



Using Gamification for improving time tracking

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Thesis to obtain the Master of Science Degree in
Information Systems and Computer Engineering

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November 2019

Acknowledgments

I would like to thank my parents for their friendship, encouragement and support over all these years, for always being there for me through thick and thin and without whom this project would not be possible. I would also like to thank my grandparents, aunts, uncles and cousins for their understanding and support throughout all these years.

To Sérgio, André, João, and Filipe for putting up with me for so long.

To Prof. Patrícia, Francisca, Rui, Francisco, Ramos, Duarte, and everyone else from PlayFun for transforming high school from something dull and tedious to an unforgettable life experience.

To all my friends and colleagues that helped me grow as a person and were always there for me during the good and bad times in my life; thank you: Sofia, Pedro, Inês, Daniel, Rui, Miguel, Joana, Matilde, Luís, Fred, Bernardo, David, Constantin, Zé; and everyone else from Gabi, Labs, and coffee breaks.

I would also like to acknowledge my dissertation supervisors, Prof. Miguel Mira da Silva and Prof. Daniel Gonçalves, for their insight, support, and knowledge sharing that has made this thesis possible.

Also, a special thank you to Rita Marques, for all the support and guidance throughout this thesis.

To each and every one of you – Thank you.

Abstract

Tracking how software development practitioners spend their time is important for organizations to measure employee performance accurately and better calculate the allocation of resources, which is usually done through digital timesheets nowadays. Still, employees often do not submit their timesheets on time, for reasons like lack of motivation or forgetfulness.

We propose a gamification solution to deal with these challenges through the use of game elements and game design techniques, with the goal of improving the submission rates of employees' timesheets. This is demonstrated through an extension to XGamify, a gamification app for Jira Software, previously evaluated in a Portuguese software development organization.

The evaluation consists of a focus group, survey, and a quantitative analysis of worklog submission rates. Although results were considered inconclusive, worklog submission rates substantially improved in one of the groups and participants stated they enjoyed the experience.

Keywords

Gamification; Time Tracking; Time Reporting; Motivation; Software Development; Information Systems.

Resumo

O tracking da forma como developers gastam o seu tempo é importante para as organizações medirem o desempenho dos seus trabalhadores com exatidão e melhor calcular a alocação de recursos, que hoje em dia é tipicamente feito de forma digital. No entanto, muitas vezes os trabalhadores não registam a tempo as suas horas trabalhadas, por falta de motivação e esquecimento.

Propomos uma solução de gamificação para lidar com esses desafios através do uso de elementos de jogos e técnicas de design de jogos, com o objectivo de melhorar as taxas de submissão dos registos dos trabalhadores. Isto é demonstrado através do desenvolvimento de uma extensão ao XGamify, um plugin de gamificação para Jira Software, previamente avaliado numa empresa de desenvolvimento de software portuguesa.

O processo de avaliação consistiu em questionários, grupos de foco e uma análise quantitativa de métricas de *time tracking* relevantes. Embora dos resultados tenham sido dados como inconclusivos, as taxas de submissão melhoraram substancialmente num dos grupos e os participantes declararam que apreciaram a experiência.

Palavras Chave

Gamificação; Motivação; Desenvolvimento de Software; Sistemas de Informação;

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Acronyms

CS Computer Science

CSV Comma-separated Values

DS Design Science

DSRM Design Science Research Methodology

MDA Mechanics–Dynamics–Aesthetics

PBL Points, Badges, and Leaderboards

XP Experience Points

1

Introduction

Most organizations require some form of time reporting from their employees, which is essential for the organization to measure employee performance and efforts accurately, and better calculate the allocation of resources, mainly time and budget. Nevertheless, employees often fail to report their time efforts timely, due to lack of motivation and forgetfulness [4].

Gamification is a recent and increasingly popular approach that, through the use of game elements and game design techniques, aims to make non-gaming processes more fun and engaging. Besides being applied with success in fields like education [5], health [6], and marketing [7], researchers and practitioners have been using gamification to make business processes in the workplace more appealing for their employees [8, 9].

Although some tools that contain time reporting have been gamified, we are currently not aware of any studies addressing the use of gamification for improving time tracking.

As such, in this thesis, we propose a gamification solution to address the problems of forgetfulness and lack of motivation associated with time reporting in software development, instantiated as an extension to XGamify [10], a Jira Software add-on created to gamify Scrum projects and previously evaluated on a Portuguese software development team.

We design and develop the tool and deploy and evaluate it in an organization that uses Jira Software for project tracking. Evaluation is performed by both quantitative analysis, based on the extracted metrics before and after the tool was in use, and qualitative analysis, through interviews and focus groups.

To conduct the research of this thesis we use the Design Science Research Methodology (DSRM), serving as a guide for the structure of this document and for the way the research is conducted. The following paragraph presents a structural overview of this document.

Following up this Introduction, we clarify further the research methodology used in Section 2, and proceed to formally introduce the Problem in Section 3. Afterwards, we present the literature review contrived for this thesis, divided into Background in Section 4 and Related Work in Section 5.

Following up with the methodology, in Section 6 we detail our Proposal making use of the Gamification Design Framework and, in Section 7 we expose the demonstration of the tool used. Section 8 then discloses the evaluation results obtained during the demonstration. Lastly, we have the Conclusion, where we address the contributions made, inform about the research limitations and discuss future work.

2

Research Methodology

The chosen approach to conduct the research of this thesis is the Design Science Research Methodology. DSRM provides a framework for accessing a design problem, described by Hevner et al. [11] as a “problem-solving process”, Design Science (DS) focuses on the design and performance analysis of a developed artifact with the goal of achieving functional performance. DSRM artifacts, perceived as knowledge containing, can be human-computer interfaces, process models, algorithms, and more.

Although its application is not field-restrictive, it is most notable in the Engineering and Computer Science (CS) disciplines, where it can be seen as “a quest for understanding and improving human performance” [11, 12].

DSRM describes guidelines for an iterative process, divided into the following six activities: [1]

1. **Problem Identification and Motivation** – Define the specific research problem and justify the value of a solution. The problem definition should be atomized so that the solution can capture its complexity.
2. **Definition of the Objectives for a Solution** – Infer the objectives of a solution from the problem definition and knowledge of what is possible and what is feasible. The objectives can be quantitative, such as terms in which a desirable solution would be better than current ones, or qualitative, such as a description of how a new artifact is expected to support solutions to problems not already addressed. The objectives should be inferred rationally from the problem specification. Resources required for this include knowledge of the state of problems and current solutions, if any, and their efficacy.
3. **Design and Development** – Determine the artifact's desired functionality and architecture, and create the artifact. Conceptually, a design research artifact can be any designed object in which a research contribution is embedded in the design.
4. **Demonstration** – Demonstrate the use of the artifact to solve one or more instances of the problem. This could involve its use in experimentation, simulation, case study, proof, or other appropriate activity. Resources required for the demonstration include adequate knowledge of how to use the artifact to solve the problem.
5. **Evaluation** – Observe and measure how well the artifact supports a solution to the problem. This activity involves comparing the objectives of a solution to actual observed results from use of the artifact in the demonstration. It requires knowledge of relevant metrics and analysis techniques.
6. **Communication** – Communicate the problem and its importance, the artifact, its utility and novelty, the rigor of its design, and its effectiveness to researchers and other relevant audiences, when appropriate.

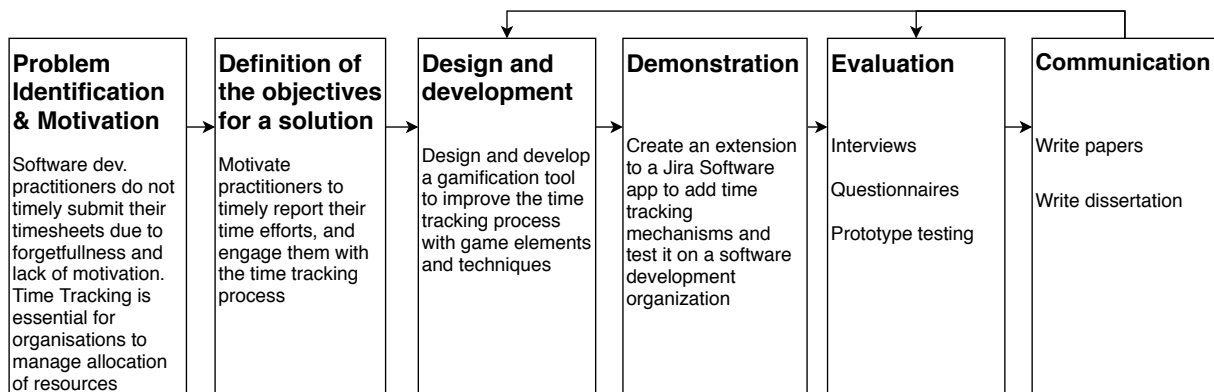


Figure 2.1: Design Science Process adaptation (adapted from [1]).

In Figure 2.1 we present our adaptation of the DSRM process. As the figure shows, it is possible to re-iterate DSRM from the Evaluation or Communication phases, back to Definition of the Objectives for a Solution. We use a problem-centered approach, being the basis of a nominal sequence. The output of this DSRM approach is an artifact of type instantiation.

3

Problem

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In this section, corresponding to the Problem Identification and Motivation step of the DSRM approach, we identify the problem at hand and motivate for the finding of a solution to address it.

3.1 Problem Motivation

Many organizations implement some form of time tracking mechanisms to measure and inform about the way their employees allocate their work hours. One of the most commonly used ways to track time workers spend on tasks is through the use timesheets, where workers actively report their time investments on a predefined time range schedule, often daily, weekly, or monthly.

3.2 Problem Identification

Despite the importance of time reporting to organizations, **employees often overlook or disregard the time reporting process, failing to timely submit their reports – often due to lack of motivation and forgetfulness** [4]. This lack of data on employee time allocation leads to difficulties in measuring their performance as well as accurately managing time on the schedule.

There is also some apprehension from workers' towards active time reporting mechanisms (e.g. timesheets), as workers sometimes feel that filling these are useless, tedious, a waste of time, motivation killers, and make them feel like they are being micromanaged [13].

4

Background

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In this section we detail some core concepts relevant to the context of this thesis. In the following sections we describe what Time tracking is and the common ways it is deployed. Afterwards we go in-depth describing Gamification; from its definition and history, to the common applications and criticism, and closing off with a framework for gamification design.

4.1 Time tracking

Time tracking can be defined as the act of recording the time a person spends on performing specific tasks. Although personal time tracking is commonly done, it is crucial in businesses, as described in our Problem in Section 3. The act of reporting time spent ranges from writing hours down on a paper, to automatic time reporting. In the following subsections we describe some of the ways time tracking (or time reporting) is done.

4.1.1 Timesheets

Timesheets are one of the most commonly used methods to track time efforts, as they are effective and simple to use and understand. Dating back to the nineteenth century, then referred to as “time books”, timesheets have evolved over the years. Although formerly used in a paper form, timesheets have recently been transitioning to digital format, in both spreadsheet format and other custom software applications.

4.1.2 Time Tracking tools

Clockify is a popular free “time tracker and timesheet app for tracking work hours” used by teams to track their time and generate analysis reports on it. Although it is a standalone app, it offers many integrations with other apps, to facilitate the time reporting process. Another app with the same goal is Tempo¹, a popular time tracking app with the same goal as Clockify, but deeply integrated with Jira Software.

There are also some apps that completely automate the time tracking process. QualityTime² is a mobile app that reports to the user how much time they spend on each mobile app. This time tracking feature, aiding in self-awareness and digital health, was considered so relevant that it is now a feature of mobile operating systems.

¹Tempo: <https://tempo.io>

²QualityTime: <https://www.qualitytimeapp.com/>

4.2 Gamification

Gamification is a term widely used for representing the application of game design techniques and game elements in non-gaming contexts with the purpose to improve user motivation and engagement [14, 15] and usability. It has been applied across many fields, including marketing [7], education [5], health and fitness [6]. Figure 4.1 shows the top Google Trends³ trending topics associated with gamification.

