Using gamification for improving time reporting

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Abstract: Time reporting is an essential process for companies, but often employees fail to timely report the time they spent working on different tasks. To address this problem, we propose an extension of an already existent solution to gamify software development practitioners' work to make the time reporting task more engaging for employees. This solution was built upon the Jira core mechanism for time tracking and evaluated with a team of five employees in a Portuguese small consultancy group. Results showed meaningful improvements in this team's practices, particularly for one employee, but these changes must be validated with the team to understand if they occurred due to the gamification solution or due to other external factors. In the future, the solution will be improved based on these findings and evaluated with the same and other teams.

Keywords: gamification; time reporting; work process; motivation; employee engagement.

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1 Introduction

Improving employees' productivity represents a major challenge for most companies, especially regarding routine, repetitive, and monotonous tasks, which are usually not motivating. One example is the reporting of time spent working on different tasks. This task is required by most companies to understand how and where employees' time is invested, which in essential to measure employees' performance and better allocate the organisation's resources.

Despite the importance of this task for companies, employees often fail to properly and timely report their time. Some of the underlying reasons include their lack of motivation and forgetfulness; the lack of a clear deadline; and the perceived low priority of the process (Marques et al., 2019).

Because such tasks cannot always be designed, companies can try to improve employee engagement, which is proven to positively influence productivity (Markos and Sridevi, 2010). In turn, this goal can be achieved by applying gamification, the use of game design and elements in non-game contexts (Deterding et al., 2011), to improve employee motivation and engagement in the workplace (Reeves and Read, 2009; Alsawaier, 2018). Therefore, gamification might help increase employees' completion of tasks related to time reporting according to the company's requirements (Simpson and Jenkins, 2015; Marques et al., 2019).

In this paper, we propose a gamification solution to improve employees' motivation and engagement in reporting time timely. This solution was implemented as an extension of an already existent Jira Software app that gamifies software development practitioners' work, more specifically those behaviours related to Scrum practices (Marques et al., 2020). This extension is built upon the Jira core mechanism for time tracking, which allows to report time directly on the issues that describe that work[1].

The proposed solution was evaluated with a team of five employees at a Portuguese small consultancy group, whose insights were collected during a focus group session and with a survey. The impact of the gamification solution was evaluated by comparing two metrics that reflect the time reporting performance related to three periods: before using gamification; while using the original solution; and while using the extended solution with game mechanics for time reporting.

Results showed meaningful improvements in the time reporting performance of this team, particularly for one employee. Nevertheless, this quantitative data must be validated with the team using methods such as interviews or surveys. In the future, the solution should be improved not only to address some of the challenges encountered, but also to explore different game elements that promote other motivational factors.

We start the paper with an analysis of related work, including the gamification solution this research work is based on. Afterwards, we present the results of a task analysis with the studied team, followed by the method used. After presenting and discussing the results, the paper closes with some conclusions and future work.

2 Related work

Gamification adds game elements and game design to make tasks related to real-world problems and goals rewarding for themselves (Werbach and Hunter, 2012), thus creating incentives without incurring into high costs. However, gamification solutions are not full-fledged games: they just particular parts of games (i.e., game elements) in an already existing process (Deterding et al., 2011). A successful gamified experience need not incorporate all possible game elements, but rather only those that better serve the defined goals (Werbach and Hunter, 2012).

Gamification solutions are highly complex information systems since they focus on multiple aspects of a specific context. Therefore, the design of a gamification solution should always consider the context analysis; high involvement of end users; and early

testing of design ideas; so that the solution can be effective in achieving its goal (Morschheuser et al., 2018; Koivisto and Hamari, 2019).

This recent but popular approach has been used to understand how to engage and motivate people to adopt new behaviours (Werbach and Hunter, 2012). This motivation can be classified as either intrinsic (the activity is inherently interesting) or extrinsic (the activity leads to a separable outcome) (Ryan and Deci, 2000). Gamification can have a positive effect on intrinsic motivation (Xi and Hamari, 2019), and can help internalising extrinsic motivation (e.g., to help achieve a perceived personal value) (Mitchell et al., 2020). Overall, mostly important is to understand the different motivators and how to foster them.

Gamification has been successfully applied in fields ranging from education (Barata et al., 2013; Nabizadeh et al., 2021) to health (Marques et al., 2017), and is also being widely applied in workplace environments (Ferreira et al., 2017), where evidence exits that such approach can lead to significant improvements in employee engagement (Reeves and Read, 2009).

In fact, play can take an important role in workplaces, allowing employees to develop social relationships, learn new skills, or to simply explore and explain organisational practices and places (Chughtai, 2020). Nevertheless, it is crucial that gamification is implemented in a sustainable way, while bringing value not only to the employees, but also for managers and the organisation (Mitchell et al., 2020).

