Chapter 9
Gamification: Analysis and Application

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Abstract In this chapter, we present a method for applying gamification as a tool to improve the participation and motivation of people in performing different tasks. We analyse what are the psychological and social motivations of human beings and what game mechanics can help to satisfy these needs. In the same way, we propose a method for analysing the effectiveness of gamification based on a quality service model and the metrics associated with the properties of the playability as a measure of fun induced by the process of gamification.

9.1 Introduction

Since the early 1980s, researchers in the field of Human-Computer Interaction have tried to apply game design elements in contexts that have nothing directly to do with entertainment. Early studies focused on the use of game mechanics that would allow converting user interfaces in more pleasurable interaction systems [1, 2]. Other research emphasised the importance of carrying out further analysis of the meaning of fun [3] and its relation to the concept of usability [4], in order to improve the process of analysis of satisfaction of interactive systems.

In 2010, within the conference that took place at the DICE Summit held in Las Vegas (Nevada), the game designer Jesse Schell gave a talk in which he presented a hypothetical future where video games would be part of our lives [5]. Daily tasks would be related to some kind of game that we would get points and rewards based on our behaviour.

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This fusion of the real and the virtual world through game mechanics is what Jesse Schell referred to gamification. From that moment, the term gamification was acquiring greater relevance and several articles from different fields were published, such as research related to marketing [6, 7] or Human-Computer Interaction [8].

Gamification is defined as the use of game design elements in non-gaming contexts [9]. The elements used in the processes of gamification are related to games, that is, they belong to structured activities with explicit rules and not to spontaneous activities or improvised behaviours. Unlike serious games, that are complete games designed for a primary purpose other than pure entertainment, gamification only uses game elements without constituting a full game itself. The application of the game elements is not limited to digital media nor is linked to any particular technology or any particular design practice [9]. Gamification can be used as a tool to improve the participation and motivation of people in carrying out diverse tasks and activities that generally could not be very attractive. Its application is not restricted to any specific area and can be used in contexts as diverse as education [10], the development of respectful behaviour towards the natural environment [11, 12] or to improve the well-being of the elderly [13].

Currently, the relentless advance of ubiquitous computing driven by the integration of mobile devices in the society has become a particularly interesting scenario for the inclusion of game mechanics in different contexts with the intention of motivating people to perform certain tasks.

In this article we propose a method that facilitates the analysis of tasks that you want to gamify. Based on the macro self-determination theory of human motivation, we define a framework that allows us, on the one hand, to determine what type of game mechanics should incorporate these activities to meet the psychological and social needs of human motivation [14] and, on the other, to assess the effectiveness of the process of gamification based on fun, the properties that characterise the playability and the degree of improvement in obtaining satisfactory results using a quality service model.

9.2 Video Games and Human Motivation

A video game is a computer programme specially created to entertain, based on the interaction between a person and a machine where the video game is executed [4]. Fun and highly interaction are some of the most interesting features of these systems. Thanks to these and other characteristics, video games can be used as a motivational tool of human behaviour [15, 16].

The self-determination theory, proposed by Ryan and Deci, is a macro theory of human motivation concerning people's inherent growth tendencies and their innate psychological needs [14]. According to this theory, intrinsic motivation is the core that is associated with sports and gambling. Intrinsically motivated activities are those that the individual finds interesting and performs without any kind of conditioning, just by the mere pleasure of carrying them out.

To maintain the intrinsic motivation in individuals, it is necessary to satisfy the following psychological and social needs:

- *Autonomy*: Autonomy refers to the sense of will when performing a task. When activities are performed by personal interest, perceived autonomy is high. Providing opportunities to choose, using positive feedback and not controlling the instructions given to people, have been shown to improve the autonomy and, consequently, the intrinsic motivation of individuals [17].
- *Competence*: Competence is the need of the people to participate in challenges and feel competent and efficient. The factors that improve the experience of competition, such as the opportunities for acquiring new knowledge or skills, be optimally challenged [18] or receive positive feedback, improve the perceived level of competition, and therefore it also improves intrinsic motivation.
- *Relatedness*: Relatedness is experienced when a person feels connected to others. Intrinsic motivation will be strengthened in relations that convey security, making this type of motivation appears more frequently and in a more robust way [14, 19]. The current integration between games and social networks is very interesting to use it as a reinforcing motivation.