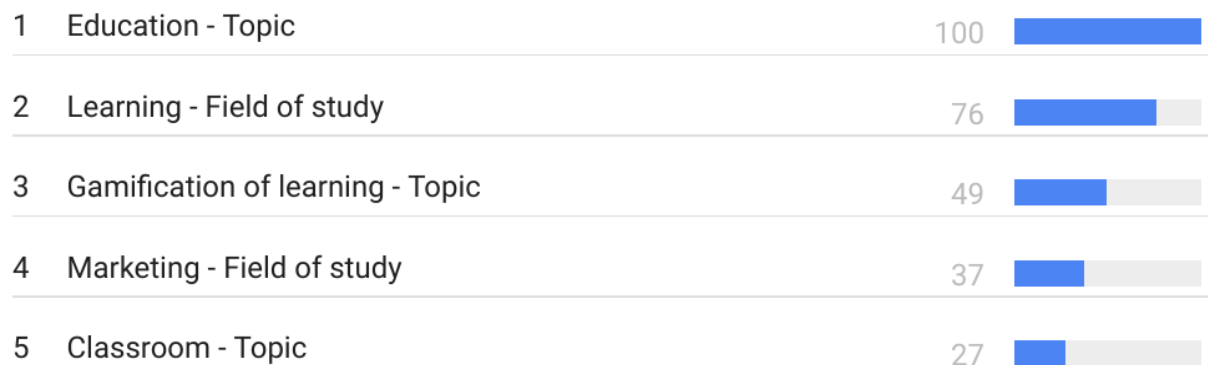


Figure 4.1: Google Trends: Gamification top related topics (Dec 2018).

Although being related to gaming, a gamified system is not full-fledged; they simply employ game elements in an existing process. This is in contrast to serious games, which are full-fledged games whose design goes beyond simply entertainment [16], aiming to educate its players in a particular topic, like health care or military defense [17].

4.2.1 History

The term gamification was first used in 2002 by Nick Pelling [18] in a generic fashion and in 2008 by Waltz and Deterding in the context of computer software [19]. Gamification started gaining popularity around 2010, as seen from Figure 4.2, and although it is somewhat recent, the concepts and elements have been used for many years prior, for example: frequent-flyer loyalty programs [20], retailer's store cards, scouts' badges, and military awards.

4.2.2 Gamification Elements

Werbach and Hunter [2] developed a framework which defines and organizes the key elements found in gamification: Components, Mechanics and Dynamics. It is inspired in the popular Mechanics–Dynamics–Aesthetics (MDA) Framework [21] used in game design to analyze and develop games.

³<https://trends.google.com/trends/explore?q=/m/0cm8xv9>

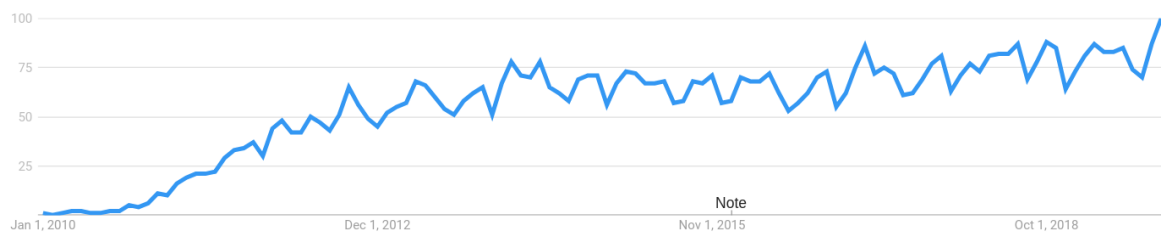


Figure 4.2: Google Trends: Gamification interest over time (Jan 2008 — Dec 2018).

The framework of gamification element is structurally represented as a pyramid, establishing a notion of both size and dependence. Elements at the bottom are more numerous and low-level than elements at the top, and top elements are constructed using elements from the layer below. For example, multiple components create Mechanics, and multiple Mechanics create dynamics.

The following list presents a general description for each gamification component, as well as a figure (Figure 4.3) displaying the Components–Mechanics–Dynamics pyramid of components and some example element for each.

- **Components**, functioning as a baseline of the framework and pyramid, these are specific core elements of the system. These elements are the least abstract of the three and lead to actual tools that can be employed to incorporate gamification. Some components include:
 - Points – are an effective way of keeping score and displaying progress, as well as to provide scaled feedback of actions.
 - Levels – often used along with points, these give a sense of progress in defined steps.
 - Achievements – achieving well-defined objectives.
 - Badges – similar to achievements, but often linked with a visual representation.
 - Avatars – visual representations or personification of the player’s character.
 - Leaderboards – by listing players by their score, leaderboards provide feedback on group progress and give a sense of competition.
 - Quests.

- **Mechanics**, are the processes that drive users to engage with the content and components, and give a sense of continuity and evolution, to drive the action forward. Some mechanisms are:
 - Challenges – prompted tasks for the user to find a solution to.
 - Competition – player versus player challenges.
 - Cooperation – multiplayer challenges that promote cooperation.

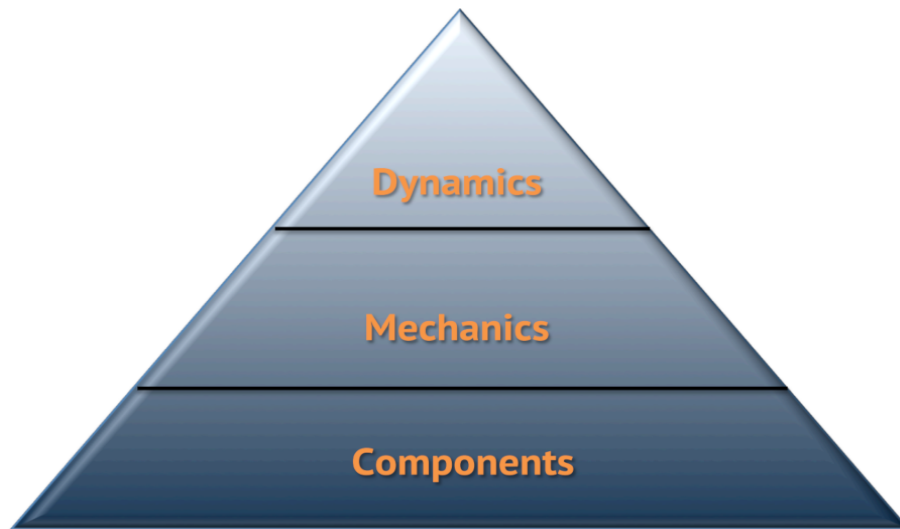


Figure 4.3: Gamification Pyramid of Elements (adapted from [2]).

- Rewards.
- Win-states.
- **Dynamics**, representing the way the mechanics come together to create a unified and coherent experience. They are the implicit high-level structure of the gamified system and can be manifested through constraints, a flow of narrative, emotions, or sense of progression.

4.2.3 Motivation

Even though we have mentioned that gamification can be used to increase motivation, it is a process that should be carefully implemented. Ryan and Deci, in their study of self-determination theory and motivation stated that “To be motivated means to be moved to do something” [22]. This concept is extended further with the understanding of the two types of motivation, intrinsic and extrinsic.

Gamification works towards improving intrinsic motivation through exploring certain dynamics (e.g. by motivating players without pressuring them; a user performs activities because it chooses to). Although gamification aims to motivate players to perform activities intrinsically, users will eventually encounter tedious and repetitive tasks that have to be performed. In these cases, it may be suggested to motivate players using extrinsic rewards, such as task completion badges or progress-informing experience or levels.

Deci and Ryan created Self-Determination Theory [23] in order to better comprehend people and change their behavior, explaining the psychological processes that promote optimal functioning and



Figure 4.4: Activity Cycle: Engagement Loop (extracted from [2]).

health. They add that in order to understand motivation, there must be a consideration of innate psychological needs for competence, autonomy and relatedness. When a task activates one or more of these innate human needs, it tends to be intrinsically motivating. [2].

- Competence concerns the capability of dealing with the external environments efficiently.
- Autonomy is the capacity of feeling in control so that actions are aligned with one's values.
- Relatedness is analogous to the interaction with others and the desire of comparing results with others.

4.2.4 Activity Cycles

Learning what motivates people to perform tasks is necessary to figure out what can be done to contribute to that motivation and how the use of gamification complements this. Werbach and Hunter defined the usage of activity cycles when addressing gamification [2], which are generally used to keep a user engaged in the tasks he has to perform. There are two types of activity loops:

Engagement loops are cycles comprised of motivation, action, and feedback, with the purpose of keeping the player engaged. A loop starts by exposing the player to a situation that may motivate or encourage him to perform an action. Afterwards, once a player acts, he is provided with immediate feedback from the system, which in itself serves as motivation, thus completing the cycle. Figure 4.4 illustrates this activity cycle and the idea that it goes through a logical loop.

Progression loops are cycles that can be seen as a series of steps that lead the player to an ultimate goal. These approach the game from a broader perspective and aims to break down the ultimate goal

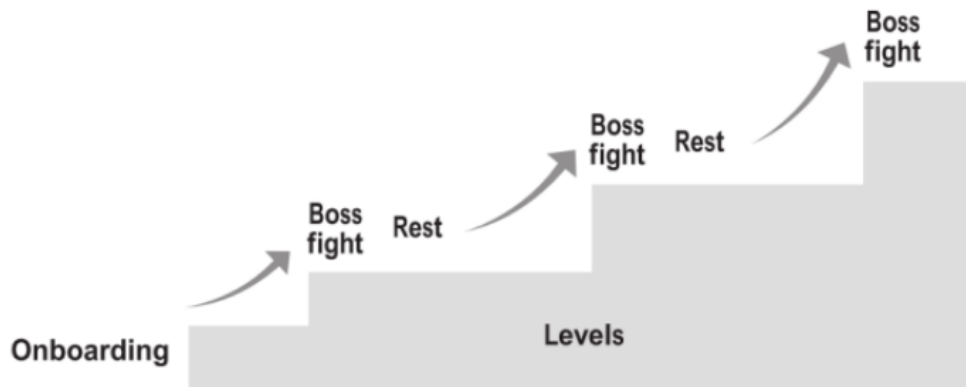


Figure 4.5: Activity Cycle: Progression Loop (extracted from [2]).

in a series of simple steps that can be more easily managed. Figure 4.5 illustrates the idea of step-progression using the challenge of defeating ever-more-challenging bosses in games as an example, which can be interpreted as achieving intermediate goals requiring intermediate progress to unlock or overcome.

4.2.5 PBL and Criticism

Gamification is many times associated with Points, Badges, and Leaderboards (PBL), a triad of gamification components that stand out from the others as they are the most commonly used [2]. Werbach and Hunter concluded that the PBL triad are “practical and powerful” components, if they are used right [2].

- **Points** are an effective way of keeping score and displaying progress, as well as to provide scaled feedback of actions.
- **Badges** can be seen as publicly displayed (e.g. public player profile) visual representations of achievements, signaling importance or authorization.
- **Leaderboards** consist of ranking participants by their score or other variables, providing feedback on interpersonal progress and a sense of competition. These can sometimes exhibit demotivating effects for players that are less predisposed to competition and for players that fall behind compared to others.

The popularity and simplicity of PBL has been leading to some perceptions that the gamification process is straightforward, leading some system designers to believe that implementing gamification dumbs down to just gluing some game elements together on a system, without adequately analyzing and understanding the system in question; like not taking the systems’ goals into consideration or having ignoring the users’ conditions and motivations. Because of this, gamification has been subject to some criticism.

Some critics assessed gamification as inherently evil, and the terms pointsification and exploitationware have emerged [2]. Robertson coined the term pointsification [24] claiming that the common game elements used in gamification, like points, levels, achievements, and leaderboards, are the least relevant elements in games, and as such, are incapable of producing a sense of real engagement or improve motivation by themselves, like a real game would do.

Another criticism of gamification takes the name of exploitationware [25]. Bogot coined the term and claimed that some gamification dynamics could indeed be effective, to the point that it coerces users to engage with the system and be performant in a forceful way, instead of encouraging and motivating users to perform their tasks.

