Gamification Aspects in the Context of Electronic Government and Education: A Case Study

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Abstract. The user experience, product quality and confidence in the institution are critical success factors in the use of services in e-government. The usability evaluation and analysis of user interaction in e-government, usually occurs in a timely manner and limited to few users. One way to provide the user immediate feedback and get usage statistics of a continuously service is using the technique known as gamification. The objective of this study is to propose a method to select and apply electronic game elements as motivational factors in access to information produced by the government and then test the impact of these elements. Thus, this research focuses on scenarios where e-government services have an emphasis on providing information to citizens and enabling a two-way interaction. It is intended to identify gamification mechanisms such as points, badges, levels, rankings and others and apply them to the application's tasks and user's different motivations when they are immersed on a virtual environment. The purpose of this work is to develop an experiment gamification technique in the stages known as improved information services and transactional services of e-government which allow two-way interaction with citizens. This article presents ways to motivate the user and improve citizens feedback. The results demonstrate the successful use of gamification technique in e-government scenarios that provide educational services to citizens.

Keywords: Gamification · User motivation · e-government

1 Introduction

Nowadays, e-government is already spread all over the world, including Asia, Europe, North America and South America, and is implemented on different stages and maturity levels [1, 2]. In Brazil, 25 % of e-government users search for educational services [3]. However, a great part of total internet users, 63 % of citizens, do not access e-government services complaining about the difficulty to find desired services and lack of responses from the government side when requesting a service. In this scenario, raises

the question on how to achieve a large number of users and engage them in using e-government services, and provide immediate feedback and an assessment mechanism of an e-government service. Usage of rewarding systems on industry [4] and scenarios like education [5, 6] and enterprise services [7] is considered a way to increase productivity, encourage learning and engage users on using continuously an application. In the e-government context, the research by Bista et al. [8] proposes a model that uses game mechanisms like points and badges as rewards to increase citizen participation and contribution in a virtual community.

This paper aims to extend this model, including new game elements and defines a method to implement and select these elements to new projects. We'll start by defining some key concepts on e-government and its stages, and then we will discuss gamification, user motivation and then explain the proposed gamification method, concluding with the use case and its results.

2   E-Government

E-government could be defined as the "use of information and communication technologies to deliver government information and services to citizen" [9]. There are some authors that categorize e-government on four stages [24, 25]. The usability issues are highlighted as relevant in several works in e-government scenario, focusing on the user profile, user behavior [26] or interfaces evaluation procedures [10, 11]. The United Nations model [9] also defines a four stage model, where the first stage is called Emerging Information Services, when the e-government service is provided in a one-way direction, so the citizen only gets the information and do not send information to the governmental agency. The second stage is called Enhanced Information Services when there are means that citizen can communicate with the governmental agency, and request some service, e.g. through online forms. In this stage, there is a simple two-way communication between citizens and the governmental agency. The third stage is called Transactional Services, when the government agency receives input on government policies, regulations, etc. It could also exist some financial transactions on a secure network to the government. The last stage, called Connected Services, involves agencies cooperating and providing services using interactive tools such as Web 2.0 through integrated applications.

This research intends to explore the use of gamification on stages 2 and 3 exploring the two-way communication with citizens in order to engage users on e-government services. The next section explores what drives user motivation.

3   User Motivation

To understand user experience and motivation when interacting with a product or interface, it's necessary to understand user emotions, what the product represents to the user, his relations with the product and how the user understands the operation of the product [12]. To Hassenzahl [13], the user experience is composed by two perspectives, one being what the product provides to the user so he can achieve his objectives,

and the other perspective being what the product provides to satisfy the user needs during his interaction time with the interface. User experience also relates with how the user feels when performing a task, what are his needs and intrinsic motivations like self-affirmation, autonomy, competency when executing the task, comparing positions to other users or enlarge his social network.

