Using gamification for improving time tracking

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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

1. Introduction

Many 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* [15].

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 [2].

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 [21], health [12], and marketing [10], researchers and practitioners have been using gamification to make business processes in the workplace more appealing for their employees [6, 8].

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 [13], 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 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. DSRM provides a framework for accessing a design problem, described by Hevner et al. [11] as a "problem-solving process", design science 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.

DSRM describes guidelines for an iterative process, divided into the following six activities: [18]

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; **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; **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; **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; **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; **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.

2. Literature Review

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. 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 is done.

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.

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.

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 [9, 19] and usability. It has been applied across many fields, including marketing [10], education [21], health and fitness [12]. 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 [7], aiming to educate its players in a particular topic, like health care or military defense [17].

Hamari et al. [10] 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 [5].

Feger et al. [6] 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.

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 [14]. Some of the problems identified by the professionals included lack of motivation and feedback, which gamification can undertake.

In later studies, Costa [4] and Marques [13] 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 Software, 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.

3. Proposal
3.1. 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 previously described, by following the 6D gamification design framework[22], detailed in the following subsection.

3.2. Design and Development
The **6D Gamification Design Framework** [22] was chosen as the framework to guide the design and development based on the fact that this framework is the most used and complete for gamification [16].

3.2.1 Define Business Objectives

In order to build a successful gamified system, our goals should be accurately formally defined. As described above, 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.

3.2.2 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.

3.2.3 Describe Your Players

As described by the Bartle taxonomy of player types [1], 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 [3]. 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.

3.2.4 Devise Activity Loops

Designing activity loops is a significant step to engage users with the system. There are 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: "Good job! You have logged 4h/8h today!".

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 progress of logged hours for the given day; a **daily streak** mechanism, displaying the current number of consecutive days that a player has logged their full work hours.

3.2.5 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.

3.2.6 Deploy Appropriate Tools

In regards to technical implementation and deployment, our solution is be implemented as a Jira Software app, as an extension to the **XGamify** app, described in Section 2, to support time tracking and our additional elements. Further details and Demonstration are explained in the following section.

4. Demonstration

Our solution is built upon XGamify, a Jira Software gamification app developed in the scope of agile software development. XGamify includes base gamification components 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.

Our solution iteration consists of extending XGamify to support time tracking, as described by 6D. 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.

To demonstrate the devised artifact, 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. Company A uses Jira Software and Confluence to manage their development processes, as well as Tempo Timesheets to facilitate the time reporting process.

It has around seventy employees, most of which 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.

4.1. App Features

Users using XGamify extended with time reporting mechanism gain XP (experience points) and Rewards when submitting worklogs. After enough XP is gained, the user levels up. 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 experience points P for a given streak of n days is calculated by the following logarithmic formula: $P(n) = 1 + round(m \times \log_2(n))$, where m is a multiplier factor, which was given a value of 2 and n is the number of days of streak.

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 1).
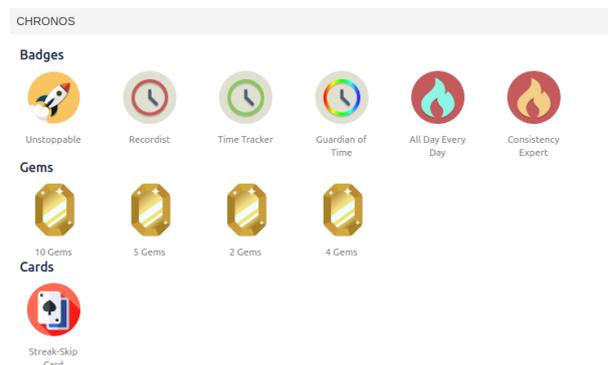

Figure 1: XGamify: Rewards page – Chronos category.

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.

4.2. 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: Characterization of the interviewee; Jira Software level of usage and opinion; Experience with Scrum; Experience and opinion of the time reporting process; Experience with games and/or gamification; Insights about the proposal.

Time Reporting

From Group 2, and regarding the current time reporting process, A2 admits that they delay reporting time for as long as they knows 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.

