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A GAMIFICATION FRAMEWORK AS A COLLABORATION MOTIVATOR FOR SOFTWARE DEVELOPMENT TEAMS

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To my family, my wife, my friends,
and specially to my advisor, for
all the time invested helping me to
achieve this work.

“What if we decided to use everything we know about game design to fix what’s wrong with reality?”
(Jane McGonigal)

A GAMIFICATION FRAMEWORK AS A COLLABORATION MOTIVATOR FOR SOFTWARE DEVELOPMENT TEAMS

RESUMO

Gamification é o uso de elementos de jogos em contextos além de jogos para motivar pessoas a atingirem seus objetivos. Seu uso tem se tornado popular nas empresas de desenvolvimento de software devido a este tipo de trabalho ser baseado em atividades cognitivas e intelectuais. Esta dissertação apresenta um framework que identifica problemas comuns de colaboração em equipes de desenvolvimento de software e como podemos aplicar elementos de jogos para mitigá-los, agindo como catalizador de mudança de comportamentos. O framework foi definido baseado em uma revisão de literatura e em um estudo de campo com profissionais de desenvolvimento de software e gamification. Na avaliação preliminar realizada com especialistas, foram encontradas evidências da aplicabilidade desde framework como um motivador para incentivar a colaboração em equipes de software. Este framework pode ser usado por gerentes e líderes para promover mudanças de comportamentos em equipes, pesquisadores para aprofundar os conhecimentos nos tópicos de gamification e colaboração, e designers para desenvolverem práticas de gamification em ferramentas de colaboração de equipes.

Palavras-Chave: gamification, colaboração, framework, equipes, software, motivação.

A GAMIFICATION FRAMEWORK AS A COLLABORATION MOTIVATOR FOR SOFTWARE DEVELOPMENT TEAMS

ABSTRACT

Gamification is the use of game elements in non-game context to motivate people to achieve goals. Its use is becoming very popular in software development organizations due to work being based upon human-centric and brain-intensive activity. This research presents a framework that identifies common collaboration issues that affect software development teams and how to apply game elements to mitigate them by jump starting behavior change. The framework is defined based on literature and on a field study with gamification and software development professionals. In its preliminary evaluation with practitioners and specialists, they presented evidences of the applicability of this framework as a motivator to foster collaboration in software teams. The framework can be used by management to promote behavioral change in their industrial teams and by researchers to advance the state of the art in collaboration in the field. Tool designers can also benefit from it by having access to the comprehensive and compiled body of knowledge to inspire them to design new tools or improve current ones to support collaboration in software teams.

Keywords: gamification, collaboration, framework, software teams, motivation.

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1. INTRODUCTION

The information technology industry is evolving fast. Taking the Internet as an example: by the year of 2000, only half percent of adults in the USA were online, and most using dial-up connection [Sor15]. In 2014, these numbers had increasingly changed: 87 percent of adults were online, and this number goes up to 97 percent, if we consider the ages of 18 to 29. This fast evolution is making software and hardware more complex every year.

A software development process requires creative discourse among team members to design and to implement a novel and competitive product that meets usability, performance, and functional requirements set by the customer [NBG+10]. In other words, software development demands a lot of cognitive effort of those involved with it.

There are software that can be created only by one person. Jonathan Blow, for example, is a programmer and game designer. He decided to create alone, from 2004 to 2008, one of the most successful games for the console Microsoft XBox, called "Braid" [Con15]. He is an inspiration for other lone programmers that are investing in a specific game market called "indie games".

Besides that, the process of software development is usually a collaborative activity with the participation of professionals that work together to design solutions and to produce quality code [dSMP11]. Team members must coordinate the activities, plan actions, make decisions, execute tasks and also communicate to create a software. They need to collaborate with one another.

A good example of the importance of collaboration in software development is Facebook, the famous social media company. The company is growing fast: the software engineering department, for example, has more than 2000 employees. Managers and teams have to deal with daily challenges. To foster collaboration in software teams, the company invest on activities like, for example, a boot camp for new members (where they receive training for technical and soft skills), autonomy for senior engineers to improve the software, distribution of projects based on personal interests and stand up meetings to make team members aware of each work status [Lee11].

Since software engineering has a high dependence with human factors (e.g., communication, trust building, coordination, negotiation, etc.), a large number of issues faced during software development is associated to people [KSSS11]. Collaboration plays an important role in determining the success of a software project [KSSS11].

A successful game saga could be an illustration of one of the biggest failures involving software development teams. Duke Nukem Forever was a sequel to one of the best-selling games in the 1990's era. Created by the mainstream company, called 3D Realms, the game start to be produced in 1997 and was only launched in 2011. During the devel-

opment years, a lot of problems involving technology and, more specific, collaboration and motivational aspects involving teams, managers and producers made this game a failure project, even when finally launched [Tho09].