For some authors, to understand user motivation, it's necessary to understand the motives that lead a user to perform some task, like the works by Fadel et al. [14] and Zichermann and Cunningham [15] that divide user motivation on two categories, intrinsic motivation and extrinsic motivation. Intrinsic motivation is when the user performs a task by his own, because the activity is pleasurable, challenging or offers the opportunity to learn something new or develop new skills [14]. Extrinsic Motivation relates to the context in which the user is inserted, where the user has the need of an external reward, like social recognition, material rewards or virtual rewards that gives the user status among other users. In this context, we use in this research gamification elements as an approach to reward the user when completing a task, exploring the effects of extrinsic motivation.

4   Gamification

According to Deterding et al. [16], gamification is defined as "the use of game design elements in non-game contexts". The use of game elements as badges and points to reward users tends to create positive experiences [17]. Although, Hamari and Sarsa [18] cites that there should be caution when implement those elements, in order to avoid excess of competition, requiring a good design interface project.

The research made by Borges et al. [19] finds out that a large number of gamification papers focus on engaging users on executing tasks, improve learning experience, improve user skills and there are some papers that propose solutions on how to use gamification. In the next subsections, we will explore the gamification components and mechanics and propose a method to apply gamification based on related works.

4.1   Gamification Elements

Schell [20] defines the elements that compose a game as: mechanics, history, aesthetics and technology. The mechanics are the rules that describe the game objectives, how the players can achieve those objectives and what happens when they achieve them. The history drives the user actions, while aesthetics acts on user feelings and technology is whatever resource that enables the game experience. To Zichermann and Cunningham [15] the games are composed by Dynamics, which focuses on user interaction with another element, Mechanics which are the rules of the game and Aesthetics which are the result of the mechanics and dynamics that acts on user sensations during system interaction. These components are known by the acronym MDA. Next we will explore which mechanics exists to use in our proposed method.

4.2 Gamification Mechanics

The basic gamification mechanics are known as points [15], which enable other game mechanics, such as badges and levels. The Table 1 shows some mechanics used on the case study based on the studies of [15, 21, 22].

Table 1. Gamification mechanics

Mechanic	Description
Points	Numeric value given when executing an action or series of actions
Badges	Visual elements to reward user when performing a task and grant user status among other users. E.g. Reader badge
Levels	Users are Rewarded in a growing order when accumulating points getting new titles or status. E.g. Master, Rookie, etc.
Ranking	Players classification based on user punctuation
Achievements	Usually are capabilities that are locked and are unlocked when certain activities are executed or when user get a determined number of points or level
Quests	Journey or series of tasks that user or a group of users must complete

Such mechanics described on Table 1 are presented on our case study and were selected according to user needs based on the profiles described on virtual environments [22]. The profiles are described in the next section.

4.3 User Profiles on Gamified Environments

The analysis made by Bartle [22] on the different kinds of players on virtual environments like Multi User Dungeons (MUD), which was a real-time virtual world based on text, defined four types of players, describing their characteristics and goals on the MUD environment. Based on those players, some authors defined personality characteristic of each player and game elements that best suits each personality [21].

Using Bartle´s player definition, we selected the mechanics defined in [21] that best suits each player to be part of our proposed method. The Table 2 shows such game mechanics.

Table 2. Player types and gamification mechanics

Player	Personality	Game mechanics
Killer	Agressive, dominance	Points, achievements, combos, progress, ranking
Achiever	Perfectionism	Badges, bonuses, combos, levels, progress, reward schedule
Socializer	Extroversion	Quests, customization
Explorer	Independence	Quests, reward schedule

With the player types, personality and game mechanics defined, we researched methods to apply gamification mechanics on new projects. Next section, we describe our findings.

4.4   Gamification Method

This section is a brief overview on the literature to discuss solutions for applying gamification on new projects. The work of Fadel et al. [14] uses concepts of the heuristics of Nielsen [23] to propose a framework called GAMINQ in order to gamify educational applications. The work bases on the theory of learning through a series of questionnaires, where the user is responsible for his own learning progress. The author also shows some prototypes, however, it is not clear the steps to apply the gamification framework.