Some authors conducted more conceptual studies regarding the application of gamification in the workplace, such as the proposal of principles to implement gamification to engage employees to adopt and use work processes (Oprescu et al., 2014); the three steps-method to implement gamification in Business Process Outsourcing industry (Neeli, 2012); and the discussion of challenges affecting gamification initiatives in customer service (Makanawala et al., 2013).

Additionally, some authors proposed concrete solutions to gamify workplace environments, such as the gamified service desk system for improving employees' motivation and service system quality (Surendro and Raflesia, 2016); the gamification model to improve service desk performance (Conceicao et al., 2014); or the gamification system developed to motivate employees to share knowledge (Elm et al., 2016).

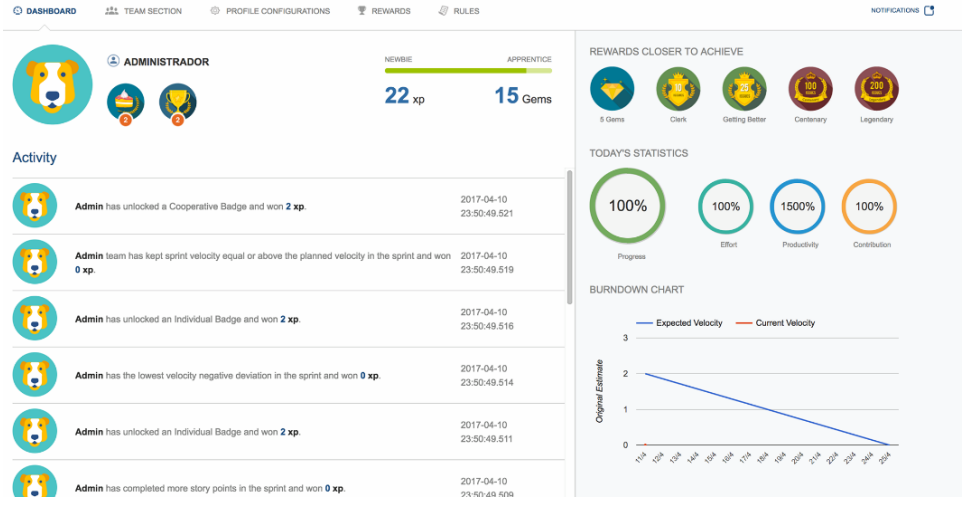
One of the most studied areas is software engineering, with an increasing number of studies conducted and published (Porto et al., 2021). Some examples are the gamified version control system to encourage computer science students to commit more frequently (Singer and Schneider, 2012), a reputation system to improve the quality of collaboratively written code through documentation (Prause et al., 2012), and the gamification model to motivate developers to pay more attention to good coding practices (Foucault et al., 2019).

From these, we highlight the Jira Software gamification app to increase employees' engagement and motivation in implementing Scrum (Marques et al., 2020). This contrasts with other proposals, which are often standalone applications requiring employees to use a separate tool for gamification. However, for a gamification initiative to be successful, it should not make major changes to the way people work and the tools they use to at the beginning, to avoid change resistance (Alhammad and Moreno, 2020).

This solution was designed by following the 6D Framework (Werbach and Hunter, 2012), an iterative game design process composed by six steps that supported the gamification design. The *dashboard* presented in Figure 1 displays some players' information regarding one Scrum project, including players' experience points (XP),

current level, and rewards. These rewards can be either badges or gems and can be unlocked individually or based on cooperative challenges. Players get positive feedback through pop-up notifications to inform them if they are performing the target behaviours or guide them otherwise. They can see information of their team members in the *team*'s page.

Figure 1 Project dashboard of the gamification solution (see online version for colours)



The same authors proposed a generic gamification solution to make time reporting tasks more engaging for employees, which can be adapted to an organisation's time reporting process and employees' profile (Marques et al., 2019). This solution was also designed by following the 6D framework and implemented as a prototype named *Game O'Clock* using Google Suite[2] technologies. In this gamification system, players are challenged to report time within the defined period. They also compete in teams, and team members are rewarded if all of them comply with the reporting deadline. Players progress through levels instead of points, which are illustrated with an expression of a main character. By the end of the defined period, players can unlock dynamic badges (which are lost if they stop performing the target behaviour) and receive feedback in the *challenges* page.

This solution was evaluated with the 28 students of a post-graduation course. Although results suggest that the number of submitted timesheets slightly improved, players were not more motivated to report time because the app is too simple to be engaging. They believe that points are essential for gamification, and despite enjoying badges, their implementation should be improved. Most of the improvements suggested are hardly achieved without a more powerful tool that does not pose as many limitations.

To the best of our knowledge, this is the only research work exploring the potential of gamification to improve time reporting. Some tools such as Microsoft Dynamics 365[3] and SSW Time Pro[4] have been gamified with some game elements, but they are not focused on this process and there are no public studies available evaluating their application.

Overall, there seems to be potential in applying gamification to the time reporting process. There are already many studies on how to use gamification to motivate employees to follow varied work processes, which are mainly conceptual or solutions that were implemented as a separate tool. The only research work we are aware of that uses gamification to motivate employees to timely report their time has many limitations, including the use of a simple and less powerful technology. In this paper, we propose to extend an existent gamification solution to cover time reporting tasks.