4.2.6 Player Taxonomy

The Bartle taxonomy of player types specifies four character types that can be used to characterize player styles, and link to their personalities [26]. The character types are listed below, along with a chart in Figure 4.6 displaying where each character stands in relation to the others.

- **Achievers**, who “regard points-gathering and rising in levels as their main goal”.
- **Explorers**, who like having the game expose its internal machinations to them.
- **Socialisers** are interested in person–person interactions.
- **Killers** have a strong sense of competitiveness, processing a desire to be more successful than their peers and “imposing themselves”.

This characterization of players can help us better understand our players and what might motivate them. If we figure out our players’ characters, we can use that information to determine which game elements will be more effective. For example: if our players are very social, we can assume that leaderboards and cooperation or competitions mechanics will be more effective than badges.

This information will be especially useful later in our Proposal, more specifically in Section 6.2.3, where we instantiate the 6D Framework.

4.2.7 Gamification Design Framework

Considering all previous information, we understand that gamification should be implemented carefully, taking the system, its users, and the environments in consideration. Therefore, we conclude that using a formal gamification framework to streamline and aid the design and development of the gamified system beforehand is favorable.

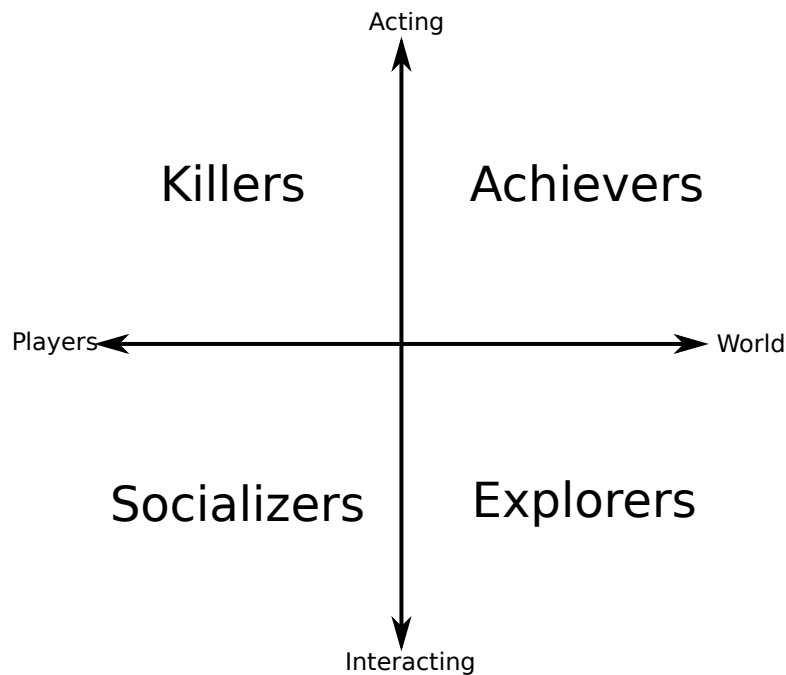


Figure 4.6: Bartle character theory chart. [3]

Mora et al. performed a literature review on several Gamification Design Frameworks [27] and classified each one according to their academic background and scope, effectively making an analysis of completeness, from which the authors concluded that the “Six steps to Gamification” (also known as 6D) Design Framework, introduced by Werbach and Hunter [2], is the most complete framework, as well as the best-known.

The six-step iterative framework breaks down the design process of gamification of a system in the following six steps:

1. **Define Business Objectives** – What are the objectives of the business and how will it benefit from this application?
2. **Delineate Target Behavior** – What are the players supposed to do and how will it be measured?
3. **Describe Your Players** – Who are the people using the system and how can we use this information to motivate them?
4. **Devise Activity Loops** – How will we continuously motivate users regarding engagement loops and progression loops?
5. **Don't Forget The Fun** – How can we intrinsically motivate our players with our system?
6. **Deploy Appropriate Tools** – How can we apply the components, mechanics, and dynamics in a correct and meaningful way?

5

Related Work

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In this section, we will discuss the scientific work previously done in the themes related to this thesis. As, to the best of our knowledge, there is currently no scientific literature available on applying gamification or game design to time tracking, our scientific literature review will be narrowed to applications of gamification in software development and in the workplace and some other relevant case studies.

Hamari et al. [7] performed a literature review on empirical studies on gamification. They concluded that gamification indeed works, with most of the studies showing at least some positive results, being most of them behavioral and some of them psychological. However, they concluded that the effects of gamification are considerably dependant on the context, with education/learning being both the most common context and the one with the most favourable results. Some identified negative results include the adverse effects of increased competition and design features. Moreover, Hamari et al. also found a case where gamification was effective, but only for a short amount of time [28]. This study also reinforces the popularity of PBL, which were the most commonly found components in the reviewed literature, being followed by challenges and levels, which themselves are related to badges and points, respectively.

5.1 Gamification in the workplace

Gamification in the workplace is commonly used to boost worker engagement or impact the behaviour of both employees and customers. This push is proven to increase productivity and engagement, as well as to foster innovation across organizations [29]. Although correctly employing gamification in the workplace is not always straightforward, evidence shows that, by using it the right way, it can influence users to change their behavior [30].

Feger et al. [8] investigated whether applying gamification for intrinsically motivating workers in a scientific workplace as CERN would be different to the usual corporate workplace. In their study, they state that an “absence of a strong, enforcing command structure (...) establishes a special need for motivational design”. They postulate that since “simple extrinsic rewards cannot evaluate the process of scientific knowledge creation”, extrinsic rewards such as leaderboards and levels will not have much impact in this workplace. They close off advocating for more meaningful motivational design.

Oprescu et al. proposed ten principles to integrate gamification in work processes to engage employees to adopt these [31]. A design centered on the user is followed, where tailoring to specific user preferences is given priority, and should be supported by psychological theories and oriented to learning.

5.2 XGamify

Marques et al. studied failures in Portuguese companies during their software development processes through the use of semi-structured interviews with professionals responsible for the implementation of

their organization' processes and mapped these against the existent literature and identified possible sources of problems [32]. Some of the problems identified by the professionals included lack of motivation and feedback, which gamification can undertake.

In later studies, Costa [33] and Marques [10] defined one of the main problems as being the software development process workers' lack of motivation and commitment and developed a software tool where gamification would be used on the Scrum projects, with the goal of raising teams' engagement, and motivation to adopt the Scrum methodology.

XGamify is an app for Jira Software¹, a software development product that allows for agile project tracking and management, where gamification techniques were employed to promote good practices among teams. The app uses experience points (XP) for tracking and motivating every time a user performs a specific action (related to Scrum project management) and allows users to level up upon reaching certain XP thresholds. Progress can be seen in a user dashboard, along with badges users are close to achieving and statistics informing on users' contribution.

XGamify is detailed further in Section 7, as it will be the basis for this thesis' Proposal.

5.3 Summary

Closing off our literature review, we recognize that there is significant evidence that gamification can be successfully used to engage and motivate people to perform desirable behaviors – and more specifically in the subject matter of workplace and software development. Although, there is no proof (as we found no literature of such) that it works for time tracking; we will attempt to fill this gap with this thesis by studying, deploying, and evaluating a gamification solution to address time tracking.

¹Jira Software: <https://www.atlassian.com/software/jira>

6

Proposal

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In this section we explain the proposal for this thesis corresponding to the **Definition of the Objectives** and **Design and Development** phases of our Research Methodology, previously described in Section 2. We start by describing the objectives for this thesis, motivated in Section 3, and then propose a solution based on the lessons learned in Section 4 and in Section 5.

6.1 Objectives

The objectives of this thesis' proposal are to **increase the time reporting submission rates** of the software development practitioners, and to **engage practitioners with the time reporting process**.

To achieve this, we design, develop, and deploy a gamification solution to solve the problems described in Section 3 by following the gamification design framework described in Section 4.2.7 and its details explained in the following subsection.

6.2 Design and Development

The design of the gamification tool used in software development projects for time tracking is done using the **6D Gamification Design Framework** [2]. The choice of this framework, as initially mentioned in Section 4.2.7, is based on the fact that this framework is the most used and complete for gamification [27].

6.2.1 Define Business Objectives

In order to build a successful gamified system, our goals should be accurately formally defined. As described in the previous Section 6.1, our primary objectives are to:

- Increase the time reporting submission rates, within the established deadlines.
- Engage practitioners with the time reporting process.

To achieve these objectives we use gamification to motivate and prompt the user to report their time efforts within time, as well as to engage them with the process. The users should therefore express specific behaviours.

6.2.2 Delineate Target Behaviors

In order to achieve the defined objectives, we must define desirable behaviours for the practitioners to exhibit. Our gamified system must support these behaviours and allow for an analysis of the performance of players and the system itself. These behaviours will be controlled through the use of defined metrics.

The primary behaviour we want our players to exhibit is to feel engaged and motivated to report their time efforts timely, under the predefined time span defined by the organization. Although there is no direct quantitative metric to measure motivation or engagement, we measure whether the behaviours are achieved qualitatively by way of interviews and focus groups. Regarding the time reporting rates metrics, we analyze and compare the differences between the tool with gamification and the tool without gamification.

6.2.3 Describe Your Players

As described by the Bartle taxonomy of player types [26] in Section 4.2.6, a player can be characterized by one of the following four characters: Achiever, Explorer, Socializer, Killer.

Our target players are comprised of software developers practitioners using Scrum for project management. Capretz and Ahmed found out that developers, especially programmers, are more inclined to be introverted than extroverted [34]. Taking this in consideration, we can more safely assume that our players will lean towards the characters of Achiever and Explorer, as these are more motivated to interact with the environments around them than interacting with other players.

Taking this into consideration, we estimate that game elements such as levels or badges will have more effect than elements like leaderboards or competitive challenges.

Although we initially planned to evaluate our proposal in a single, already known organization, we will not go any further in describing the players in this section, as we want to leave a margin for applying this proposed solution in another organization.

6.2.4 Devise Activity Loops

Designing activity loops is a significant step to engage users with the system. As mentioned in Section 4.2.4, there are two types of activity loops to focus on: Engagement loops and Progression loops. Along with the definition of desired behaviours, implementing the appropriate triggers is a way to motivate users to adopt the behaviours.

To motivate users to timely report their time efforts, we propose, for each loop type, the following:

Regarding engagement loops, which aims to keep the player actively engaged, we propose the use of **feedback notifications**. When a practitioner logs time for a given issue, a pop-up notification shows up, congratulating the player on the submission and displaying the progress for the given day. For example: “Worklog registered! You’re on a 12-day logging streak!”.

For progressions loops, aiming to engage a player on a longer time scale and breaking down the tasks in a series of steps, we propose:

- A **progress bar**, displaying the current logging streak, with checkpoint-rewards on the bar.

- A **daily streak** mechanism, displaying the current number of consecutive days that a player has logged.

6.2.5 Don't Forget The Fun

In this step, we attempt to find fun elements to encourage software development practitioners to engage with the solution. As the time reporting process can be seen as progress towards a milestone (gradually logging tasks over the day or week), we have identified, in the previous section, the following suitable game elements to motivate the players and keep them engaged: feedback notifications, progress bar, daily streaks.

Beyond this, it is vital that the system is easy and intuitive to use. Its interface should be clean and appealing.

6.2.6 Deploy Appropriate Tools

In regards to technical implementation and deployment, our solution is to be implemented as a Jira Software app, as an extension to the **XGamify** app, described in Section 5.2, to support time tracking and our additional elements. Further deployment details, and **Demonstration** are explained in the following section.

7

Demonstration

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This section is intended to detail the steps to implement the Proposal defined in Section 6, in accord to the step of the same name in the DSRM.