The work of Bista et al. [8] proposes a model to be used on online communities on e-government, composed by seven elements, and define steps to apply gamification mechanics on new applications. First the designer identifies the members of a community (M), then identify which actions (A) they can perform in the context (C) of the application. For each combination of member, action and context, like John Doe (M) posts (A) on forum (C), are defined rules to obtain points (Rp). The user that accumulates a determined number of points (P) can be rewarded by a badge (B) according to rules defined to obtain those badges (Rb). This research had considered some e-gov aspects like anonymous users and so proposed a few gamification mechanics. However it serves as a base to define contexts and actions that could be gamified.

In an attempt to define a method to apply gamification and select gamification mechanics, we used a subset of the model proposed by Bista et al. [8] and combined with the selection of mechanics proposed by Ferro et al. [21]. The following table lists the steps used to apply gamification on our experiment.

Table 3. Gamification contexts and mechanics selection method

Step	Description
1	Identify contexts (C) and actions (A) that can be gamified on your application. E.g. User comments (A) on a forum (C). User evaluate (A) other users's comment on a forum (C)
2	Select gamification mechanics based on user's expectations. Select at least one gamification mechanic so all kinds of players are addressed

The first step defined in our gamification method is extracted from the Bista et al. model [8]. It provides an identification of what tasks and contexts to gamify an application. The second step identifies which elements to apply based on user profiles [21]. Using the steps from Table 3, we designed an experiment to apply gamification on an educational scenario, where it is possible to distribute content from government to students and there were no e-gov restrictions like user data confidentiality regarding their progress and posts.

5   Project and Experiment Design

The research made by Borges et al. [19] approaches several experiments using gamification and concludes that on the most studies there's a subjective description of the results. The author suggests defining control groups with similar expectations and contexts to focus on the results on the gamification itself. Based on this study, we designed an experiment with two groups of students of professional formation schools.

Then, we developed two different versions of a mobile application composed by a series of questionnaires, so users could learn while using the application, as pointed out by Fadel et al. [14]. One developed application was gamified and other not. This way, we could compare results from both applications to validate gamification effectiveness. To design the applications, we followed the steps proposed by our method presented on Table 3. First we identified the actions and contexts as following the first step on Table 3. The results are shown on Table 4.

Table 4.   Contexts and actions

ID	Context	Action(s)
1	Registration	Register on application
2	Questionnaires	Answer single questionnaire, conclude lesson, conclude theme
3	Comments	Post comment, evaluate other users comments

Then, following the second step proposed by our method, we selected gamification mechanics that suit each context inside the application. The results could be found on Table 5.

After the context and actions defined as well as the gamification mechanisms selected, we developed the mobile applications so we could use on the experiment. We used as comparison variables, the number of executed tasks like questionnaires answered, lessons completed, and frequency of access on each application.

The variables were selected because they were common to both gamified and non-gamified versions of the applications and could show a perspective of the user's interaction with the product.

The total number of volunteers for the experiment was 26 students divided on two groups. Each group was composed by students registered on the same course but on

Table 5.   Gamification mechanics per Action

Context ID	Action	Gamification mechanics	Description	Players approached
1	Register on the application	Points, levels	Grant 100 points for registration and show rookie badge, so the user knows that exists gamification elements	Killer, achiever

(Continued)

Table 5. (*Continued*)

Context ID	Action	Gamification mechanics	Description	Players approached
2	Answer a single questionnaire	Points	Grant 50 points for each correct answer	Killer, achiever
2	Conclude lesson	Points, levels, ranking, quest	Display total points by lesson. Display badges unlocked. View ranking by points. Each lesson concluded, unlock other lessons, as a quest to finish the theme.	Killer, achiever, explorer, socializer
2	Conclude theme	Badges	Grant bronze, silver or gold medals based on user's performance.	Explorer
3	Post comment	Points, badges	Grant 100 points for each comment. Grant Mentor badge for 2 comments with positive evaluation by other users	Killer, achiever
3	Evaluate other users comments	Points, badges	Grant 20 points for evaluation. Grant Moderator badge for 2 evaluations	Achiever killer

two different schools. Each group had 15 days to use the application, and all the tasks performed were logged in a database so we could compare the results from each group.