3 Task analysis

This research work was conducted in a consultant group with approximately 70 employees that mainly provide software services, but also some products. The company started using Jira Software five years ago, replacing all internal tools used until then. The five participants are part of team A (anonymous name), which was previously invited by the company's director to participate in the research. All team members voluntarily accepted.

Participants were studied during a focus group session and via a survey, following the same protocols used by Marques et al. (2019). The goal was to understand how time reporting was being implemented in this team; the challenges they encounter; and possible solutions to address them. We also wanted to study the team's gaming habits and how game mechanisms could help addressing such challenges.

The focus group session was conducted with all but one team members (who was on holidays) in the company's office for 40 minutes. A semi-structured protocol was followed to allow for flexibility and improvisation, which consisted of six parts: interviewees' characterisation; use and opinion about Jira Software; experience and insights regarding time reporting; and experiences with games/gamification. The survey was built using Google Forms[5] and disseminated by e-mail to all team members, being open for one month. Three responses were received, all considered valid (response ratio of 60%). The questionnaire had sections on demographics; time reporting; and games and gamification. The outputs of both methods are presented and discussed below.

3.1 Team A

Team A's project started in September 2018, five months before gamification was implemented. This team was formally focused on service management, but the participants considered their tasks as more related to product management. Because this project's client was a government entity, their priorities were often changing and were hard to establish a work routine.

Team A was composed by five people, three of them aged between 26 and 35 (according to the survey results) and all with a graduate degree. The four team members who participated in the focus group session are characterised in Table 1.

Table 1 Team A members' characterisation

Questions	*A1*	*A2*	*A3*	*A4*
Main role(s)	Project manager	Developer	Developer	Developer
Education and training	BSc and PhD in IT Engineering	MSc in IT Engineering	BSc in IT Engineering	BSc and post-grad in IT Engineering
Years of experience	10 years	3 years and 4 months	1 year and 5 months	9 years and 10 months
Time at the company	10 years	3 years and 4 months	1 month	5 months
Past experiences	None	None	Software developer in an IT company	Software developer in two large consultant groups

Respondent A1 is the project manager of the team. She started her career in this company 10 years ago and completed a PhD while working there. A2 joined the company three years and four months ago, right after his graduation. A3 and A4 started working there one and five months ago, respectively, but this was not their first professional experience. All team members hold a degree in IT engineering, and agree that the team was very cooperative, and not competitive. All team members were focused on the project's success and work together to achieve their goals. A5 was responsible for the project's quality assurance but did not participate in the focus group session.

3.2 Time reporting

All employees of the organisation must report the time they spend working on their tasks directly in the issues that describe that work. This is a built-in Jira core mechanism for time tracking that is integrated with Tempo Timesheets[6], an app providing more functionalities such as the possibility to generate reports and scheduling vacations. The organisation goal is for everyone to report all their time by the end of the work week. However, many people often forget to report their time.

A1 identify the lack of habit and forgetfulness to submit as the main reasons affecting a proper and timely time reporting. Because people do not establish a routine, and often work on five or six issues simultaneously, they lost track of the work done, and end up not complying the defined deadlines. Forgetfulness was also reported in the survey as being one of the main challenges affecting time reporting ($\tilde{X}$ = 4, IQR = 0.5), along with the lack of a clearly defined deadline ($\tilde{X}$ = 5, IQR = 0.5) and due to being a time-consuming activity ($\tilde{X}$ = 4, IQR = 0.5). Moreover, A2 admits he delays the time reporting task for as long as possible. He considers that not having timely access to issues where they must report time (e.g., like the timeslot for this focus group session) hampers the process.

In the survey, we asked respondents to evaluate the importance of the seven initiatives listed in Table 2 [1 – not important, 5 – very important], and to rank them based on the motivation they provide them to report time. Respondents believe that the definition of an official deadline ($\tilde{X}$ = 4, IQR = 1), the possibility to report time daily ($\tilde{X}$ = 4.5, IQR = 1.25), and the usage of a simple and user-friendly tool ($\tilde{X}$ = 4, IQR = 0.75) are the initiatives with most impact on the process. Oppositely, respondents

believe that comparing reported hours with peers is not very important ($\tilde{X}$ = 2, IQR = 0.25). 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 ($\overline{x_w} = 1.67$).

Table 2 Impact of some initiatives to improve time reporting and a classification of their importance for the process

Initiative	*Importance*		*Motivation provided (weighted average)*
	Mdn	*IQR*	
Comparing reported hours with my peers	2	0.5	6.67
Implementing analytics based on hours reported	2	1.5	4.00
Possibility to report hours every day	4	0.5	4.33
Having a simple and user-friendly time reporting tool	4	0.5	3.33
Having an automatic login system to record time	3	0.5	4.67
Definition of an official deadline	4	0.5	1.67
Reminders for reporting time	3	1.5	3.33

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.