7.1 Jira Software

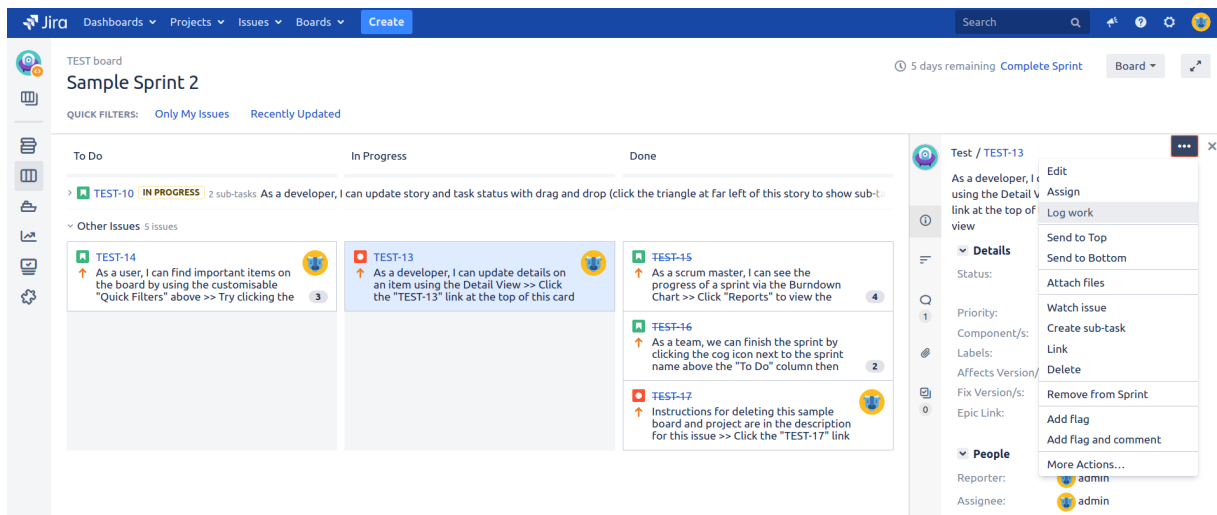


Figure 7.1: Jira Software current sprint, displaying current tasks being worked on.

Jira Software is a project management and bug tracking system mainly used for for managing agile projects. It has support for plugins (apps), and is used by organizations worldwide.

The reasoning for adopting Jira Software as the platform of choice lies on its wide adoption by many organizations, its complete set of tools, and many customization options. Jira also already includes time tracking features out-of-the-box, allowing users to give a time estimate when creating tasks, and logging work on each task and view the real or estimated remaining time to completion (Figure 7.2).

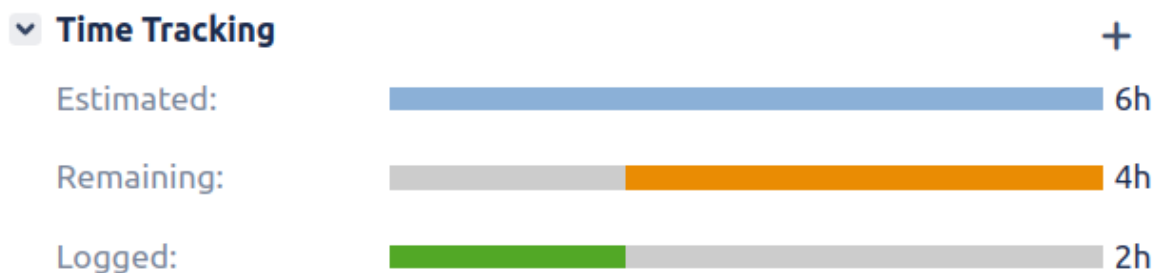


Figure 7.2: Jira Software issue Time Tracking bar.

Our solution is built upon XGamify, a Jira Software gamification app developed in the scope of agile software development, initially described in Section 5.2. XGamify includes base gamification compo-

nents and mechanics around points, gems, and badges that can be reused to implement our solution. This will facilitate the storage of the necessary information of the gamification dynamics, and reuse of base components for our time tracking solution.

Figure 7.3 displays the main Dashboard on the baseline version of XGamify which we extend upon.

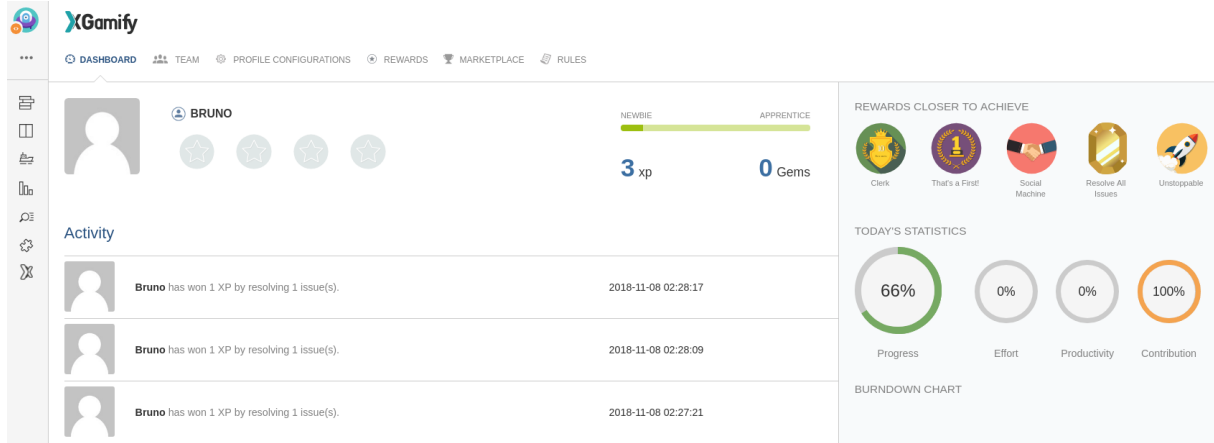


Figure 7.3: XGamify Activity Dashboard

Our solution iteration consists of extending XGamify to support time tracking, as described in Section 6.2.6. We implement listeners for whenever a user performs a time logging operation, and attach these operations to trigger feedback notifications, as well as awarding the user with experience points and badges, accordingly. Further implementation details are explained in App Features, Section 7.3.

7.2 Business context

To demonstrate the devised artefact, we collaborated with a company (from now on referred to as Company A, for privacy-related reasons) that provides software products and services, and has a governmental entity as their main client.

7.2.1 Company description

Company A uses Jira Software and Confluence to manage their development processes, as well as Tempo Timesheets (mentioned in Section 4.1) to facilitate the time reporting process. It has around seventy employees, most of whom are software engineers.

Company A provided two software development teams (Team A and Team B) for this demonstration to take place, and we were also given access to the Jira Software projects (Project 1 and Project 2) that Team A and Team B were working on, respectively, to integrate with XGamify.

7.2.2 Proposal adjustments

Our initial proposal assumed that the teams would be working full-time on the projects that XGamify was going to be integrated with. Unfortunately, Team A and Team B were also working in parallel in other projects outside of XGamify's scope.

In an initial conversation with Company A's Head of Software Development, we were encouraged to gamify reporting time only on worklogs that are "valid". The executive defined a worklog to be valid if:

- The worklog is reported on the day it refers to;
- The worklog is registered on an issue in the current active sprint;
- The worklog is registered on an issue that is not already closed (Done/Resolved).

As suggested, we opted to build a filter that ignores worklogs registered on issues that are not in the current sprint or that are already closed.

We also dropped the initial proposal to award points and rewards based on the number of hours reported, since it would be unfair towards team members more dedicated to other projects. We, therefore, focused the worklog scoring scheme on the proposed streak system.

7.3 App Features

7.3.1 Streaks

Users using XGamify extended with time reporting mechanism gain Experience Points (XP) and Rewards when submitting worklogs. After enough XP is gained, the user levels up. Figure A.1 presents the list of levels, their names and the required experience to reach that level. The experience table was updated to scale better with the addition of time reporting to the app.

When a user records their first valid worklog on a given day, their logging streak increases, and they earn experience based on the number of days of streak. If a user does not log any work on a given work day, they lose their logging streak – unless they have a Streak-Skip Card (a new Reward/type).

The XP P for a given streak of n days is calculated by the following logarithmic formula:

$$P(n) = 1 + \text{round}(m \times \log_2(n)),$$

where m is a multiplier factor, which was given a value of 2 and n is the number of days of streak.

7.3.2 Rewards

A user of XGamify app will earn Rewards when certain conditions are met; there are three reward types, Badges, Gems, and Streak-Skip Cards.

- **Badges** are visual representations of achievements or milestones;
- **Gems** are a type of currency to be exchanged;
- **Streak-skip cards** are a consumable reward that is used whenever a user is to lose a streak due to not logging on that given day.

A user can see their current rewards and how to obtain the one they are missing on the Rewards page of the app (Figure 7.4).

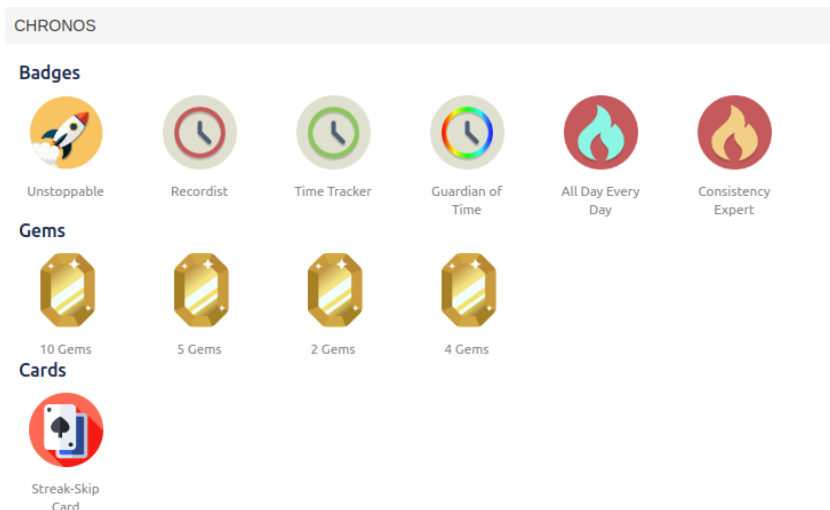


Figure 7.4: XGamify: Rewards page – Chronos category.

7.3.3 Notifications

Notifications were added to aid the time reporting process. These notifications serve the following three primary purposes:

- **Reminder:** To remind the user, at a certain time of the day, that they should not forget to do so; or whenever a reward is close to achieving;
- **Achievement:** To congratulate the user whenever they unlock rewards, gain experience and increase their streak;
- **Feedback:** Notifications to warn the user that something unusual happened.

Figure 7.5 shows a real scenario of Achievement Notifications being triggered, and a list of the notifications added to XGamify to support time reporting is present in Table A.3.

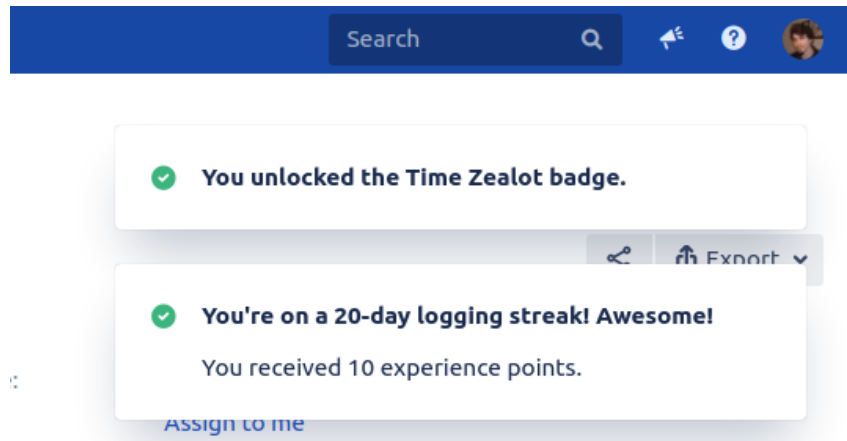


Figure 7.5: XGamify: Notifications example.

7.3.4 Dashboard

The XGamify Activity dashboard was also improved to support the visualization of the new streak feature, as well as to give a better overview of current user stats (XP, Gems, Skip cards). Activity Feed messages were also added to map to the added events that trigger rewards or XP being awarded, as shown in Figure 7.6.

