challenges, certificates and quests. The students who preferred the *free spirit* player type found less easy the activity and suffered certain level of stress. The difficulty of modifying and creating assignments, and exploring new lecture contents, may be the reason. Finally, the students who preferred the *socializer* and *philanthropist* player types did not find the activity difficult, although they had to work in pairs or groups. This issue seems to be the reason for the lowest levels of stress.

5. CONCLUSIONS AND FUTURE WORK

In this paper we have proposed a generic framework for the implementation of gamified activities in a given domain, and have instantiated and empirically validated it in the educational domain, in the form gamified assignment solving lectures. The conducted user study has also allowed bringing ideas about how to develop effective gamified e-learning activities in the classroom.

We shall use the experience and results achieved in the study to complete the proposed framework with components related to the subjects of interest, e.g., in a educational context, both the learning materials and gamification strategies may be personalized to each student, based on issues such as their learning styles, learning difficulties, achievements and goals, and personality traits such as extraversion and openness.

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