In fact, A1 suggested during the focus group interview that having an automatic mechanism based on commits could help improving the time reporting for software developers, but the problem remains for other roles. Likewise, A2 thinks that automatic reporting would be a good but not viable solution. A3 suggested that using an incentive (like a reminder) could alter his behaviour.

All participants agree that reporting time allows the organisation to understand how and on what employees are working, and if the estimates are precise (i.e., the time estimated is the time spent performing the task) according to the planned work. Although A2 feels he does not benefit from reporting time, A3 says he enjoys the pressure he feels for having to report time complying with the estimations, and A4 says that reporting time allows her to understand how much time it takes for her to perform a task.

Overall, survey respondents believe that reporting time is useful for both the company ($\tilde{X}$ = 5, IQR = 0.5) [1 – strongly disagree, 5 – strongly agree] and employees ($\tilde{X}$ = 4, IQR = 1), as presented in Table 3. Important metrics can be extracted from this process, which can be used to identify bottlenecks and optimise work processes ($\tilde{X}$ = 4, IQR = 0.5) and by employees to monitor their productivity ($\tilde{X}$ = 4, IQR = 1) and improve their work practices ($\tilde{X}$ = 4, IQR = 1).

Table 3 Agreement with facts related to time reporting

Reporting time…	*Median*	*IQR*
...can benefit the organisation.	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 organisations identify bottlenecks and optimise work processes.	5	0.5

3.3 Games and gamification

All respondents liked to play games, but only A2 played regularly, mostly to seek the feeling of progression, achieving objectives, and winning. A1 sometimes played board, mobile, and social games with her kids, while A3 and A4 stopped playing regularly after they started working. Survey results showed that two respondents considered themselves as casual gamers (66.7%) and one as something between hardcore and casual (33.3%). As players, they preferred multiplayer (66.7%) over single player (33.3%) games and preferred to play offline with people they know (100.0%).

All respondents knew what gamification was and had previous experience with gamification solutions. A1 used gamification during her PhD thesis to motivate the requirements elicitation activity. She said that while some people were motivated by game elements, others found it childish and did not enjoy the experience. A2 experienced a gamified course in college, which he thought was very fun and motivating. A3 used the app *Habitica*[7], but his motivation dropped quickly, as the app was too complex and requires discipline in recording tasks. A4 worked in a company where the employees' evaluation process was gamified. Though she left the company shortly after the introduction of gamification, she enjoyed the experience, where employees were 'crew people' in a virtual spaceship who were given 'missions'. Regarding gamification's benefits, A2 considered that this approach makes work more interesting; A3 thought it stimulate people to be more proactive; and A1 and A4 believed that gamification can be very appealing to younger people. There was no agreement with the premise that a gamification solution would not represent a distraction from their work nor in the focus group, nor in the survey work ($\tilde{X}$ = 2.5, IQR = 1)[1 – strongly disagree, 5 – strongly agree].

3.4 Summary

In this team, people often forget to report time. Having a governmental entity as customer hampers the establishment of a routine, as employees may work on many issues simultaneously. In parallel, people not always have access to the issues where they must report the time. Forgetfulness was another main reason for not reporting time, which can be mitigated with some reminders. They consider that having a defined deadline for reporting time is important but is not a problem in this company. However, the possibility to report time daily can impact the process. Using a simple and user-friendly tool or

having an automatic system to report time are good alternatives, but not feasible to be implemented in this company.

Team members were young and mostly considered themselves casual gamers with different gaming habits. All participants knew and had used at least one gamification solution. Two participants had experienced gamification solutions in the workplace, but they did not agree on whether such initiative would be a distraction from their work.

4 Method

This paper proposes a solution based on the two described in Section 2. We propose to extend the Jira Software app that gamifies software development practitioners' work according to the Scrum framework (Marques et al., 2020) to cover the time reporting task. This extension was based on the generic gamification solution to make time reporting more engaging, which follows the steps of the 6D framework (Marques et al., 2019). The proposed solution was not only based on the results of these two previous works, but also on the task analysis with the team members described in Section 3.

By developing a solution for a more sophisticated tool, we can overcome the technological limitations posed by the *Game O'Clock* tool. Additionally, this tool already belongs to employees' current workflow and extends an already evaluated solution that has proven to have some impact.

After developing the proposal, a baseline study was conducted based on historical data extracted from the team's Jira Software instance. Afterwards, the team started using the original Jira Software gamification app without the time reporting task gamified. Finally, the extended solution was deployed, and a second field study was conducted. The results of these three studies are presented in Section 5 and compared and discussed in Section 6. In the next subsections, we describe the 6D framework's steps and the solution.

4.1 Define objectives

The goal of this solution is to improve the rates of time reporting of the team. Although the company has established the end of the week as the deadline for reporting time on all tasks, their goal is to promote a daily reporting of time on tasks that belong to the currently active plan and that are not formally finished.