So, having people and collaboration as critical success factors in software development, it is important to find ways to motivate software teams members to foster collaboration among themselves aiming to avoid difficulties or even failure.

Games have always played an important part in people's life. In 2007 an excavation in Iran discovered one of the most ancient evidences of games played in earlier civilizations: a black gammon board dated from 2500-3000 BC [Ira07]. People in ancient ages were already investing hours of their lives playing and having fun.

In a recent study, Microsoft released statistics that showed that XBoX One owners have spent 2 billion hours playing video game [Mak14]. People also invest hours not playing games but instead watching others playing. A recent article from the Washington Post states that users spent 2.4 billion hours watching others playing competitive video games in the Internet [Dew14].

Video games are also changing the traditional concepts about playing. Forbes Magazine published that parents need to rethink the relationship between kids and video games since a recent research showed that video games can positively impact children in the same way that other traditional forms of play [Sha14].

It is understood that one plays games because it is fun, enjoyable and also challenges one to go "deeper" in the related activity [Csi91]. Good games also make one experience a sense of a fully focused and engaged mind in the activity itself [Csi91]. Therefore, it is expected that games should challenge one in a borderline between too hard and too easy, to create the engagement and fun that is desirable (Figure 1.1).

In the last years, researchers started to study ways to bring this gaming spirit into other contexts and activities, using game elements, mechanics and components as key

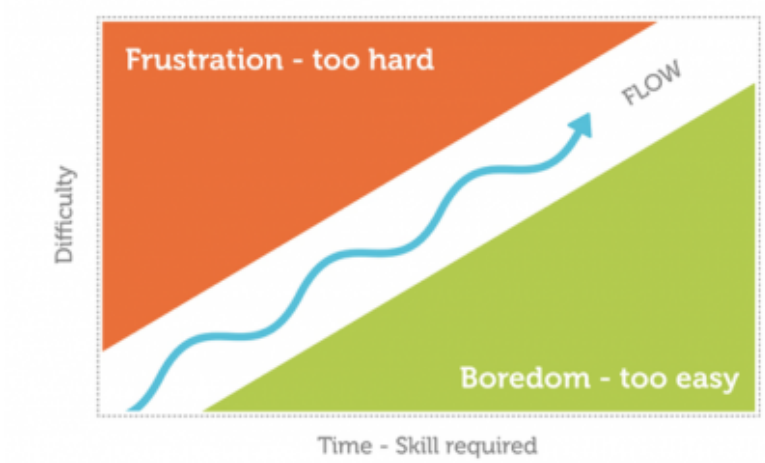

Figure 1.1: The Flow Theory in Games [Csi91]

factors to engage, motivate and change behavior in people [DDKN11]. This was the first step for what is called *gamification*.

Gamification is the use of game elements in non-game contexts [DDKN11]. It has being used in areas like Marketing [Ste14a], Education [BT13] and Health Care [LWC+14]. The idea was to motivate people bringing a different approach to regular activities and tasks.

An example of gamification in non-game contexts is Duolingo [Ray16]. Launched in 2012, this language learning multi-platform application has become one of the most successful case of using gamification. Using the idea that people enjoy turning life' small things into bite-sized, recreational competitions, Duolingo motivate students to keep on track learning English, Spanish, Portuguese, French, etc. by using a key educational approach: repetition. The application transforms the study into an amusing diversion, completed with game elements like points and leaderboards. At the end of each completed round, players are rewarded with a trumpet fanfare and a delicious sense of accomplishment [Ste14b]. Figure 1.2 presents the interface of the application.

The use of gamification also attracted the attention of software organizations. This type of organization depends on knowledge, creativity and cognitive efforts to create software products, with quality and innovation. That is why motivation of software development employees - that is recognized to have the single largest impact on productivity and quality [BBH+08] - gained attention from managers.

There are several studies about gamification applied to work situations written in the last years. For example, focusing in gamification as a tool to assist the participation and motivation of people in carrying out tasks and activities [AVSM12] [TSJG13], as a way to