In one of his books [20], Daniel H. Pink identifies three key elements that allow achieving personal well-being and personal satisfaction: autonomy, mastery and purpose. Autonomy responds to the desire of all people to control their own lives and how they do their jobs. Mastery concerns the desire to constantly improve and achieving personal satisfaction through challenges that fit the capabilities of each individual. The purpose acts as a connecting thread of the intrinsic needs of people and it enables personal fulfilment.

9.3 Description of the Method

From a functional point of view, the game can be split in three in three parts: game core, game engine and game interface. The game core defines the elements that will characterise and differentiate the nature of the game. The game engine handles the representation of each element of the game and how the user interacts with them through a series of software routines, modules or subsystems. The game interface is responsible for displaying the final appearance of the game and for managing the interaction that makes the user with the game, and it presents all content with which the player can interact with, such as options, virtual world scenes or controls [4].

When we want to perform a process of gamification, we will focus mainly on the game core, which defines the game mechanics, the storyline and the user experience. The game mechanics determine the operations and laws that shape the virtual world that is recreated in the video game, the storyline manages the argument of the video game and its narration, and the user experience defines the elements that are related to user interaction [4].

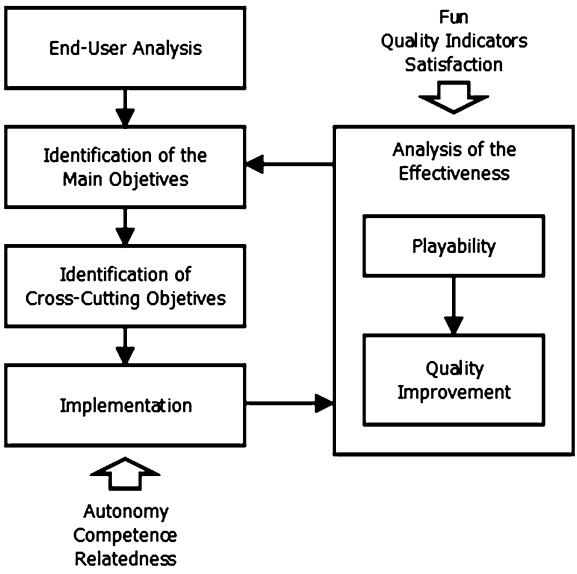

Fig. 9.1 Activities of the method that we propose

In gamification processes, it is necessary to identify which set of mechanics are most interesting based on the objectives of the task that you want to gamify.

In general, our method can be defined by a basic sequence of activities. The first one is to analyse the types of users who will use the system. The second is to identify the main objective of the task that you want to gamify. In the third activity, we identify one or more underlying objectives that are interesting for people. In the fourth activity, we make a selection of game mechanics in accordance with the context in which the process of gamification is applied. At the same time, we determine the types of interactive experiences that support the selected game mechanics. Finally, in the fifth activity, we analyse the effectiveness of the implementation of gamification based on fun, quality indicators and customer satisfaction and service quality. This last activity is linked to the cross-cutting objectives to define an iterative process.

This sequence of activities proposed can be repeated for each of the objectives or tasks that define the business model you wish to perform the process of gamification.

To make an effective process of gamification, we propose the following activities (Fig. 9.1):

1. *End-user analysis*: Determine who will use the gamified system, what are their motivations, needs, interests and preferences.
2. *Identification of the main objectives*: Identify the main purpose of the task you want to gamify. The main objectives correspond with the main objectives of the business process or any of the objectives of the tasks that are performed in that process. These tasks are normally not motivating and it is desirable to improve its efficiency.