To illustrate the experiment applications, next are shown a few prints of the mobile applications and the basic differences between them.

The Fig. 1 shows the main differences between both applications. The image on the left shows the non-gamified application, while the figure on right shows the gamified application.

The figure also shows the gamified application including gamification mechanics such as badges and ranking on the bottom menu.

Next we show the core activity screen that included responding to a series of questionnaires (Fig. 2).

The main differences between them are the visual elements representing the gamification mechanic of points and the visual representation of attempts that user had when responding a question. Also, in the gamified version, it was possible to use points acquired and trade them for tips on the actual question through a help button.

After development, we selected two professional schools and for each school, we separated two groups, where in one group we delivered the gamified application, and in the other group we delivered the non-gamified version. The users were guided on the basic tasks of each application, and were instructed on how to use the application and the two-week trial period. The results are shown in the next section.
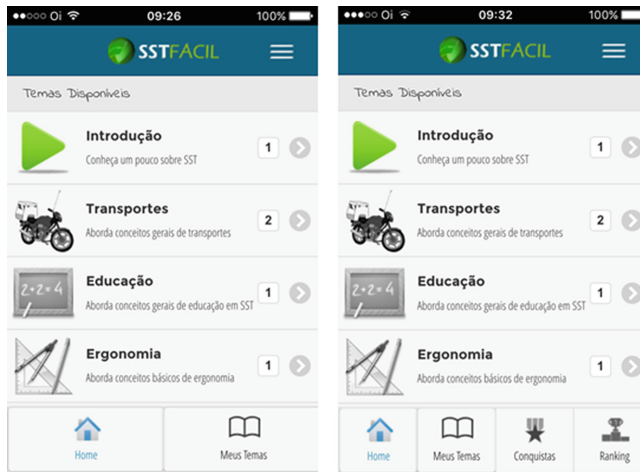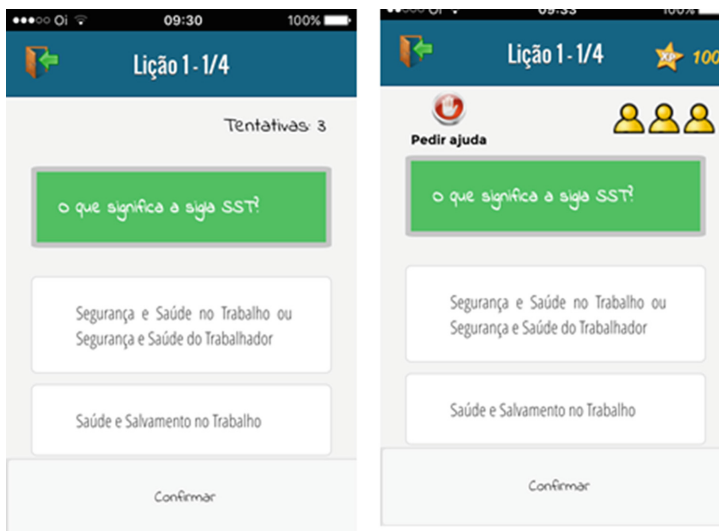
Fig. 1. Developed applications - initial Screens