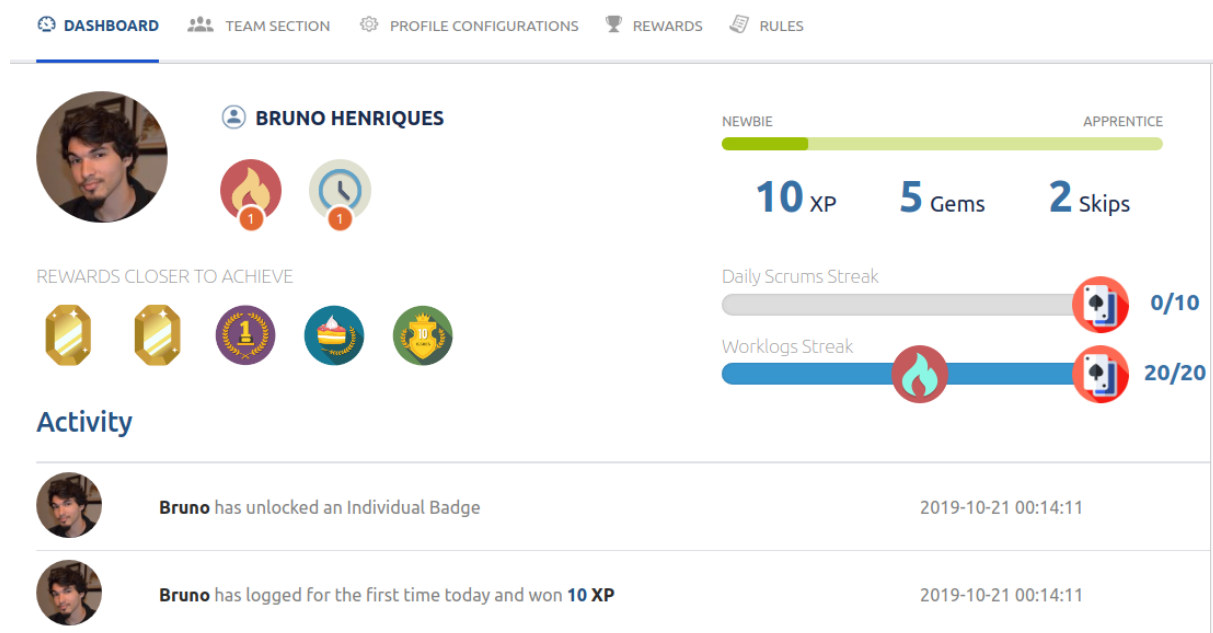


Figure 7.6: XGamify: Updated Dashboard with Streak bars and streak progress rewards.

7.4 Focus groups

The initial focus group session was designed to be semi-structured, to allow for interviewee improvisation and overall flexibility, although some questions were predefined. The protocol consisted of the following six segments:

1. Characterization of the interviewee
2. Jira Software level of usage and opinion
3. Experience with Scrum
4. Experience and opinion of the time reporting process
5. Experience with games and/or gamification
6. Insights about the proposal

Three focus group sessions were planned and conducted, one with the Scrum Masters and Product Owners (two persons), and two with the members of each team, three persons each. The decision to divide Scrum Masters and Product Owners from the development teams was because these two roles are assigned to management people, therefore it might influence the development teams' answers due to their superiors being present. All focus group sessions were held in February 2019 in Company A's office. Each session took around 40 minutes, with the exception of Team B, whose session lasted for one hour and forty five minutes.

The researchers started by giving an overview of the study's objectives and tried to ensure that the participants were as comfortable, so that their answers would be as sincere as possible, in order to represent the real scenario.

One researcher worked as a facilitator of the session by motivating the participants to discuss and by leading the discussion. Another researcher took notes using the interview guide as data collection template. Instantly afterwards, those notes were revised to create a final script. The script was then simplified by removing nonessential words. Each entry was kept in a different line and labelled with an ID corresponding to the participant. Then, each transcript was assigned to a category based on the protocol. Although not needed, we were open to create new categories if needed. Finally, a heading title was chosen for each category, and the main findings were summarized. The anonymity of participants in the focus group is protected in this report.

7.4.1 Jira Software

Company A started using Jira Software five years prior, replacing their then used internal tools. Apart from Jira, they also use Confluence as internal wiki, and Tempo apps (including Tempo Timesheets) to

Team	Group	Person	Role	Education	Years of Experience	Time at the Company	Past experiences
A	G1	A1	Scrum Master Product Owner	PhD IT Engineering	10	10 years	None
	G2	A2	Developer	MSc IT Engineering	3	3 years	None
		A3	Developer	BSc IT Engineering	2	1 month	Software Developer
		A4	Developer	BSc IT Engineering	10	5 months	Software Developer
B	G1	B1	Product Owner	BSc Electrotechnical Engineering	23	13 years	Software Developer
	G3	B2	Scrum Master	MSc IT Engineering	16	16 years	None
		B3	Functional Analyst	High School	40	18 years	Cobol programmer
		B4	Functional Analyst	MSc IT Engineering	5	3 years	Software Developer

Figure 7.7: Company A teams, their roles, education, and professional experience.

aid in the time reporting process.

Although Group 1 did not have training for Jira Software, they considered the tool intuitive to use, and claimed that they spend ten to twenty percent of their day using Jira.

No participant from Group 2 had Jira training either, but B3 and B4 had used Jira in their previous companies. As for B2, Company A was the first time they used Jira. The two most experienced developers (B2 and B4) spend about one hour using the tool per day, while B3 uses it for around 20 minutes. B4 uses Jira as soon as they arrive at the office to consult the Dashboard page for a status update. The group agrees that Jira's integrations and extensions are the tool's main strength.

Group 3 also had no training on Jira, and they first used the tool on Company A. B2 says they used the tool during 20 percent of their work day, increasing up to 30 percent closer to the sprint's end. B2 also checks the dashboard to have an overview of the work. B4 spends about 10 percent of the day using Jira, primarily to create issues and to report time. B3 claims that they only used Jira to report time, except when a new contract with the client is established, during which they spend the whole day working on the tool alone. The whole group agrees that the largest portion of the time spent using Jira Software, is to report time. They consider Jira a complete tool that provides an overview of the project's status. This group also consider that the tool's integrations a major strength. Participants B2 and B3 have used another project management tool in the past, and both agree that Jira Software is more powerful than it.

7.4.2 Time Reporting

All Company A employees must report the time they spend on each Task, directly mapped to a Jira issue that describes that work. Jira Software has a multi-in mechanism to perform this, and Tempo Timesheets integrates with this mechanism, allowing to generate time reports. The organization's goal is for everyone to report all their worked hours by the end of each work week. However, many people forget to timely report their time efforts. The teams' Product Owners identified lack of habit and forgetfulness as the main reasons they don't timely submit their work.

Since workers don't establish a routine, and often work simultaneously on five or six issues, they often lose track of the work done, and end up not complying with the defined deadlines.

7.4.2.A Observations on the current process

A participant from Group 1 suggested that an automatic mechanism based on user commits could help improving the time reporting process for software developers; but the problem would still remain for roles other than developers.

From Group 2, and regarding the current time reporting process, A2 admits that they delay reporting time for as long as they know they can. They consider that not having timely access to issues where the team must report time hampers the process. Although A2 thinks that automatic reporting would be a good solution, the solution is not viable. A3 suggested that using an incentive (like a reminder) could alter his behavior.

Concerning the current time reporting process, B2 says that they lack discipline to report time as they perform the work. They prefer to annotate everything on a text file instead, and only report time in Jira by the end of the week or month. Likewise, B4 also takes notes first, but on a physical notebook, before updating Jira as they concede that it is harder to remember about time reporting during during periods of higher workload. B3 is the only participant from the group who records the time right after the moment they execute the work, claiming they would most likely not remember anything later.

7.4.2.B Benefits

Both participants from Group 1 agreed that reporting time is fundamental for the organization, mainly to report to the client.

All three participants from Group 2 acknowledge that reporting time allows the organization to understand how and on what employees are working, and if the estimates are according to the planned work. Although A2 feels they do not benefit from reporting time, A3 says they enjoy the pressure they feel for having to report time, complying with the estimations. Participant A4 says that reporting time facilitates their understanding of how much time it takes for them to perform a task.

B2 considers that time reporting would benefit them if they could access reports with time reported by requirement¹, and not only per person or per project. B3 considers that reporting time is a work task as important as they others, and that people must understand this to comply with defined deadlines and understand the benefits of this process.

7.4.3 Gaming Habits

Both participants from Group 1 claim that they play board, mobile, and social games with their kids, not because they like it, but because they have to.

All participants from Group 2 like to play games, but only B2 plays regularly. B3 and B4 stopped playing regularly after they started working. B2 likes to play adventure, puzzles, and competitive games in all formats (like board and video games and escape rooms), mostly seeking the feeling of progressing, achieving objectives, and winning.

Every participant from Group 3 likes to play games, but only participant B4 regularly plays. B2 likes to play board and mobile games of almost all genres, but has little time to do so. Participant B2 seeks in a game the ability to socialize, solve riddles, and embody other characters to “escape from reality”. B3, despite not currently actively playing, likes to solve puzzles and play console.

7.4.4 Experience with Gamification

While B1 knows the concept of Gamification, but has never used it, A1 has used gamification during their PhD thesis. A1 adds that, while some people were motivated by game elements, others found it childish and did not enjoy the experience. Both participants agree that gamification benefits depend a lot on the person’s profile, and age. They asked for these teams to participate in this experience because they believe that they will enjoy the experience, given their profiles. Furthermore, they do not consider that this will be a distraction from their current workflow nor that the experience will have a negative impact on them, as long as they do not link the gamified solution with the evaluation process.

From Group 2, all participants know what gamification is and had previous experience with gamification solutions. A2 experienced a gamified course in college, which they think was very fun and motivating. A3 used the app Habitica, but their motivation quickly declined as the app was complex and required discipline recording tasks. A4 worked in a organization where the employees’ evaluation process was gamified. Though they left the organization shortly after this introduction of gamification, they enjoyed the experience. In the gamified tool, employees were “crew people” in a virtual spaceship, who were given “missions” to complete. Regarding gamification’s benefits, A3 considers that this approach makes work more interesting; B4 thinks it stimulates people to be more proactive, and A4 believes that

¹By issue type (i.e. issues of type Epic)

gamification can be very appealing to younger people. Nonetheless, A3 thinks that a gamification solution at workplace can potentially be a distraction from work, and to this A2 added that using more game mechanics can increase the odds of losing focus on work. A4 also believes that competitiveness might lead to problems within the team.

In Group 3, all participants also know what gamification is and only B3 did not have previous experience with gamification solutions. B2 uses StackOverflow (which employs some gamification techniques), and B4 experienced a gamified course in college, which they considered fun and provided an immediate contribution for the grade. They believe the process became less stressful for them. No participant from this group knew about any gamified solution applied in the workplace. B4 does not believe that such a solution would be a distraction for their team, as the work rhythm would not allow. B2 believes people might resist to use gamification if they feel that those rewards are considered for the organization's evaluation process. B3 thinks that gamification can boost team spirit by leading people to work together towards a common goal, but it can also hamper collaboration if everyone struggles to stay on top. They believe that even when promoting collaborative work, individual achievements should also be taken into account.

7.4.5 XGamify first impression

Both participants from the first group enjoyed the XGamify demonstration overall, but believe that only after the teams start using it they will be able to provide proper feedback. From Group 2, A2 enjoyed the gems and the activity feed, and A3 liked the profile, which creates a virtual identity for the person. However, he did not understand the meaning of XP, and did not not understand how to unlock the badges. Regarding the Group 3, all participants liked that the tool feeds from already existing information and does not add additional steps to the team's workflow.

7.4.6 Discussion

These focus groups allowed us to understand how this organization adopts time tracking and its associated tool, Jira Software. We were able to characterize the members of each team and their opinions and experience regarding gamification. Both teams admitted they do not timely and correctly report their time, with Team B being the team with more trouble complying. Overall, the participants linked with management roles seemed to find time reporting more benefiting, likely because the information is closely-linked to their work functions. The exception to this is the Scrum Master from Team B, admitting that he does not report this time nor does he find utility for him to do so. Some participants recognize that there is room for implementing small strategies to facilitate the time reporting process, like providing reminders for submitting reports on time. This technique, known as nudging, can be a subtle notification

to remind or influence workers to change their behaviours, through positive reinforcement, as proposed by Thaler and Sunstein [35].