3. *Identification of cross-cutting objectives*: Identify one or more transversal objectives that are interesting to the person. Based on these objectives we will use game mechanics to create a process that improves the interest of the individual and promotes the development of intrinsic motivation.
4. *Implementation*: Selection of game mechanics that match the objectives and support the needs of human motivation (autonomy, competence and relation) and implementation of the gamification process. This process may consist in the creation of a new system or improving an existing one, the development of an advertising campaign, the design of a website and so on. Some examples of these mechanics are:
   - *Autonomy*: The game mechanics that reinforce the autonomy are those that allow carrying out elections and not forcing the user to perform certain actions. It is important to avoid any kind of reward that deflects the internal motivation of the person towards external causality. In the same way, we must avoid the supervision and control of the user's actions since otherwise the feeling of autonomy would diminish. Examples of such mechanisms are profiles, avatars, macros, configurable interface, alternative activities, privacy control and notification control.
   - *Competence*: The perception of competence may be favoured by those mechanics that enable the user to feel competent in the system. In this sense, positive feedback plays a very important role, but it is essential that it does not overlap the perception of autonomy, since otherwise the user will not feel responsible for the actions that have allowed him to achieve this positive situation. In the same way, it is important to adjust the objectives of the activities to the possibilities of each user, providing them with optimal challenges that favour the perception of competence. We must avoid transmitting the user any negative information, since this will impact negatively on his intrinsic motivation. Examples of such mechanisms are positive feedback, optimal challenge, progressive information, intuitive controls, points, levels and leader boards.
   - *Relatedness*: Relatedness is another psychological needs associated with intrinsic motivation. We need to facilitate the mechanics that give support to communication with others and reinforce the relationship between individuals. Also, we must incorporate game mechanics that allow users to both express their ideas as influencing other people. Examples of such mechanisms are groups, messages, blogs, connection to social networks and chat.
5. *Analysis of the effectiveness*: The analysis of the effectiveness of the gamification process must be done from two different points of view. Firstly, we must assess whether the application of gamification generates fun tasks through integration with the game mechanics that have been defined in the system. This aspect is very important, since it constitutes the basis of motivation that is intended to achieve with gamification. In our proposal, this assessment will be based on the analysis of the metrics associated with the property of playability, defined by González [4]. Each of these metrics focuses on a concrete vision of the game and allows

you to measure the player's experience during the process of interaction with the system. On the other hand, these metrics focus on the evaluation of the playability based on the culmination of objectives, something that is in accordance with the method of analysis and application of the gamification that we have proposed.

The analysis of the fun based on the metrics associated with the playability will take place through user testing and through the completion of questionnaires and test users with specific metrics or performing a heuristic evaluation by experts. Secondly, it is necessary to examine whether the process of gamification has generated an improvement in results that meet the objectives of the activities (increase in productive tasks, increase in the number of clients, increase in customer loyalty . . .). To analyse the effectiveness, we use a service quality model and we set quality parameters that match the objectives that we have identified before (activities 2 and 3). Then, we make a comparison between the values obtained prior to gamification process and the results that have been achieved before. This allows us to identify whether the process has been effective and whether the application of game mechanics have resulted in an improvement of the motivation of people, reflected in the completion of objectives.

– *Analysis of fun*: One of the concepts that we must take into account in assessing the effectiveness of the gamification is fun. Video games can motivate people because of the fun they generate. The gamification is at a much more granular level than the video games, but in the same way, it is necessary that the process that is generated after applying gamification is fun for the user. The game mechanics associated with human motivations represent only the structure on which to settle the fun. The confluence of the game mechanics and fun is required to make an effective gamification process.

  The analysis of the playability, which is defined as the set of properties that describe the player's experience in a particular game system, can help us in determining the degree of fun that has a system in which a process of gamification has been conducted. The interaction experiences can be characterised on the basis of a series of attributes present in the usability concept. These concepts acquire different nuances in the video games, complemented with other attributes which together seek to characterise the experience of the player.