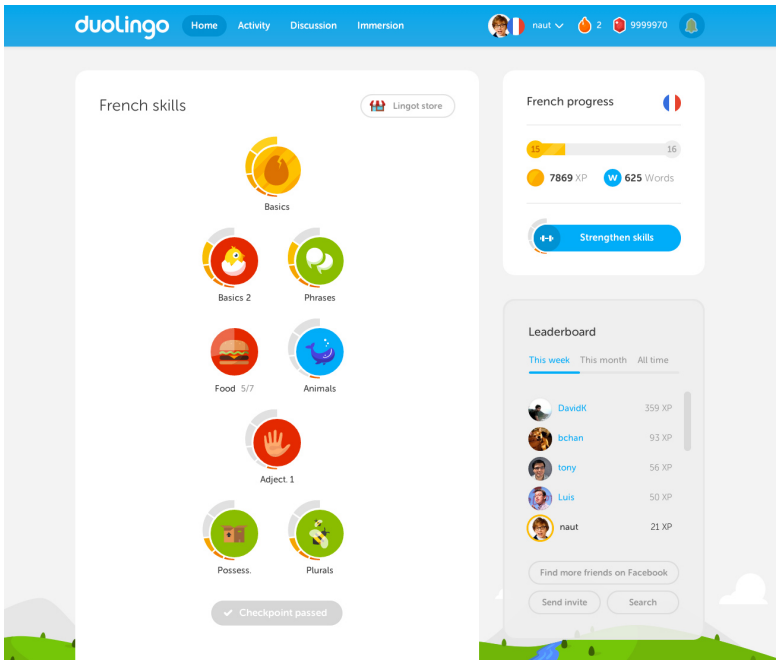

Figure 1.2: Duolingo Application Interface [Ray16]

improve the adoption of software engineering practices for developers [SS12], or to improve internal documentation in software projects [Pra11].

Based on this concept of gamification, this thesis proposes a research to create a framework to jump start behaviors that foster collaboration in software teams using game elements. Based on a literature review and on a set of interviews with practitioners and specialists in gamification and software engineering, evidences of the potential of use of this research were found. These evidences creates opportunities for future works on this topic.

The remainder of this thesis paper is organized as follows: This chapter introduces the research, describes the motivation for this research and presents the research goals, questions and objectives. Chapter 2 describes the related concepts about this thesis. Chapter 3 presents related work associated to gamification applied to software development resulting from a literature review on the topic. Chapter 4 presents the research methodology applied in this work. Chapter 5 presents the final version of the proposed framework, as a result of the research process. Chapter 6 presents the evaluation and threats of validity. Chapter 7 presents the final considerations and future work of this thesis.

1.1 Main Research Goal and Questions

The main goal of this work is to propose a framework of game elements to motivate collaboration in software teams, jump starting behavior change and mitigating collaboration issues. To achieve it, I posed two research questions as stated below:

Research Question 1 (RQ1):

Which are the **most common** collaboration issues in software development in literature?

Research Question 2 (RQ2):

Which game elements could help to **mitigate** these issues?

1.2 Objectives

To achieve the main goal and answer the posed research questions, I defined the following objectives:

a. To identify the concepts of gamification and game elements;

b. To identify the concepts of collaboration and motivation in software development;

c. To identify how gamification can be applied to work environments, more specifically to software development;

d. To identify the main collaboration issues in software development and to which collaboration aspect (e.g., coordination, communication, etc) they are related to;

e. To map which game elements can address the collaboration issues identified in item d;

f. To propose a framework of game elements to motivate collaboration in software teams, jump starting behavior change and mitigating collaboration issues.

g. To conducted a preliminary evaluation of the proposed framework with practitioners who are experts in software development and/or gamification.

1.3 Boundaries of this work

Since software development teams, collaboration and motivation affects a big number of variables that are part of software development scope, this subsection describes the boundaries of this work, in order to fit this research within the time limits of the Master's degree program. Also, it leaves some extra variables that could be researched in further work considering this proposal.

This work assumes a **software development team** as people working together as a team in the same projects and located in the company's building. Team members are coworkers that could be considered as developers, engineers, testers, etc. Managers, clients and executives are described in the framework as stakeholders that influence the projects, but are not part of the team. So, **Collaboration** and **Motivation** were analyzed in the scope of the presented boundaries for software development teams.

Distributed development, global software development and concepts related requires a more complex analysis and were not considered in this first-step present work.

2. RELATED CONCEPTS

This chapter presents theoretical background about the main concepts related to this research: Collaboration and Motivation in Software Development, and Gamification.

2.1 Collaboration and Motivation in Software Development

Software development has evolved in the last decades. The early processes were based upon the idea of sequential development - which is best represented by the Waterfall process - and consists in stages where some specific activities are conducted in a certain order to produce the software. Figure 2.1 illustrates the Waterfall model.

After several years of adoption, professionals realized that the Waterfall model imposes several issues; the main one is related to the difficulty to deal with changes to the software requirements since they are often not completely understood at the beginning of the project [FDF11].