All participants across both teams already knew what gamification was, only some used it before. We observe that Team A, being the younger team, has more gaming habits, and all members had previously experienced at least one gamification solution.

The two participants with the most gaming habits also had the experience of having a gamified course, during their degree. This course was itself subject of a large research effort, and results show that students considered the course more motivating and interesting than other courses. Both Scrum Masters were worried that workers would resist to use gamification if they feel this solution could be linked with the formal evaluation process. All participants agree that gamification will not be a distraction from their work due to the work rhythm.

7.4.7 Conclusions

This study provides insights about the organization prior the introduction of gamification. Although the teams' sentiment regarding time reporting is divided, many participants still do not record time accurately nor timely, and do not think that they would benefit in doing so. All participants were very active and engaged in the discussion and showed interest in the themes discussed.

7.5 Surveys

A survey was developed and disseminated to members of two Scrum teams from a consultant group providing mainly software services, but also some products. The goal was to understand how time reporting is being implemented in these teams; the challenges they encounter; and possible solutions to address them. We also wanted to study how game mechanisms can help addressing such challenges, and which factors motivate the respondents.

The survey was built with support from Google Forms, and comprised seven sections, each intended to collect a different type of information:

- **Demographics:** sociodemographic and professional information of the respondents;
- **Time Reporting:** evaluation of the participants' teams compliance with the organization's time reporting process, problems affecting a correct time reporting, and solutions to address them;
- **Games/Gamification:** characterization of respondents' gaming habits and knowledge regarding gamification;

- **Gamification in the Workplace:** extension of the previous section, focused on the context of workplace;
- **Motivation:** characterization of respondents' preferences towards motivation factors, based on Gamification User Types Hexad framework [36].
- **Final Comments:** other remarks.

7.5.1 Demographics

7.5.1.A Team A

Out of three respondents, one is male and his age is between 26 and 30 years old (33.3%), while two are females whose age is between 31 and 35 years old (66.7%). All respondents are Portuguese (100%) and have either a MSc (66.7%) or an advanced graduate diploma or PhD degree (33.3%). All studied Computer Science and Engineering or Telecommunications and Informatics Engineering. One respondent is Project Manager and has been working for the organization for between 10 to 20 years since she started her career path. The other two respondents are software engineers, where one started working in the organization for one to five years as a first professional experience, and the other one started working in the organization less than a year ago, with a professional experience of six to 10 years.

7.5.1.B Team B

All respondents are Portuguese (100%), where two are male (50.0%) and two are female (50.0%). Regarding age, one respondent is 26 to 30 years old, one respondent is 31 to 35 years old, and two are 36 or older. Except for one respondent, all have a MSc degree (75.0%) in Computer Science and Engineering (50.0%) or Electrical and Computer Engineering (25.0%). One respondent is the team leader who has been working in the company for 11 to 20 years since he started his career path. One respondent is a functional analyst working in the company for the last 11 to 20 years, with more than 20 years of experience. The two software developers have been working in the company for one to five years, being this their first professional experience.

7.5.2 Time Reporting

7.5.2.A Team A

All respondents already had to report time in one or more academic or professional contexts. Overall, participants think that reporting time is useful for both the company (Mdn=5,IQR=0.5) [1–Strongly Disagree, 5–Strongly Agree] and employees (Mdn=4,IQR=1), as presented in Figure 7.8. Important metrics

can be extracted from this process, which can be used to identify bottlenecks and optimize work processes (Mdn=4,IQR=0.5) and by workers to monitor their productivity (Mdn=4,IQR=1) and improve their work practices (Mdn=4,IQR=1).

Reporting time...	Median	IQR
...can benefit the organization.	5	0,5
...can benefit my work.	4	1
...help me reflect on how I am spending my time.	5	1,5
...help me understand and improve my work practices.	4	1
...allow me to monitor my productivity.	4	1
...help organizations identify bottlenecks and optimize work processes.	5	0,5

Figure 7.8: Team A – Agreement with facts related to time reporting.

Respondents believe that the lack of a clearly defined deadline (Mdn=5,IQR=0.5), forgetfulness (Mdn=5,IQR=0.5), and being a time-consuming activity (Mdn=4,IQR=0.5) are factors that affect a proper and timely time reporting, as shown in Figure 7.9. Other respondents believe that the perception that this task is tedious can negatively impact this process.

Factors	Median	IQR
Inexistence of a defined deadline	4.5	1.25
Forgetfulness	4	0.5
Difficulty in remembering hours of past days	5	0.25
Lack of motivation	4.5	1,75
Considered a low-priority process	5	0
Time-consuming activity	4	0.75
Lack of perceived benefits	4.5	1.75

Figure 7.9: Agreement with facts related to time reporting.

We asked the respondents to evaluate the importance they think some initiatives have in improving the time reporting process [1–Not Important,5–Very Important]. Respondents believe that the definition of an official deadline (Mdn=4,IQR=1), the possibility to report time daily (Mdn=4.5,IQR=1.25), and the usage of a simple and user-friendly tool (Mdn=4,IQR=0.75) are the initiatives with most impact on the

process. One respondent suggested that giving motivational rewards or status could also be used to improve time reporting. Oppositely, respondents believe that comparing reported hours with peers is not very important (Mdn=2,IQR=0.25).

Afterwards, respondents were asked to rank these initiatives based on the motivation they provided them to report time. Calculating a weighted average of the results for each initiative showed that respondents are mostly motivated by comparing reported hours with peers ($\overline{X_w} = 6.67$) and having an automatic login system to record time ($\overline{X_w} = 4.67$). However, they do not seem to be motivated by usage of a simple and user-friendly tool ($\overline{X_w} = 1.67$).

By comparing the classification of importance and motivation, we can see that comparing reported hours with peers was not considered important, but respondents seem to be motivated by this initiative, and the definition of an official deadline was considered important, but respondents stated not to be motivated by it.

7.5.2.B Team B

Three respondents already had to report time in one or two academic or professional contexts (75.0%), and one answered they did not have to report time in any context, although they certainly did at least in this organization. Overall, participants think that reporting time is useful for both the company (Mdn=4.5,IQR=1)[1–Strongly Disagree, 5–Strongly Agree] and employees (Mdn=4,IQR=0.25), as presented in Figure 7.10. Important metrics can be extracted from this process, which can be used to identify bottlenecks and optimize work processes (Mdn=4,IQR=0.5) and for workers to self-reflect to understand how they are spending their time in specific tasks (Mdn=4,IQR=0.25).

Reporting time...	Median	IQR
...can benefit the organization.	4.5	1
...can benefit my work.	4	0.25
...help me reflect on how I am spending my time.	4	0.25
...help me understand and improve my work practices.	3.5	1.25
...allow me to monitor my productivity.	3	0.25
...help organizations identify bottlenecks and optimize work processes.	4	0,5

Figure 7.10: Team B – Agreement with facts related to time reporting.

Respondents believe that the low-priority of the process when compared to other tasks (Mdn=5,IQR=0), the difficulty in remembering hours of past days (Mdn=5,IQR=0.25), the lack of a clearly defined dead-

line (Mdn=4.5,IQR=1.25), and forgetfulness (Mdn=4,IQR=0.5) are factors that affect a proper and timely time reporting, as shown in Figure 7.9. Other respondent suggested that the quick switching tasks can negatively impact this process.

Afterwards, respondents were asked to rank these initiatives based on the motivation they provided them to report time. Calculating a weighted average of the results for each initiative showed that respondents are mostly motivated by comparing reported hours with peers ($\overline{X_w} = 6.50$) and having an automatic login system to record time ($\overline{X_w} = 5.00$). However, they do not seem to be motivated by usage of a simple and user-friendly tool ($\overline{X_w} = 1.75$).

By comparing the classification of importance and motivation, we can see that comparing reported hours with peers was not considered important, but respondents seem to be motivated by this initiative, and usage of a simple and user-friendly tool was considered important, but respondents stated not to be motivated by it.

7.5.3 Games and Gamification

7.5.3.A Team A

Concerning the gamer profile, all respondents like to play games (100.0%), but only one plays regularly every week (33.3%), while the others play occasionally (33.3%) or rarely (33.3%). Respondents mostly consider themselves as casual gamers (66.7%), with only one considers him/herself as something between hardcore and casual (33.3%).

As players, they prefer multiplayer (66.7%) over single player (33.3%) games, and prefer to play offline with people they know (100.0%). Two respondents prefer to play in their smartphones (66.7%), and the genres they enjoy playing the most are adventure and board/card/trivia games (66.7%).

All respondents knew what gamification is (100.0%). They know some popular solutions like MBWay², Pokémon Go³, and Nike+⁴ (66.7%), which they also have used.

Two participants have knowledge of a gamification solution applied in the workplace to engage workers (66.7%), which included a solution to motivate the requirements elicitation activity and another for evaluation. There seems to be no agreement regarding with the premise that such solution would not be a distraction from their work (Mdn=2.5,IQR=1)[1–Strongly Disagree,5–Strongly Agree].

7.5.3.B Team B

Concerning the gamer profile, all respondents like to play games (100.0%), but only one plays regularly every week (25.0%), while the others play occasionally (75.0%). Respondents mostly consider them-

²MBWay: <https://www.mbway.pt/>

³Pokémon GO: <https://www.pokemongo.com/en-us/>

⁴Nike+: <https://www.nike.com/member/profile>

selves as casual gamers (75.0%), with only one considers him/herself as something between hardcore and casual (25.0%).

As players, they prefer multiplayer (75.0%) over single player (25.0%) games, and prefer to play either online (50.0%) or offline (50.0%) with people they know. Two respondents prefer to play in consoles (50.0%), one in computers (25.0%), and other in smartphones (25.0%). The genres they enjoy playing the most are adventure (75.0%), sandbox (25.0%), and strategy games (25.0%).

All respondents knew what gamification is (100.0%). They know some popular solutions like MBWay (50%), Pokémon Go (50%), Duolingo⁵ (50.0%), and Foursquare⁶ (50.0%), which they also have used.

Only one respondent has knowledge of a gamification solution applied in the workplace to engage workers (25.0%), but did not identify which one. Respondents tend to disagree that such solution would not be a distraction from their work (Mdn=2.5,IQR=1)[1–Strongly Disagree,5–Strongly Agree].

7.5.4 Motivation – Gamification User Types Hexad

Motivation was also evaluated using the survey response scale developed by Tondello et al. to score respondents' acceptance towards Gamification User Types Hexad framework's motivators [36]. We asked respondents to rate how well each of the 24 items describes them in a 7-point Likert scale. As suggested by the authors, items were presented without identifying the corresponding type and in random order.

For all items relating to the same user type, their scores were added up to calculate how representative that user type was for the respondent. As each user type has four items, the maximum score is four times four, i.e. 28 (100%).

7.5.4.A Team A

Two respondents had a single strongest user type, while one had three strongest types: Philanthropist, Socializer, and Achiever, suggesting that this player is intrinsically motivated.

Figure 7.11 presents the mean and standard deviation of the scores score (as the sum of each item's rates) and the number of times the user type was the strongest, for each of the six user types. We can see that the average score for the achiever was the higher, although it was the strongest type for only one respondent. Socializer was the most common user type, but was the third highest average score. Disruptor type had the lower average score.

⁵Duolingo: <https://www.duolingo.com/>

⁶Foursquare: <https://foursquare.com/>

User Type	Score		Strongest Type	
	mean	st-dev	number	%
Philanthropist	24,67	2,08	1	33,33
Socializer	24,33	3,06	2	66,67
Free Spirit	23,00	4,58	1	33,33
Achiever	25,33	2,08	1	33,33
Disruptor	16,00	2,65	0	0,00
Player	23,00	1,73	0	0,00

Figure 7.11: Team A – Average scores, standard deviation, and number of times as strongest types for each Hexad user type.