  For this analysis, we will adapt the metrics associated with the playability.

– *Selection of quality indicator*: Quality indicator will allow us to assess the effectiveness with which the gamification has been applied to a particular process. In general, any activity can be quantified in a parameter to evaluate the degree of satisfaction achieved and the overall quality that has been reached at the end of the process. The selection of the quality indicator will be linked to the definition of the objective of the task as well as the context in which we are applying gamification. There are contexts in which the indicator can be easily identified, as it could be the case of a support system for teaching in which

each person has a qualification related to their academic performance. Quality indicator must be analysed prior to the gamification process in such a way that it can be made a later comparison with data obtained once the game mechanics have been applied.

– *Satisfaction and quality of service*: From the point of view of the services marketing, gamification may be defined as a form of packaging of services in which a basic service is improved using a set of services based on rules that give the user feedback and interaction mechanisms [21]. This definition provides an interesting insight when considering that the gamified service is not which provides mechanisms for interaction and feedback to the user, but one that improves their service thanks to these mechanisms. Moreover, this definition does not take into account the nature of the basic service, which means that a video game could be gamified for creating what we call a meta-game.

In this way, we could analyse quality improvement that has occurred after applying gamification to a service based on a service quality model. From this model, we can determine whether, as a direct cause of intrinsic motivation, there has been an increase in the scope of objectives and whether the overall quality of service has increased.

A service quality model that can be particularly interesting to analyse the gamification is that proposed by Professor Richard L. Oliver of Vanderbilt University [22], later modified by Richard A. Spreng and Robert D. Mackoy [23]. This model seeks to integrate customer satisfaction and quality of service, defining the entities that affect their value.

The quality of service would be determined by comparison of the ideas that has the person regarding the service and performance that has obtained by using it, while satisfaction would be defined based on the comparison of expectations and ideas that had the customer service and expectations and ideas that have not been met. The expectations of the customer would also have influence on performance that is perceived when using the service.

The measurement of the degree of satisfaction and quality of service will be done through questionnaires to each of the entities that are defined in the model. The questionnaires related to the expectations and ideas should be made prior to the use of the service by the customer [23]. The rest of entities will be evaluated using the same method once the client has finished using the service. Finally, we will apply a model of factor analysis to obtain results regarding the entities and their correlations.

This process should be done both before and after applying gamification, to allow comparison of the results and determine if service satisfaction and quality have been increased thanks to the gamification.

The intended purpose of the analysis process is fed back to the activities of cross-target identification and selection of game mechanics. That way we can optimally adjust the transversal objectives to the objectives of the tasks that we are applying the gamification.

9.3.1 Gamification and the Importance of the Analysis of the Playability

In our method, we use the definition of playability as a mechanism to analyse the fun and effectiveness that occurs in a gamification process. The analysis of fun is one of the most difficult and important aspects of the method, so it is important to understand its definition and the concepts on which it is based.

Many authors consider playability as a representative element for the quality of interaction and user fun. Rollings presents the 'triad of playability' [24], which contains three key elements for identifying the fun of an interactive environment: rules of interactions, objectives and goals to achieve.

Ben Shneiderman in 'Designing for Fun: How Can We Design User Interfaces to Be More Fun?' shows that user interfaces for playing should use clear and direct metaphors for the users, applying attractive graphics, animation and sounds, and these types of interfaces improve the fun and the effectiveness of the interaction system [25].

Furthermore, Akihiro Saito [26] indicates that the player experience and fun is identified by 'Gamenics': the quality of play, the quality of the platform on which a programme runs and the mechanics of the interaction (GAme + MEchanics + electroNICS). The work established four principles to consider within the proposed guidelines:

- Intuitive User Interface (emphasising ease of use).
- Interact without manual (the users should not feel confused about what to do and how to do it).
- Interfaces that help overcome the traditional learning curve (producing excitement in the users helped by the device).
- Reality: We should bear in mind that the user is familiar with their environment and context of life, and thus, when designing a programme, we need to provide the user with familiar interaction mechanisms to ensure his or her integration with the system.