In 2001, a new way of thinking software development started to gain attention, based on the idea of following an incremental and iterative process: the agile development [BBvB+01]. That was the rising of frameworks like Extreme Programming (XP) and Scrum

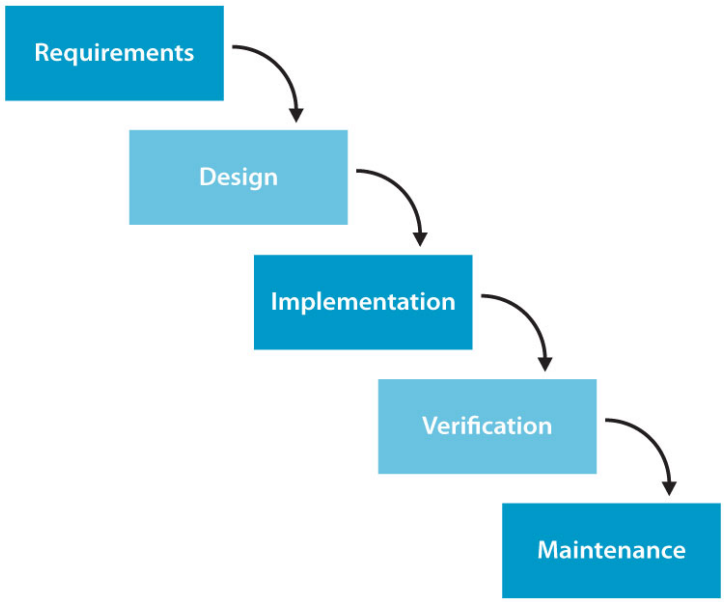

Figure 2.1: Illustration of the Waterfall Process

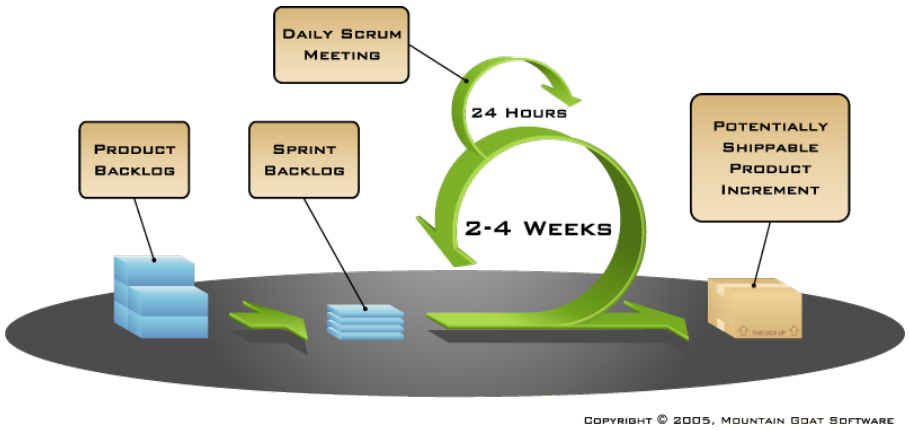

Figure 2.2: Agile Software Development: Scrum Process [Sof05]

(illustrated in Figure 2.2), based upon delivering software in small amounts of time and reconsidering the scope at each new development cycle.

Besides these two different approaches, that represents two of the most used software development processes, they have something in common: the need to have people involved and working as a team to achieve the project's goals.

The software development process requires creative discourse among team members to design and to implement a novel and competitive product that meets usability, performance, and functional requirements set by the customer [NBG+10]. In other words, software development demands cognitive effort of those involved with it.

Having people working in software projects as teams is one of the best ways to produce quality software. Teams can be defined as collectives who exist to perform organizationally relevant tasks, share one or more common goals, interact socially, exhibit task interdependencies, and maintain and manage boundaries [KI06]. Software development teams are a composition of people from different functional areas who have varying technical skills and personalities [AHYD15].

Complex and quality software and hardware are produced as a result of specialists working together as a team. Falcon 9, the space rocket produced by SpaceX company, has successfully took off, delivered a satellite on orbit and landed safe in Florida, being the first successfully rocket to do such thing [Ken15]. All this technology only could be accomplish with the work of thousands of people.

Given that software development is a knowledge-based activity that requires human interaction, researchers have been studying how human factors impact the software development processes. Motivation is reported to have the single largest impact on practitioner productivity and software quality management [BBH+08]. As a consequence, many companies are rethinking their strategies to motivate their employees.

Google, for example, has developed a culture of benefits and perks for their workers [Ste13]. Atlassian, an Australian software company, motivate their employees using a

internal program called "ShipIt", where people should decide an innovation project, assemble teams and try to deliver the project in 24 hours [LaB12]. This idea is reported to energize their engineers and also deliver new features and software in the last years.

Getting the best from people, achieving results through individuals and teams, maintaining consistent high performance, inspiring oneself and others into action – all depend on the skills of motivation [AT04].

Motivation can be drive by internal or external forces. Intrinsic motivation refers to doing something because it is inherently interesting or enjoyable [RD00]. For example, playing a game is an activity that people invest time because of its intrinsic rewards, like satisfaction, fun and autonomy. Extrinsic motivation refers to doing something because it leads to a separable outcome [RD00]. For example, working on a task just because there is a money reward for it. Both kinds of motivation are not exclusive, and could be used together to improve performance, satisfaction, trust, and well-being in the workplace [GD05].