4.2 Delineate target behaviours and metrics

The behaviour that translates the defined objective is for employees to report the time they spent working on their tasks on the day it refers to, on tasks that belong to the currently active plan, and that are not formally finished. The metrics used to measure this behaviour are the rate of records performed on the correct day (i.e., the submission rate), and the number of days taken to perform this record, both per employee.

4.3 Describe your players

To describe our players, we considered not only the factors listed by Marques et al. (2020) that are likely to motivate software development practitioners, but also the task analysis discussed in Section 3.

Overall, we confirmed that this team is very cooperative and likes to contribute to the overall success of the project. As most of them enjoy playing games, we hypothesise that they also like to receive rewards and incentive based on relevant feedback.

4.4 Devise activity cycles

Both works define that players should engage in a cycle where they receive immediate, positive, and constructive feedback regarding their performance. This feedback should create awareness regarding their compliance (or not) with the target behaviour and motivate them to take further action. This feedback can be provided not only as encouraging messages, but also with game rewards, for example.

4.5 Do not forget the fun

We kept the fun-providing elements already presented in the original solution, because the same type of players is targeted. Moreover, the task analysis in Section 3 shows that this team is motivated by many of the factors previously identified.

Additionally, we believe that reporting time daily can be more fun if a continuously challenge is implemented as a streak mechanism, which players must keep by performing the target behaviour.

4.6 Deploy the appropriate tools

The tools used to build the gamification solution, i.e. the game elements and software, were mostly reused and adapted from the original Jira Software gamification app, as they are still adequate for promoting this new behaviour. Contrarily, not all the game elements implemented in *Game O'Clock* fit this solution. For example, grouping people in different teams every day to compete would not be feasible, as people would not have time to bond and compete with one another. Nevertheless, some mechanisms were kept, such as having cooperative challenges that are awarded with rewards.

Despite the company using Tempo Timesheets for more advanced time tracking features, this gamification solution was built upon the Jira core time tracking mechanism. Otherwise, we would be creating dependencies with a third-party app and would have to split the solution between two tools. Consequently, this solution cannot currently detect holidays and vacations (i.e., days where players must not report time).

Each time record in Jira is called 'worklog', and the aggregate amount of time logged in an issue is recorded in a 'time spent' field. This solution rewards players for recording, at least, one worklog per day, independently of whether they record more. To be considered valid, these worklogs must comply with the following conditions:

- reported on the day it refers to
- registered on an issue that belongs to the current plan

- registered son an issue that is not already closed (status *done* or *resolved*).

Although this solution aims to motivate employees to report all worklogs on the day they refer to, by rewarding only the first worklog we try to avoid players to play around the system's rules (Werbach and Hunter, 2012). For instance, if players were rewarded for reporting individual worklogs on the correct day, they could start breaking large worklogs into many smaller ones. Therefore, we intend to motivate players to record worklogs more often and timely.

To promote consistency, we applied the concept of streaks in the daily time reporting: players are more rewarded the more consecutive days they report at least one daily valid worklog. In other words, when a valid worklog is recorded on a day, the player's streak increases and (s)he wins XP and rewards based on the number of days of the streak. If no worklog is reported on a given day, the streak is lost. This way, the loss aversion endorsed in Game O'Clock by the dynamic badges is also promoted.

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

$$P(n) = 1 + round\left(2 * \log_2(n)\right)$$

To allow players to occasionally fail without being penalised, a new type of reward was added: the streak-skip cards. Players can hold at most two simultaneously streak-skip cards (to avoid card hoarding), which they can use to keep the streak after failing once.

Table 4 Rewards created in the solution to award the behaviour related to time reporting (see online version for colours)

Icon	*Type*		*Name*	*Description*
	Badge	Individual	Recordist	Record a worklog in the day 5 times
	Badge	Individual	Time tracker	Record a worklog in the day 10 times
	Badge	Individual	Time zealot	Record a worklog in the day 20 times
	Gems	Individual	1	
	Badge	Individual	Time keeper	Record a worklog in the day 50 times
	Gems	Individual	2	
	Badge	Individual	Guardian of time	Record a worklog in the day 100 times
	Gems	Individual	4	
	Badge	Individual	All day everyday	Record daily worklogs for 2 weeks (10 days)
	*Streak-skip card*	Individual		
	Gems	Cooperative	5	
	Badge	Individual	Consistency expert	Record daily worklogs for 4 weeks (20 days)
	Gems	Individual	4	
	Gems	Cooperative	12	

The rewards created are presented in Table 4. Just as in the original solution, rewards are linked with both individual and cooperative achievements, where the whole team must accomplish the achievement for the reward to be unlocked. Rewards are either related to the total number of worklogs recorded and to the consistency in keeping streaks.

More immediate feedback was added in the form of pop-up messages. Besides including reminders and achievement notifications for unlocking the rewards, reminders for recording time and keeping the streaks are launched twice. Every day at 11am players are reminded of the length of their streak, or if they failed in the previous day. If at 4pm the player still has not recorded any worklog, (s)he is reminded again.