Norman [27] and Lazzaro [28] propose that one of the secrets of fun is the management of emotions, where motivation is a key factor in generating a positive experience for the users. If users are continually motivated, the user experience will improve. Lepper and Malone proposed a number of factors that help improve user motivation, namely, challenges, curiosity, control and fantasy [29]. Affective improves the final experience, thanks to the quality of the art facet [30]. Aesthetic of the elements of the system also have influence in the interaction experience evaluation and testing [31].

Playability is based on Usability, but, in the context of fun and video games, it goes much further. Furthermore, Playability is not limited to the degree of 'fun' or 'entertainment' experienced when playing a game. Although these are primary objectives, they are concepts so diffuse as to require definition using a broad set of attributes and properties to measure the Player Experience.

The attributes to characterise the experience of an interactive software are [32]:

- *Satisfaction*: The degree of gratification or pleasure of the player for completing a video game or some aspect of it like mechanism, graphics, user interface, story, etc.
- *Learnability*: The facility to understand and dominate the game system and mechanics (objectives, rules, how to interact with the video game, etc.).
- *Effectiveness*: The necessary time and resources to offer fun and entertainment to players while they achieve the different game objectives and reach the final goal.
- *Immersion*: The capacity to believe in the video game contents and integrate the player in the virtual game world.
- *Motivation*: The characteristics that provoke the player to realise concrete actions and persist in them until their culmination.
- *Emotion*: The involuntary impulse originated in response to the stimulus of the video game and induces feelings or unleashes automatic reactions and conducts.
- *Socialisation*: The degree of the set of game attributes elements and resources that promote the social factor of the game experience in group.

9.4 Application Example

In this example, we will apply the proposed method to a bug tracking system. Bug tracking systems are software applications that allow you to keep a record of any errors that are detected in a software system, as well as information related to the correction of failures.

In the gamification process, we should use game mechanics that are integrated in a natural way in the context of the system, taking into account its objectives and the innate social and psychological needs of the users.

9.4.1 End-User Analysis

The end-users of the system will be those involved in the development of the computer system: developers, analysts, quality software engineers, etc. They are people who use technology on a daily basis and have advanced knowledge of use of different types of software for different platforms.

9.4.2 Identification of the Main Objective

(a) Improve the quality of the bug reports that generate the people who work in the area of software quality assurance. The increase in the quality of error reports

makes it possible that the developers can reproduce the error more easily and locate the source of the fault in less time. This speeds up the process of software debugging and reduces the error resolution time.
(b) Improve both the average number of bugs reported weekly and the average error resolution, strengthening the teamwork for the detection, documentation and error correction.
(c) Ensure the quality of the software.

9.4.3 Identification of the Cross-Cutting Objectives

Developers will be interested in resolving errors that have assigned (feeling of success) in the shortest time possible (self-improvement) and with minimal effort, something that we can achieve if we encourage to the developers to solve problems and involve quality workers to improve the error reporting.

9.4.4 Implementation

To implement the gamified system, we will modify the bug tracking system incorporating the set of game mechanics that give support to the objectives that have been identified. Some of the game mechanics that we can apply are:

- Autonomy:
  - *Profiles*. The user indicates the area in which he works and his knowledge, the software he uses regularly, the programming languages he knows, as well as personal information.
  - *Task selection*. The user can view the list of errors that have been reported and select those that best fit his professional profile and in which he is interested in working.
  - *Configurable interface*. The user customise the design of the bug tracking system by modifying the CSS template and adds a custom module to forward to his email the changes that occur in the error that he is working, as, for example, changes in the priority of the bug, change of the department that works on the error, comments from other users, etc.
  - *Privacy control*. The user sets as private his date of birth and his phone number in the profile.
  - *Notification control*. The user disables notifications of errors that have a low or very low priority.
- Competence:
  - *Karma*. The user detects an error and reports it in the bug tracking system. His karma increases by 15 points for reporting a new bug, 5 for attaching screen shots and 10 for completing all fields of the bug reporting form.