Intrinsic motivation is being discussed in recent years as the focus to engage and motivate employees, because it results in high-quality learning and creativity [RD00]. Pink, in his book, states the advantages of intrinsic motivation compared to the traditional old-school external motivation of fear, money, and rewards [Pin09]. His research has shown that people work better when the tasks have intrinsic rewards. Also, he identifies three factors that motivate people: mastery, autonomy, and purpose [Pin09].

Beecham et al. [BBH+08] conducted a systematic literature review in the topic of motivation in software engineering, and stated that the most frequently cited motivators in literature are: having clear goals and a personal interest on projects, understanding the purpose of a task, having job satisfaction, working on an identifiable piece of quality work, and having a clear career path. Also, the authors stated that the literature suggests it is important to involve the engineer in decision making, and to participate and work with others.

Another example of intrinsic motivation is the one from the Zappos company, an online shoe retailer. With 2,000 employees, the company was bought by Amazon in 2009, but is still famous for establishing the bar when it comes to putting its customers first, aided and abetted by an engaged and happy workforce [Pon15]. The focus on growing and maintaining its unique culture - an intrinsic motivator - can explain its outstanding retention record, particularly assigning more than one-third of the employees to work as customer service agents solving customer problems and taking sales orders.

Besides motivation, another human factor that is quite important to achieve success in software development process is collaboration. Collaboration, when two or more people work together on a task [RS10], is essential to foster the team to achieve goals. Most modern businesses require their workers to establish collaborative relationships to achieve organizational goals [SAS+09]. Software development is a collaborative team endeavor with team members needing to spend considerable time interacting with each other [HM03].

Whitehead [Whi07] explains that one must work together to complete large projects in reasonable time. Kotlarsky and Oshri [KO05] explain collaboration as a complex, multi-dimensional process characterized by coordination, communication, meaning, relationships, trust, and structure.

Kusumasari et al. [KSSS11] stated that collaboration in software development project plays an important role in defining the success of a software project. This importance is evidenced in the most recent version of the Chaos Report [Gro15]. The Standish Group, a research company that publishes this study every year, aims to identify the major factors that cause software projects to succeed or fail. As described in their study, the core of the top project success factors involves people and aspects of communication, coordination and cooperation. For example, the three major success factors are User Involvement, Executive Management Support and Clear Statement of Requirements. Also, the top factors that made projects fail are also related to people and the beforehand mentioned aspects. The three major failure factors are Incomplete Requirements, Lack of User Involvement and Lack of Resources.

Wildt et al.[WMLH15] pointed that organizations develop processes and tools trying to solve issues that, in fact, are caused by communication, trust on people and lack of motivation. Another important statement about collaboration is found in the work elaborated by Treude, Storey and Weber [TSW09]. Their research shown that issues related to communication, cooperation and coordination in software development has increased significantly over the last decade because both industry and academia acknowledge the importance of team work in software development.

Collaboration can be seen as a composition of three other aspects, namely communication, coordination and cooperation [FRGL05]. Communication is related to the exchange of messages and information among people; coordination is related to the management of people, their activities and resources; and cooperation is the production taking place in a shared space, generating and manipulating cooperation objects in order to complete tasks [GPFdL06]. Communication, coordination and cooperation should not be seen in an isolated fashion; there is a constant interplay between them.

A model called the '3C Collaboration Model', originally proposed by Ellis et al.[EGR91] and later extended by Fuks et al.[FRGL05], is used to model and develop Computer Supported Cooperative Work (CSCW) tools and components [FRGL05] [GPFdL06] based on communication, coordination, and cooperation characteristics.

Fuks et al.[FRG+08] instantiate the 3C Model to illustrate their proposal of using it for groupware application. The authors stated that while communicating, people negotiate and make decisions. While coordinating themselves, they deal with conflicts and organize their activities in a manner that prevents loss of communication and of cooperation efforts. Cooperation is the joint operation of members of the group in a shared space, seeking to execute tasks, and generate and manipulate cooperation objects. The need for renegotiating