All other game elements and functionalities from the original solution were kept. Some of these elements are also implemented in *Game O'Clock* but in a different way, such as the badges. Additionally, game elements such as levels and the unordered leaderboard are global in the app and reflect players' performance regarding all gamified behaviours.

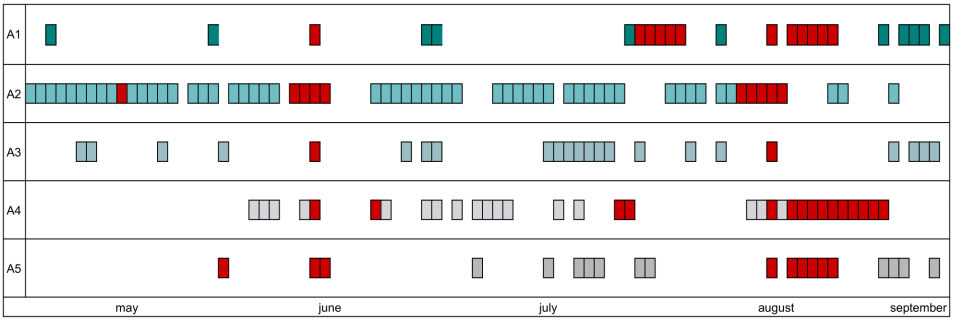
5 Results

We start by presenting the gamification results and then present and compare the values of the metrics defined in Section 4.2 between the baseline and two field studies. This way, we can understand how the team behaved regarding the gamification solution and how and if this is reflected on the results between studies.

During data analysis, we identified some activity from employees outside this team. Their activity was residual and thus removed from the analysis. Given the reduced size of the analysed sample, no statistical analysis was conducted, but results are analysed using descriptive statistics.

The gamified time reporting was introduced in the second field study, which lasted for four months and comprised 91 working days. In Figure 2, the number of days where each player recorded, at least, one worklog per day that complied with the conditions presented in Section 4.6 are highlighted.

Figure 2 Days where players recorded at least one worklog that complied with the defined conditions (see online version for colours)



Note: Holidays and vacation are represented with red.

Table 5 Metrics calculated during the three studies by employee

	Baseline study				*First field study*				*Second field study*			
	Total	*Submission rate*	*Days to submit worklogs*		*Total*	*Submission rate*	*Days to submit worklogs*		*Total*	*Submission rate*	*Days to submit worklogs*	
			Mean	*Std*			*Mean*	*Std*			*Mean*	*Std*
A1	139	0.50	0.93	1.57	31	0.48	1.32	1.81	120	0.57	0.71	1.02
A2	148	0.38	6.13	8.05	60	0.50	2.67	3.52	128	0.83	0.73	2.05
A3	52	0.23	4.98	5.96	56	0.27	7.70	9.76	107	0.27	5.73	6.49
A4	34	0.50	3.82	8.13	41	0.61	1.29	2.66	76	0.61	0.78	1.45
A5	29	0.28	3.83	4.32	9	0.11	3.33	2.78	59	0.44	2.86	5.03

A2 recorded a daily worklog in 51 days (57.14%), being the player with more streaks by completing ten streaks, six of them with a duration of at least five days. He unlocked all badges related to the total number of worklogs possible in this study but did not unlock any consistency reward. However, if holidays were not considered in the streaks, he would have unlocked the badge for recording worklogs in ten consecutive days. A2 was clearly the player that more consistently recorded worklogs, although it seems that he started missing more daily worklogs by the end of the study.

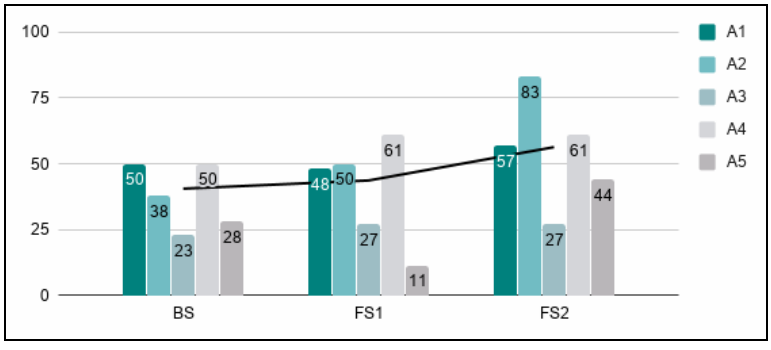
A3 was the second player with more daily worklogs recorded, with a total of 21 in 91 (23.08%). He completed four streaks, one with six days, and unlocked three badges related to the total number of worklogs. Likewise, A4 also completed four streaks, one of six days. She recorded 17 daily worklogs (18.68%). Both A1 and A5 recorded 11 daily worklogs (12.09%), completing two and three small streaks, respectively.