  - *Positive feedback*. The user reports a new error and the system displays a personalised message of thanks based on the severity of the error, the details provided in the report and the user's karma.
  - *Badges*. The user resolves a bug in less time than the average error resolution time and unlocks the 'Fast Hunter' badge.
  - *Real-time information*. The system displays the real-time activity of users and also shows links to the new system events, such as adding a new bug report to the system, assigning a bug to a user, a user comments on a bug report, etc.
  - *Challenges*. A user challenges another to solve two errors with equal priority in the shortest possible time, betting a certain amount of karma. A working group challenges another group to resolve different errors with same priority.
  - *Leader boards*. The system can display different leader boards, for example, depending on the number of bugs fixed, number of errors reported, average time of resolution, average weekly resolution of errors, average weekly reporting of errors, etc.
- Relatedness:
  - *Working groups*. The users create working groups to resolve errors together or to investigate specific parts of the software looking for errors.
  - *Messages*. The system allows sending personal messages between users.
  - *Blogs*. The user creates a new entry in his blog, which recommended a series of effective exercises for the lower body workout.
  - *Connection with social networks*. The user shares on Facebook the achievement and badges that he has achieved and the progression of his karma.

9.4.5 Analysis of the Effectiveness

To analyse the effectiveness that has had the gamification in the company, we must determine, first, whether the application that has been developed is fun for the user and, secondly, if we have managed to increase the level of motivation in workers through the game mechanics. In the same way, we should check if the application of the process of gamification has resulted in an improvement of service and customer satisfaction.

9.4.5.1 Analysis of Fun

To analyse the fun we will do a heuristic evaluation using the metrics associated with the properties of the playability and through the realisation of tests of users that we will distribute among the members of the company.

9.4.5.2 Selection of Quality Indicator

Just as in the identification of the cross-cutting objectives, the selection of the quality indicator is closely related to the objectives of the person. In our case, if the person aims to correct more errors than the rest of his teammates, we may take as a quality indicator the weekly average of error resolution. Tracking the average error resolution will allow us to assess whether there has been an increase in quality after the process of gamification.

9.4.5.3 Satisfaction and Service Quality

To determine the degree of satisfaction and quality of service, we will distribute questionnaires that analyse the wishes, ideas and expectations of the customer before and after the process of gamification. These tests will be distributed among the members of the company and subsequently applies a model analysis of factorial with the intention of collecting the desired information.

9.5 Conclusions and Future Work

In this chapter, we have presented a method of analysis and application of the gamification based on self-determination theory. We have proposed a method consisting of several activities that describe a procedure of analysis and selection of objectives, identification of context, selection of game mechanics and analysis of the effectiveness of the processes of gamification.

We have shown how it is possible to intrinsically motivate people through game mechanics that favour the perception of autonomy, competence and relatedness. In the same way, we have determined the characteristics to be met by game mechanics to motivate individuals. We highlighted that intrinsic motivation requires free partition people in interesting activities that provide optimal and novel challenges.

On the other hand, we have proposed to address the analysis of the effectiveness of the gamification from two different points of view. The first is from the point of view of the fun and using the metrics associated with the properties of the playability. The second is from the point of view of improving the effectiveness of the services, using quality indicators and a service quality model.

Finally, we have shown an example of application of the method in the creation of a gamified bug tracking system, showing examples of game mechanics that may be favourable to increase the intrinsic motivation of workers.

We are currently working on the development of methods of heuristic evaluation for the analysis of the effectiveness of gamification, we are adapting the playability analysis metrics to gamification and we are testing the application of the method in real cases.

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