Fig. 2. Questionnaire screens

6   Results

After 15 days of experiment, we could analyze the results of 26 volunteers, being 15 on the gamified application and 11 on the non-gamified application. The Fig. 3 shows the frequency of access of each group.
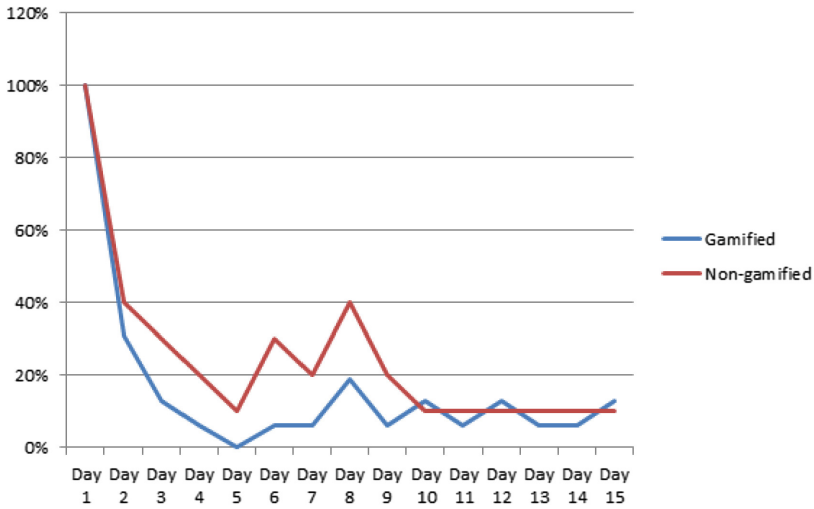
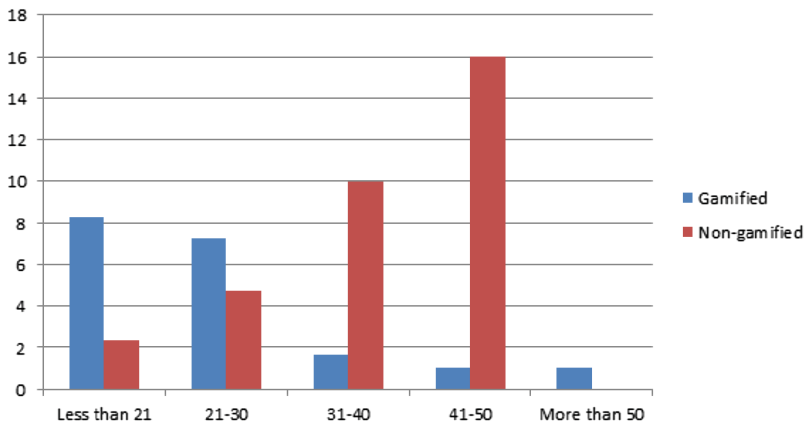**Fig. 3.** Frequency of access (Color figure online)

Fig. 4. Average of lessons completed (Color figure online)

As the graph shows, the non-gamified version started with a better frequency of access on the 10 first days, and then in the middle of the experiment the frequency of the gamified version was similar to the non-gamified version.

In order to investigate the impact of gamification on e-gov applications, we then analyzed the average of lessons concluded on each version to understand which age group responded better to gamification mechanics and determine which group have a better performance. The results are shown on Fig. 4.

The results show the number of lessons concluded for younger users were greater than the number of lessons responded by older users. Although the results could not be considered statistically due to reduced number of volunteers, it gives an overview of

what could be achieved on large experiments. Unfortunately, there were no comments in the experiment period to compare the results. Next, we show some discussion about the results.

7   Conclusion

The results show an overview of the impact of using gamification mechanics on e-gov on educational contexts. It appears that gamification elements like points, badges and ranking are more efficient to engage younger user rather than older users.

The gamification method proposed on this paper can be used to gamify other e-gov applications on different e-gov and educational scenarios. Due to the chosen e-gov scenario with younger audience and educational context that did not require user confidentiality, we could select mechanics such as points, ranking and badges that enabled comparison among other users.

Further analysis with more users need to be made to statistically compare the effectiveness of gamification mechanics on e-gov. However, the proposed gamification method proved to be viable to be implemented on new e-gov applications. The method could also be applied on different e-government scenarios and stages such as the first and forth stages. Although, the gamification mechanics should be selected and implemented respecting the context of the e-gov agency and its restrictions and confidentiality aspects respected.

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