A1, A4, and A5 unlocked two badges related to the total number of worklogs. Besides A2, no player was close to unlock a consistency reward (badge, gems, or streak-skip card).

The metrics defined in Section 4.2 are presented in Table 5 for each study and employee. The baseline study and the first field study had a duration of seven and two months, respectively.

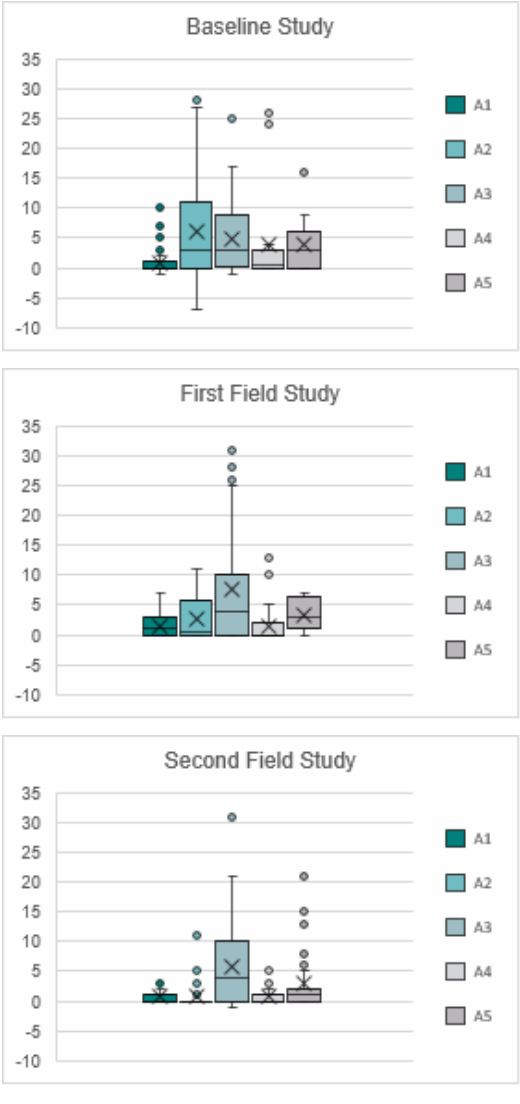
The team's submission rate between studies is presented in Figure 3. The team's mean submission rate seems to be increasing through the studies, although the individual submission rate of some players did not change too much, particularly for A1, A3, and A4. Instead, A2's submission rate increased a lot throughout studies. A5's submission rate decreased when introducing the gamification solution without the time reporting but increased a lot after gamifying time reporting.

Figure 3 Team A's submission rate between studies (see online version for colours)



Overall, the number of days that employees take on average to record their worklogs decreased through the studies, as shown in Figure 4. While only A1 stood out in the baseline study as the one taking the fewer days to record worklogs, in the second field study only A3 stands out as taking the most days to record worklogs. Another interesting result is that some worklogs were recorded a few days before the work was done, mostly during the baseline study.

Figure 4 Boxplots representing the number of days employees take to record worklogs in each study (see online version for colours)



A2's decreased a lot the number of days he took to record worklogs. In the baseline study, he took an average of 6.13 days (std = 8.05) to record a worklog, which changed to 2.67 days (std = 3.52) after another behaviour being gamified in the tool, and finally to 0.73 days (std = 2.05) after the time reporting process was gamified.

However, A3 took several days on average to record his worklogs, a value that increased when comparing the baseline (4.98 days, std = 5.96) and the second field studies (5.73 days, std = 6.49). The number of days he took to record worklogs varied a lot in all studies.

A5 seems to have slightly decreased the number of days it takes her to record worklogs, despite the presence of some outliers in the second field study. Although A1 and A4 only record between 50–60% of their worklogs on the correct they, they usually only take a few days (less than 5 usually) to comply with this task.

6 Discussion

The most prominent result of this study was A2 clear change of behaviour. He was the employee complying the least with the recording of worklogs on the correct day, and even admitted thinking this process was not beneficial and delayed it until possible. However, not only he started recording a daily worklog, but also recorded most of his worklogs just a few days after. This could be explained by the fact that this employee is interested in games and is a regular player.

Contrarily, A3's behaviour did not seem to change after introducing gamification. Despite stating that receiving an incentive (e.g., a reminder) could motivate him to report in a timelier way, he seems to be taking more days to record worklogs in the field studies. It remains important to understand why this employee did not alter his behaviour, particularly if the provided incentives were not adequate to his profile.

Despite having the lower submission rate, A5 increased the number of worklogs submitted on the correct day in the last study. She is the employee with fewer worklogs but does not seem to take too long to record them. This employee did not participate in the focus group session; thus, we do not have insights of her profile that can further explain these results.

Similarly, A1 and A4 have a submission rate of 50–60% during all studies, but they usually do not take long to record their worklogs. Moreover, they are complying with the company standards, which require worklogs to be submitted by the end of the work week. Throughout studies they seemed to decrease the number of days for recording worklogs. These two employees are usually consistent in reporting their time, which might be explained by the fact that they were the two team members who valued the time reporting process the most.