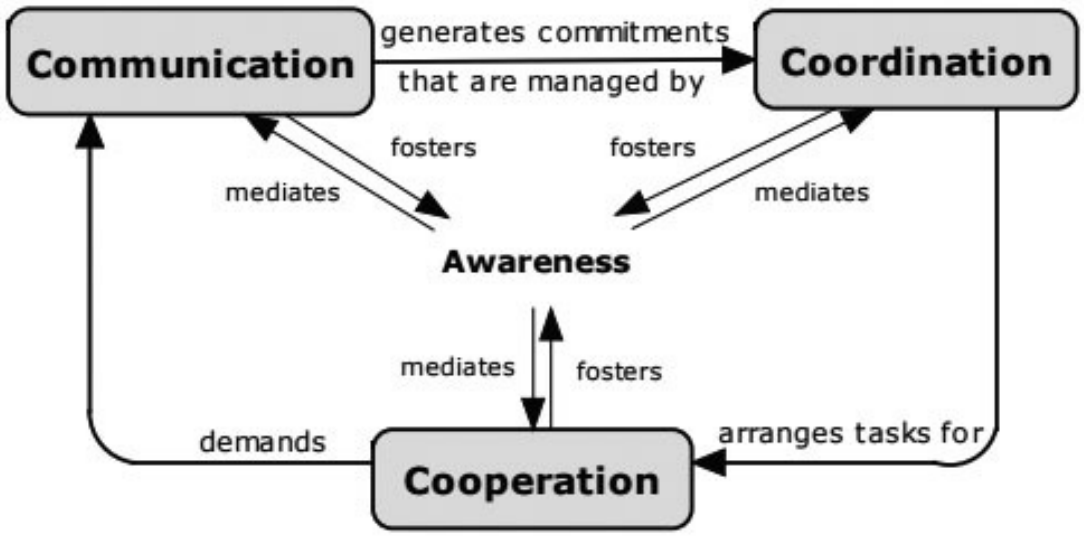

Figure 2.3: The 3C Collaboration Model [FRGL05]

and for making decisions about unexpected situations that appear during cooperation may demand a new round of communication, which will require coordination to reorganize the tasks to be executed during cooperation. Awareness is the element that intermediates these three dimensions offering feedback to users actions and giving them information about other participants of a collaborative work. The illustration of this proposal can be seen in Figure 2.3.

Later, this model was used by Steinmacher, Chaves and Gerosa [SCG10] to help categorizing papers on awareness. Awareness was explained by the authors as an understanding of the activities of others, which provides a context for one's own activities. Its objective is to allow a group of people working collaboratively to realize how and which of their contributions are relevant to the group activities.

The three dimensions used in the 3C Model were described as ontologies to guide team collaboration by Vivacqua and Garcia [VG12]. These ontologies describe a set of activities of a specific domain and its concepts, using symbols to represent a set of tasks. The idea of these ontologies are to help external agents and researchers to understand the vision of the community about the domain in question. Also, Vivacqua and Garcia [VG12] included another dimension to their ontologies about collaboration: group formation, which is necessary to take place before collaboration can happen. This dimension's goal aims to point out why and how groups and teams are formed, their motivation and alignments. Figure 2.4 illustrates the group formation ontology.

It is possible to find evidences of how motivation and collaboration are important aspects for software development teams, influencing directly the quality, productivity and success of projects. Motivation drives the real desire of team members to accomplish their tasks with quality and productivity. The 3C Collaboration Model (communication, coordina-

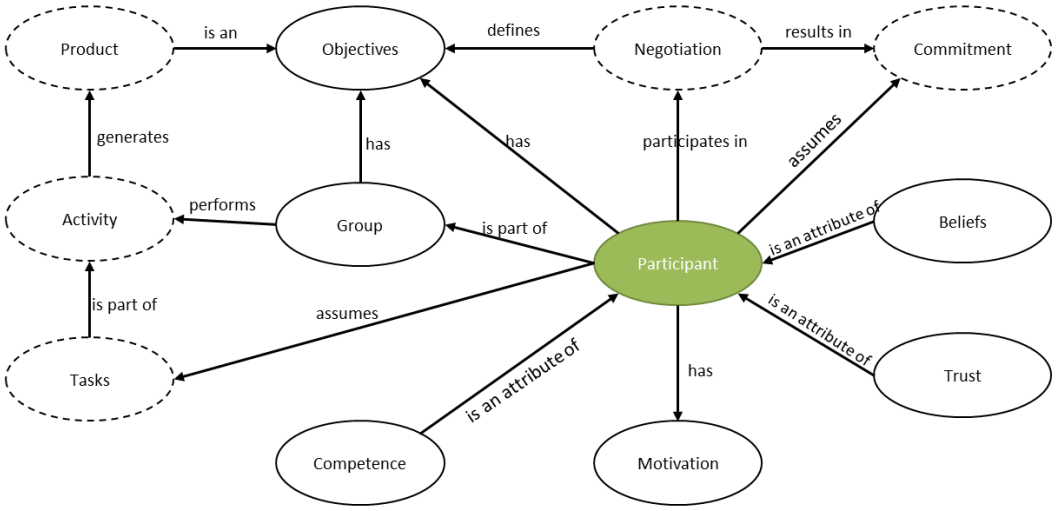

Figure 2.4: Illustration of the Group Formation Ontology [VG12]

tion, cooperation), plus awareness and group formation, are useful dimensions to identify and to evaluate collaboration aspects, challenges and issues.