4.2.1   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 enjoys the pressure they feels for having to report time, complying with the estimations. Participant A4 says that reporting time facilitates their understanding of how much time time it takes for them to perform a task.

B2 considers that time reporting would benefit them if they could access reports with time re-

ported by requirement[1], 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.

Games

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.

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 gamificaton's benefits, A3 considers that

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

this approach makes work more interesting; B4 thinks it stimulates people to be more proactive, and A4 believes that 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.

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.

Discussion

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 [20].

All participants across both teams already knew what gamification what, 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.

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.

5. Evaluation

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

In this chapter we perform the quantitative analysis of the data collected during the experiment. We start by interpreting the data related to the worklogs, obtained directly from Jira Software; and then the gamification data itself extracted from XGamify's gamification logs. The Jira Software worklogs came in 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.

Data is formally split in three datasets per project/team. The first dataset, Dataset 0 is related to the time from the project's inception until the projects/teams were first exposed to XGamify. Dataset 1 maps to the time between the moment the teams were first exposed to XGamify until the time reporting gamification solution was implemented. The third and final dataset, Dataset 3, is from the previous mentioned moment, until the end of the experiment – in 9th of September 2019. After deliberation, Data-sets 0 and 1 were merged into one.

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.

5.1. Team 1

Team 1 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.

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 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.
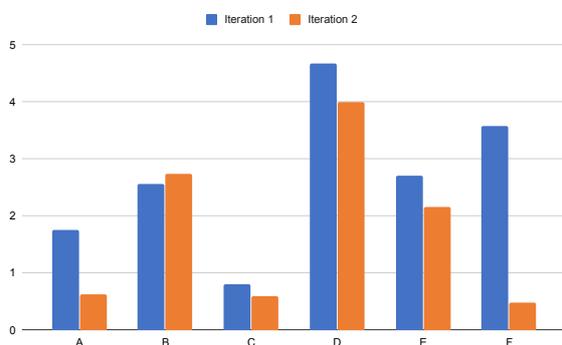

Figure 2: Floating bar chart displaying the per-user average worklog submission delays for Team 1.

5.2. Team 2

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 2 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 3 displays the user average worklogs for Team 2.

5.3. Discussion

While in Team A we observe a significant 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
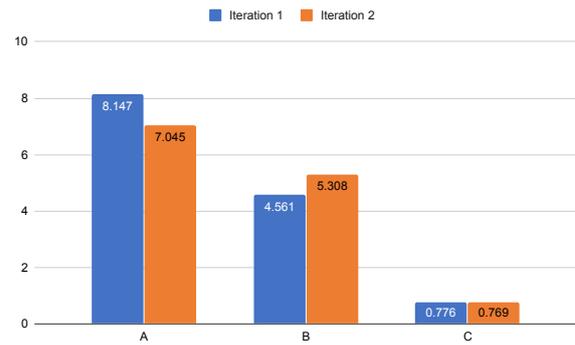

Figure 3: Floating bar chart displaying the per-user average worklog submission delays for Team 2.

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 4 displays the differences between Team A and Team B, which are considerable.
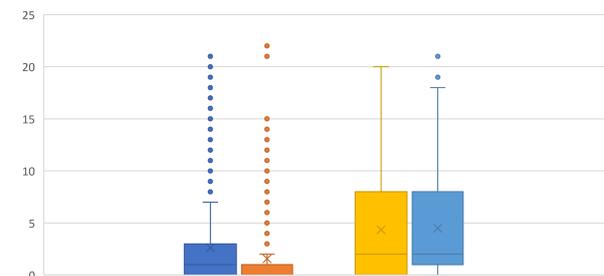

Figure 4: Box plot comparing the two teams: Team A (Iterations 1 and 2) and Team B

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 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.

6. Conclusions

With this research, leading to a dissertation to be publicly published, we expect to contribute to the fields of gamification and software development by: implementing a gamification solution to improve the timesheet submission process; providing the scientific community with more analysed data regarding the effects of gamification.

We have identified time reporting as an essen-

tial 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 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.

Closing off, possible 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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