Overall, meaningful improvements were observed after using the gamification solution, particularly for one employee. Although game elements only rewarded the first correct behaviour of the day, the target behaviour globally improved. This means that players not only performed the bare minimum to receive rewards but improved their overall performance.

Participants' behaviour changed when gamification was introduced without comprising the time reporting task. Would be interesting to understand how the exposure to gamification led to a behaviour change, or if the team was subject to other external factors, such as having a reduced workload. Overall, results must be validated with the participants using methods to collect more qualitative data, such as interviews or surveys, to validate the quantitative data analysed (Alsawaier, 2018).

These players have different profiles, and probably were not engaged with the solution equally. Indeed, the employee who played the most seems to be more motivated by the game elements implemented, which in turn were mostly linked with external motivators. This solution would benefit if different game elements were used, to

understand how to create conditions for this intrinsic motivation to occur (Alsawaier, 2018).

Results showed that while the submission rate can be reduced, the number of days taken to report time can widely vary between users. For example, while A3 and A5 report few worklogs on the correct day, A3 often takes many more days to perform this task than A5. Thus, some employees are closer to achieve the goal of reporting worklogs on day than others. Therefore, this solution could also reward players by recognising that while they did not achieve the goal, they are currently improving. This way, not only employees are provided with a sense of progression to keep them engaged (Alhammad and Moreno, 2020), but quality is being rewarded in a broader spectrum (Dale, 2014).

As discussed, rewarding individual worklogs could lead employees to play around the system's rules. One alternative would be to reward the reporting of eight daily hours on the correct day. Nevertheless, because these employees can be allocated to several projects, the app must be active in all existent projects, which was not feasible during this pilot study.

Another issue concerns the disregard of employees' holidays and vacations, which correspond to days where they must not report time. Thereby, the solution can be perceived as unfair, which might condition players' behaviour. However, solving this would require this solution to be linked with Tempo Timesheets, which in turn would create dependencies with an external app and increase the complexity of the software.

In general, these results suggest that gamification can indeed help improving employee engagement with the time reporting work process, in a stronger way when compared to previous research work (Marques et al., 2019). Additionally, we believe this solution can be adapted and used for other administrative tasks that are often repetitive and boring (Simpson and Jenkins, 2015).

We further consider that one of this solution's main strength is to be integrated with a tool that employees already use, which helps ensuring that gamification is not distracting employees from their work (Kumar and Herger, 2013). Moreover, there were some benefits in extending a solution that was already evaluated, as there was already some feedback for the game elements used. Also, gamifying several work processes in the same solution allows for a more in-depth and engaging experience at work.

7 Conclusions

Time reporting is an essential process for companies, but often employees fail to timely report the time they spent working on different tasks. Moreover, there is lack of research on how to address this problem. We extended an already existent gamification solution that is implemented as a Jira Software app to gamify software development practitioners' Scrum tasks. This extension was developed by following the steps of the 6D framework.

After using the original solution for two months, the extended solution to engage practitioners in reporting time was evaluated with a team of five practitioners at a Portuguese small consultancy group for four months. An analysis of relevant metrics collected during the three studies (before using gamification, while using the original solution, and while using the extended solution) showed meaningful improvements in this team's practices, particularly for one employee. These changes must be validated with the team to understand if they occurred due to the gamification solution or due to other external factors.

This work contributes to understand the impact of gamification to improve time reporting in companies. Both researchers and organisations can benefit from these findings to further explore this subject. In the future, the proposed solution will be improved based on findings, and different game elements will be explored to engage and motivate players with different profiles. Then, the solution must be evaluated with the same and other teams. By addressing some of the challenges encountered and creating a solution that uses diverse game elements, the potential of the solution can be enhanced.

7.1 Limitations

This research work poses some limitations. These team members can be allocated to several projects, thus there is a possibility that they did not record at least one daily worklog because they spent that day working on another project where the app was not installed. Additionally, they could not pause the streaks during holidays or vacations, where they were not supposed to report any time, which could have influenced the results. The number of worklogs reported varied a lot between studies and employees and might not be feasible to compare rates based on such different values. For instance, a submission rate of 50% can have different meanings if the total number of worklogs were 100 or 10. To cope with this limitation, we needed to know the target number of worklogs per employee and per study.

This gamification solution rewarded behaviours that are not related to the time reporting process. Although these game elements might have influenced players performance, this was left out of the analysis and must be evaluated in the future. Although results suggest that gamification positively impacted this team, the sample was very reduced and not enough to conduct a statistical analysis. We tried to cope with this limitation by carefully considering descriptive statistics and graphics not only to allow for a better understanding of the results, but also facilitate a comparison with the results of similar future studies. However, these results cannot be generalised to other settings.

Finally, this analysis might lack important insights, as not all team members participated in the focus group session and the survey. A deeper user analysis must be conducted, using methods such as interviews or surveys.

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