7.5.4.B Team B

All respondents had a single strongest user type: two Philanthropists and two Achievers, suggesting that these players are intrinsically motivated.

Figure 7.11 presents the score and user type for Team B. We can see that Philanthropist and Socializer, two user types based on intrinsic motivation, were the only main user types observed and thus the one with higher average score, contrasting with the Disruptor type who had the lower average score.

User Type	Score		Strongest Type	
	mean	st-dev	number	%
Philanthropist	25,25	2,22	2	50,00
Socializer	22,00	1,15	0	0,00
Free Spirit	22,50	2,38	0	0,00
Achiever	24,25	2,06	2	50,00
Disruptor	18,50	7,51	0	0,00
Player	22,75	0,96	0	0,00

Figure 7.12: Team A – Average scores, standard deviation, and number of times as strongest types for each Hexad user type.

7.5.5 Conclusions

The results of this study shows that respondents from both teams recognize the existence of benefits in reporting time, both for the company and themselves. They believe that having a defined deadline to perform the task is important and can have a positive impact on the project, and a lack of a defined deadline can negatively impact the time reporting process. They consider time reporting a time consuming task they often forget to do, but reporting time daily using a simple and user-friendly tool can improve

the process.

7.5.5.A Team A

Respondents classified some initiatives to cope with a low reporting ratio regarding their importance and motivation they provide. Results show that some initiatives can be considered important but do not provide motivation, and vice-versa.

Respondents are casual gamers with different gaming habits who like to play socially. Their strongest Gamification User Types suggest they are mostly motivated by intrinsic rewards.

These results suggest that they might prefer simple but engaging games and are motivated by social interaction. Respondents have contact with gamification, and two have experienced gamification solutions in the workplace, but they do not agree on whether such initiative would be a distraction from their work.

7.5.5.B Team B

However, they think that doing this task daily, receiving reminders, and using a simple and user-friendly tool can improve the process. Respondents classified some initiatives to cope with a low reporting ratio regarding their importance and motivation they provide. Results show that some initiatives can be considered important but do not provide motivation, and vice-versa.

Respondents are casual gamers that play frequently who like to play socially. Respondents have contact with gamification but only one experienced a gamification solution in the workplace. They agree that such initiative would not be a distraction from their work.

Their strongest Gamification User Types suggest they are mostly motivated by intrinsic rewards. These results suggest that they might prefer simple but engaging games and are motivated by social interaction.

7.5.5.C Results significance

The statistics presented in this report are not statistically significant due to the reduced number of answers, and thus cannot be generalized to other settings. However, these results translate some characteristics of this team, although the insights from two team members are missing.

8

Evaluation

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In this chapter, corresponding to the Evaluation step of DSRM, we start by informing on how our Proposal described in Section 6 is evaluated to solve the Research Problem described in Section 3.

To evaluate the prototype's performance, quantitative analysis is performed using the submission rates for the metrics, before and during the deployment of the prototype.

Given that the surveys and focus groups were performed ahead of the prototype iteration, and therefore its results taken into consideration to the app demonstration, both Focus groups and Surveys are instead present in the Demonstration chapter, in Section 7.4 and Section 7.5 respectively. We therefore perform the quantitative analysis of the data collected during the experiment, by interpreting the data related to the worklogs obtained directly from Jira Software.

8.1 Description of datasets

The Jira Software worklogs came in Comma-separated Values (CSV) format and XGamify data came in 'mysqldump' format. Data was parsed using Python, Excel, and Google Spreadsheets, and charts were created using Google Spreadsheets.

All data is project-scoped, meaning we do not have access of team or user data outside the project, and split in three datasets per project, as follows:

- **Dataset 0:** this first dataset is analogous to the time from the project's inception until the project-s/teams were first exposed to XGamify;
- **Dataset 1:** this dataset maps to the time between the moment the teams were first exposed to XGamify until the time reporting gamification solution was implemented;
- **Dataset 2:** this third and final dataset maps from the previous mentioned moment, until the end of the experiment – in 9th of September 2019.

First two datasets, analogous to the historical data (merged into one), map to Iteration 1. Iteration 2 is mapped from the data where XGamify with gamified time tracking is present. The table below provides a visual representation of the timeline of the experiment with the projects. The dataset that includes gamified worklogs is in bold.

8.2 Team A Analysis

Team A registered 1189 total worklogs, 672 worklogs on 129 issues in the first iteration, and 517 worklogs on 60 issues in the second iteration. Six people registered more than 10 worklogs across the entire length the project, although a total of 12 people registered worklogs.

Project	Iteration	Dataset	Start Date	End Date	Work Days
Project 1 Team A	1	0	2018-08-08	2019-03-11	194
		1	2019-03-11	2019-05-06	
	2	2	2019-05-06	2019-09-09	91
Project 2 Team B	1	0	2019-01-14	2019-03-11	81
		1	2019-03-11	2019-05-06	
	2	2	2019-05-06	2019-09-09	91

Figure 8.1: Project datasets and iterations

Participant worklogs had an average of 3 hours and 27 minutes time spent per worklog, increasing to 3 hours and 49 minutes in the second iteration. From the 672 worklogs registered in the first iteration, 282 (42%) referred to the day they were logged on. On the second iteration, this increased to 55.7%, where 288 of the 517 worklogs were registered on the day. Regarding the number of days to record a worklog, average decreased 1.05 days, from 2.63 days to 1.58 days.

Figure 8.2 displays a floating bar chart of the user averages from both iterations. A filled bar represent a decrease, while a filled bar represents an increase in days of worklog submission.

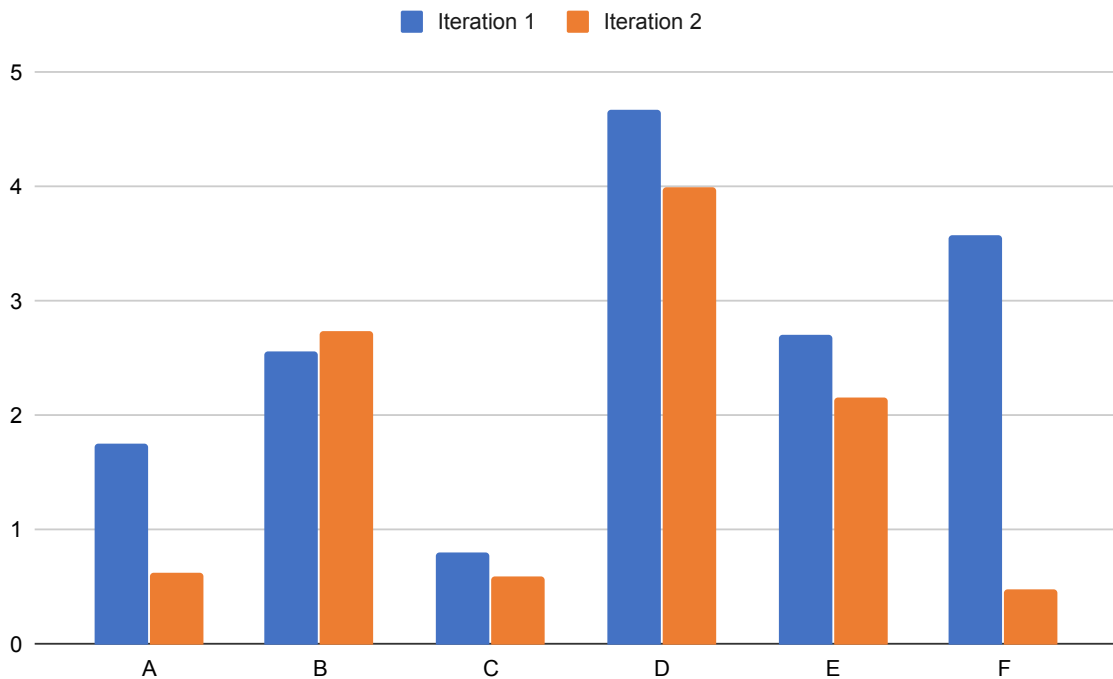


Figure 8.2: Bar chart displaying the per-user average worklog submission delays for Team A.

8.3 Team B Analysis

Team registered a total of 392 worklogs, 202 in the first iteration, and 190 in the second iteration. Although a total of 11 developers submitted worklogs, only 3 of them submitted more than 10 worklogs.

Participant worklogs from Team B had an average of 3 hours and 30 minutes time spent per worklog, increasing to 4 hours and 35 minutes in the second iteration. From the 202 worklogs registered in the first iteration, 59 (29.2%) referred to the day they were logged on. On the second iteration, this decreased to 21.6%, where 41 of the 190 worklogs were registered on the day. Regarding the number of days to record a worklog, average increased 0.18 days, from an average of 4.31 days to an average of 4.49 days to record worklogs.

Figure 8.3 displays the user average worklogs for Team B.

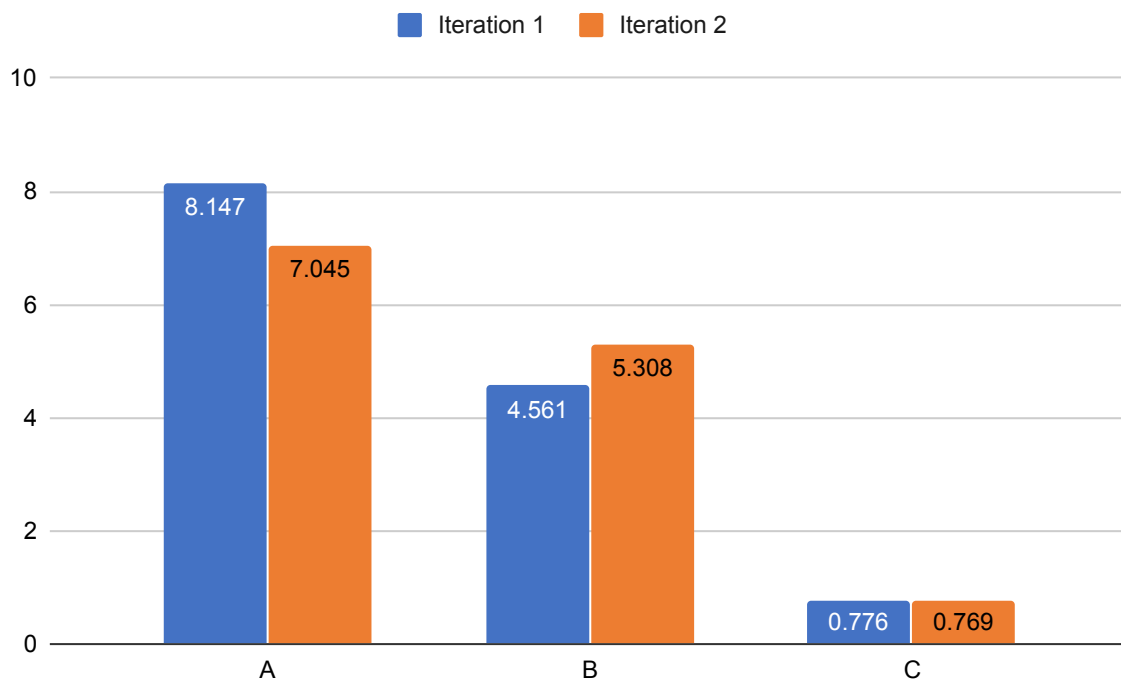


Figure 8.3: Bar chart displaying the per-user average worklog submission delays for Team B.

8.4 Discussion

While in Team A we observe an improvement in worklog submission delay, in Team B we observe almost difference. Although results from Team A improved, and are comparatively better than Team B's, we can observe a fair amount of outliers – which may be related to the experiment being performed during vacation season, when participants went on vacations.

Team B's worklog delays were negative, but also almost imperceptible. We were informed at the start of the experiment that Team B's project was not on progress, which had a strong impact on this team's results. Figure 8.4 displays the differences between Team A and Team B, which are considerable.