2.2 Gamification

Games have always been part of people's life. Grey, Brown and Macanufo [GBM10] define games as a composition of the following components: *game space*, an alternative world where players voluntarily agreed to participate; *boundaries*, where activities have a specific time frame and where the limits are well known to all players; *rules for interaction* which are defined and agreed by all players; *artifacts* that could be physical or virtual objects that hold information about the game; and *goal* which is the objective of the game, that defines how it will end and who will be the winner. These concept can be applied to every kind of game: from chess to soccer and to video games.

The Entertainment Software Association, an US association focused on supporting video games, published in its 2015 Industry Facts Sheet [Ass15] that 155 million Americans plays games. Also interesting, they stated that gamers are spending more time playing video games than other entertainment activities, like watching TV or watching movies.

A research conducted by Ramdurai [Ram14], for Google, states that gaming content on Youtube is becoming popular and is attracting the attention from advertisers, because of it capacity to override the boundaries of demographic target and its capacity for engagement. In special, a game called Minecraft, an open-world game where people have full freedom to create content, was the most searched keyword in Youtube in 2014 [Mar15].

Games motivate people. In 2010, Jane McGonigal's speech at TED [McG10] about how gaming can make a better world became very popular and is one of the most viewed

speech on the community website. McGonigal [McG11] later stated in her book "Reality is Broken" that people who play games want to know where in the real world is that gamer sense of being fully alive, focused and engaged in every moment? Also, where is the feeling of power, heroic purpose and community.

Experiments trying to answer these questions have already been executed, presenting evidences that games could help people in "real world". With the idea "that something as simple as fun is the easiest way to change people's behaviour for the better", The Fun Theory project [Vol09], sponsored by the Volkswagen company, created a set of challenges for people of certain cities, trying to change their engagement with specific tasks, like take the stairs in a metro station besides the escalators as illustrated in Figure 2.5. The result of this experiment was that most of people started to use the stairs because of that element of fun.

Nike and Apple created a successful project called Nike Plus, in 2006 [Vil06]. The idea was very simple: putting on a tennis shoes and a digital music player and collecting data on running and publishing it in an online community created for this purpose. The online community was a huge success and enables the company to connect with its customers like never before. Also, with challenges being created frequently, people could create a different perspective for their regular activity of running, with more pleasure and engagement. It is one of the best show cases narrated in history of how games can foster behaviors in people.

Also Keas, a startup which promote employee wellness and compliance, created a platform to apply in companies, whose employees form teams and earn points for completing different challenges like meditating or walking to a meeting or taking a health quiz [Nie13]. This platform uses game-based elements, in order to help people to change their behaviors and to promote healthy activities in the workspace, with more fun involved in it.

Figure 2.5: The Fun Theory Project [Vol09]

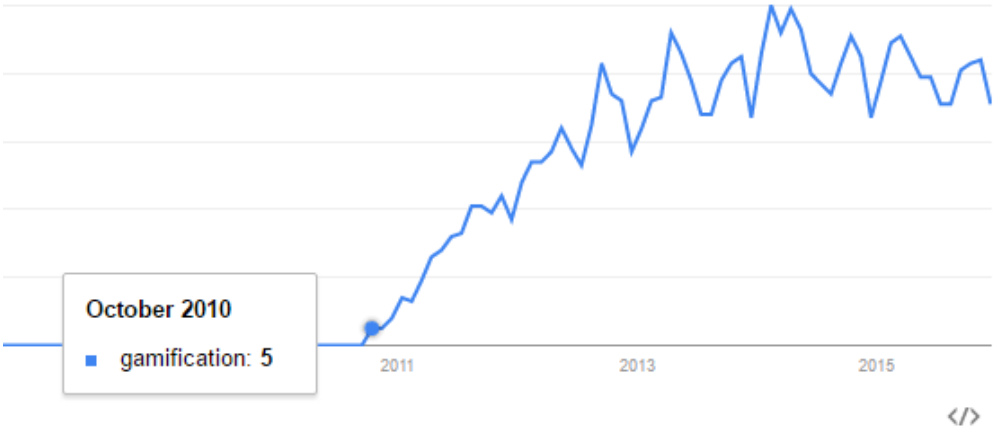

Figure 2.6: Google Trends for gamification

Bringing the aspects and outcomes of games to regular activities is the main idea of a concept called gamification. Besides the definition from Huotari and Hamari [HH12], defining gamification from a service marketing perspective, the widely spread definition of gamification is the use of game elements in non-gaming contexts [DDKN11]. Aspects of play and games may always been incorporated in non-game activities, but gamification represents a more ordered and aware approach. It has been defined as being distinct from design for playfulness, while still often resulting in playful behaviors [KB13].