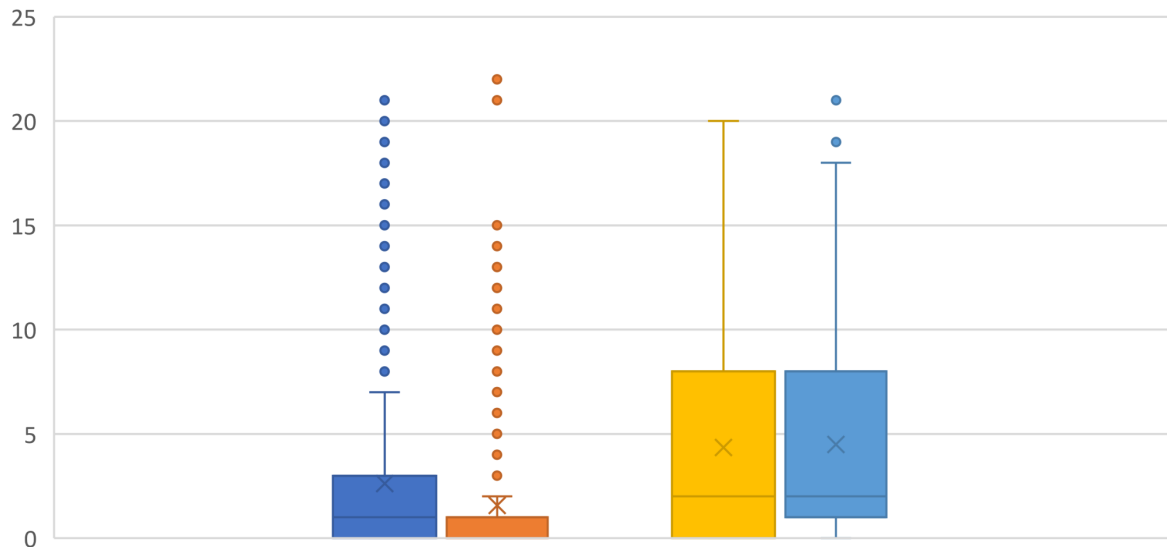


Figure 8.4: Box plot comparing the two teams: Team A (Iterations 1 and 2) and Team B

Due to limitations in Jira, we could not track whether the implemented reminder notifications had any direct impact on users' worklog delays.

We were also unable to formally determine whether participants were engaged with the time reporting process, as we did not perform interviews with them after the experience, due to time restrictions. Nonetheless, some participants mentioned that they were enjoying the experience, along its duration, and once after it had finished.

9

Conclusion

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9.1 Communication

This section corresponds to the Communication step of DSRM, informing on how the research problem and the proposed solution, as well as the obtained results, are going to be exposed to the scientific community and other relevant audiences.

With this research, leading to a dissertation to be publicly published, we contribute to the fields of gamification and software development with: the adaptation of gamification solution to improve the time reporting submission process and providing the scientific community with more analysed data regarding user behaviour and opinions and of gamification.

9.2 Lessons Learned

We have identified time reporting as an essential process in software development organizations, and the lack of timely reports filled from the practitioners, mainly because of forgetfulness and lack of motivation; we also proposed a gamification solution to improve the submission rates of the time reporting process and combat the motivational issues.

The contrived focus groups further validate the importance and problems regarding time tracking. Although quantitative results show an improvement in one of the teams, they were considered inconclusive.

9.3 Research Limitations

Although there were no major limiting factors hindering the research of this thesis, the lack of literature regarding applying gamification for time tracking made the process more challenging.

Working with organizations also proved to be difficult, primarily due to its unpredictability regarding delays, commitment, and requests to adapt the proposal to better suit the organization's needs. Results were also compromised due to evaluation being performed in the summer, during vacation season.

9.4 Future Work

Closing off, future work includes further testing the current implementation of XGamify and the exploration of different gamification techniques to further improve XGamify.

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Gamification Tables

A.1 Table of Points and Levels

ID	PROJECT			GLOBAL		
	Level Name	Old XP	New XP	Level Name	Old XP	New XP
1	Newbie	0 - 25	0 - 50	Newborn	0 - 100	0 - 200
2	Apprentice	26 - 50	51 - 150	Beginner	101 - 200	201 - 600
3	Resolver	51 - 100	151 - 300	Climber	201 - 400	601 - 1200
4	Warrior	101 - 200	301 - 500	Fighter	401 - 800	1201 - 2000
5	Hero	201 - 400	501 - 900	1st Officer	801 - 1600	2001 - 3600
6	Pro	401 - 800	901 - 1700	Captain	1601 - 3200	3601 - 6800
7	Boss	801 - 1600	1701 - 3300	Big Chief	3201 - 6400	6801 - 13200
8	Master	1601 - 3200	3301 - 6500	Godfather	6401 - 12800	13201 - 26000
9	Veteran	3201 - 6400	6501 - 12900	God	12801 - 25600	26001 - 51600

Figure A.1: Table of adapted XGamify experience points and levels.

A.2 Table of Badges/Rewards

ID	Name	Category	Type		Metric
1	Recordist	Chronos	Badge	Individual	Record a daily worklog 5 times
2	Time Tracker		Badge	Individual	Record a daily worklog 10 times
3	Time Zealot		Badge	Individual	Record a daily worklog 20 times
4			Gems (1)	Individual	
5	Time Keeper		Badge	Individual	Record a daily worklog 50 times
6			Gems (2)	Individual	
7	Guardian of Time		Badge	Individual	Record a daily worklog 100 times
8			Gems (4)	Individual	
9	All Day Every Day		Badge	Individual	Record consecutive daily worklogs for 2 weeks (10 working days)
10			Streak-Skip Card	Individual	
11			Gems (5)	Cooperative	
12	Consistency Expert		Badge	Individual	Record consecutive daily worklogs for 4 weeks (20 working days)
13			Gems (4)	Individual	
14			Gems (12)	Cooperative	

Figure A.2: Table of added XGamify Badges/Rewards.

A.3 Table of Notifications

Trigger	Message	Description
Reminder		
Worklog	The "Recordist" badge is close! You already recorded 4 worklogs.	"Recordist" badge: launched when the user records the 4th worklog
Worklog	The "Time Tracker" badge is close! You already recorded 9 worklogs.	"Time Tracker" badge: launched when the user records the 9th worklog
Worklog	The "Time Zealot" badge is close! You already recorded 18 worklogs.	"Time Zealot" badge: launched when the user records the 18th worklog
Worklog	You are close to win 1 gem! You already recorded 18 worklogs.	Receiving 1 Gem: launched when the user records the 18th worklog
Worklog	The "Time Keeper" badge is close! You already recorded 45 worklogs.	"Time Keeper" badge: launched when the user records the 45th worklog
Worklog	You are close to win 2 gems! You already recorded 45 worklogs.	Receiving 2 Gems: launched when the user records the 45th worklog
Worklog	The "Guardian of Time" badge is close! You already recorded 90 worklogs.	"Guardian of Time" badge: launched when the user records the 90th worklog
Worklog	You are close to win 5 gems! You already recorded 90 worklogs.	Receiving 5 Gems: launched when the user records the 90th worklog
Worklog	The "All Day Every Day" badge is close! You already recorded 9 consecutive worklogs.	"All Day Every Day" badge: launched when the user records the 9th consecutive worklog
Worklog	A Streak-Skip Card is close! You already recorded 9 consecutive worklogs	Streak-Skip Card: launched when the user records the 9th consecutive worklog. IF the user has one or no Streak-Skip cards.
Worklog	The "Consistency Expert" badge is close! You already recorded 18 consecutive worklogs.	"Consistency Expert" badge: launched when the user records the 18th consecutive worklog
Worklog	You are close to win 2 gems! You already recorded 18 consecutive worklogs.	Receiving 2 Gems: launched when the user records the 18th consecutive worklog
Time	Hello! You have logged work for *Days* days in a row! Don't forget to work your log today to keep the streak!	Current Logging Streak: launched every week day at 11am
	Yikes! You almost lost your streak of *Days* days... Luckily, you had a Streak-Skip card! Don't forget to log your work!	
	Oops! Seems like you lost your logging streak of *Days* days. No problem! Log your work today for a fresh start.	
Time	Don't forget to log your work today to keep your *Days*-day streak!	Logging Reminder: launched at 4pm to remind the user to record one worklog during the day, if (s)he hadn't recorded it yet.
Achievement		
Streak-Skip	Yey! You unlocked a <i>Streak-Skip</i> card.	Unlocked a Streak-Skip Card.
Worklog	You recorded a worklog! You received *XP Earned* points.	Recorded the first worklog in the day
Worklog	Wow! *# Consecutive Worklogs* worklogs in a row! Awesome! You received *XP Earned* points.	Recorded worlogs in consecutive days
Feedback		
Worklog	We love card hoarders, but you can only have 2 cards at a time!	Launched when the user records the 10th consecutive worklog, but already has two cards.
Login	You have a lot of updates! Go check the activity feed!	Launched when the user has more than 6 notifications in the pipeline

Figure A.3: Table of added Notifications to XGamify.

B

User Worklog Data

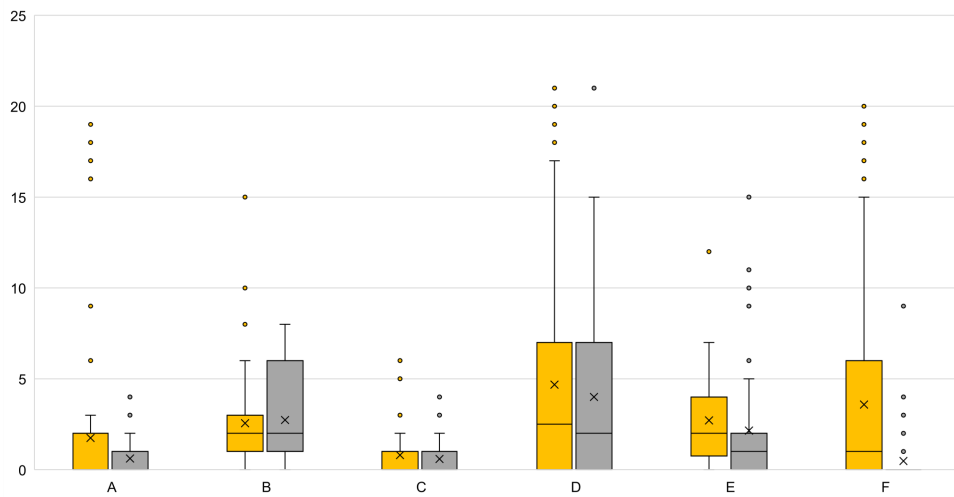


Figure B.1: Team A: worklog submission delays per user

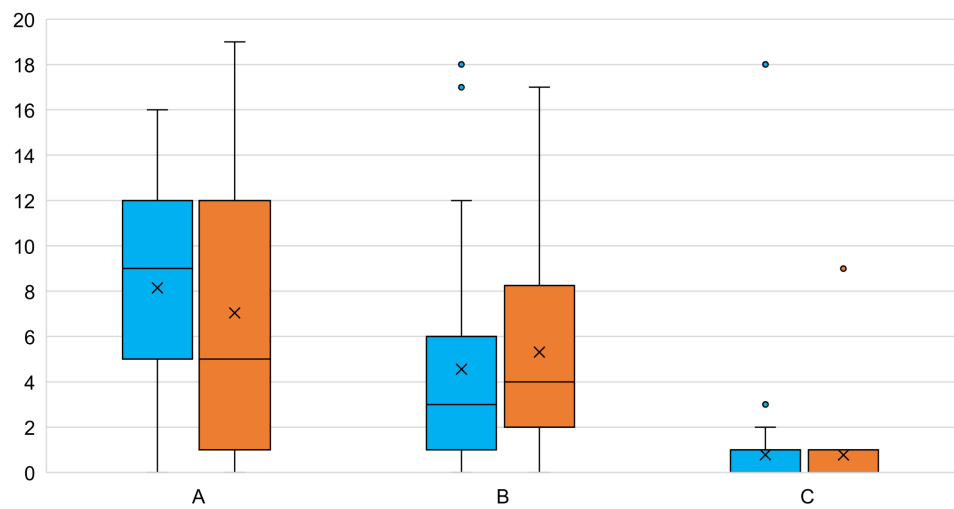


Figure B.2: Team B: worklog submission delays per user