The term gamification was first used by Nick Pelling [Fit13] in 2003 to describe his work as a consultant for making tasks more fun [Dal14], but only started to gain attention from industry and academia by the second half of 2010 [DDKN11]. The main accepted reason was the popularization of the concept by industry applications and conferences on the topic [DKND11]. Google Trends, an application that explore trends on keywords searched in their database, shows more evidences of the rising of gamification in 2010, as seen in Figure 2.6.

In 2011, Gartner predicted that over 70 Percent of 2.000 global organizations would have at least one gamified application by 2014 [Gar11], and pointed gamification as a mainstream for the next years, as showed in Figure 2.7.

Deterding et al. [DDKN11] state the difference between gamification and its similar concepts like games - the characterization of rules, competition (or strife) towards specified, discrete outcomes or goals by human participants [DKND11]; serious games - the use of games for purposes other than mere entertainment [AR12], and Game Inspired Design - when there is no actual elements from games, just ideas [Mar13a].

Serious games are often confused with gamification, but their definition are quite different: whereas serious game describes the design of full-fledged games for context beyond games purposes, gamification merely incorporate elements of games [DDKN11]. The authors suggest restricting “gamification” to the description of elements that are charac-

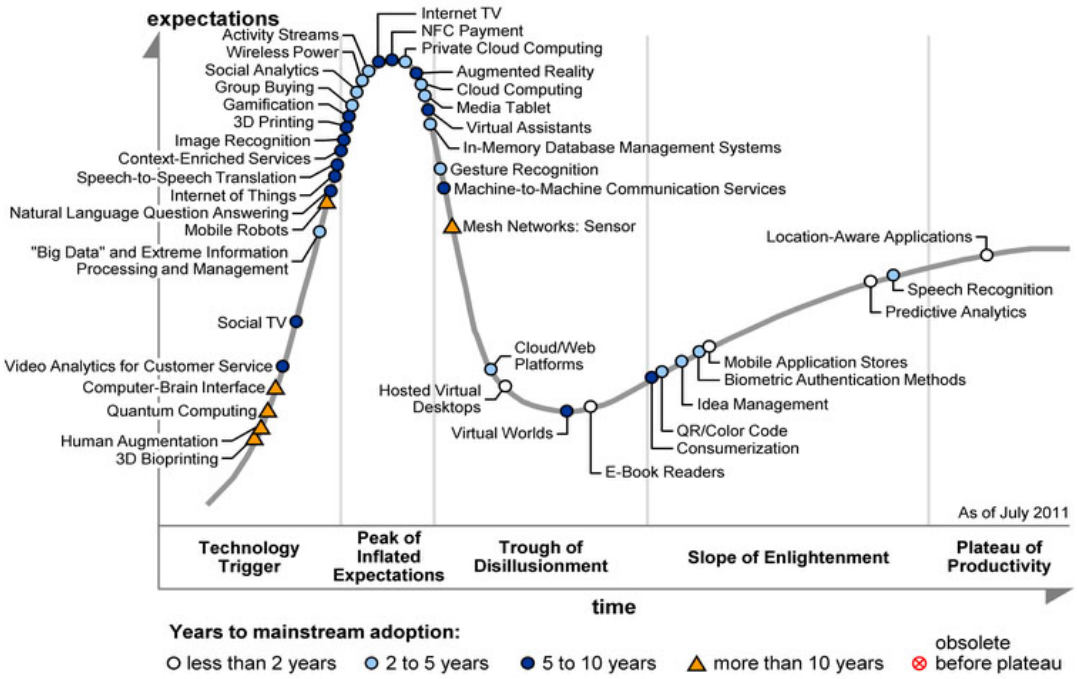

Figure 2.7: Gartner Hype Cycle 2011 [Fen11]

teristic to games – elements that are found in most (but not necessarily all) games, readily associated with games, and found to play a significant role in game playing. Although gamification is based upon the use of game elements and mechanics, there is still no consolidated list or classification of these game elements in literature. For example, Dubois [DT13] reports that the most elementary gamification element, named challenge, consists of a reward mechanism that awards people in response to the accomplishment of certain activities that need to be encouraged.

Reeves and Read [RR09] identified ten game elements described as ingredients of great games, including self representation with avatars, narrative context, feedback, teams, etc. Kumar et al. [Kum13] cite that points, badges and leaderboard (also known as PBL) are among the most used elements for engage and motivate people.

The MDA framework, proposed by Hunicke, Leblanc and Zubek [HLZ04], provides a way to understand the game elements as game mechanics, dynamics, and aesthetics. Mechanics describe the data representations, algorithms and rules that make up a game; dynamics refer to the resulting run-time behavior over time, and aesthetics characterize the player's emotional response [HWKG14]. Zichermann [ZC11] presents a more comprehensive list of game elements interconnected. It is called gamification Loop and is composed by elements such as win Condition, rewards, leaderboards, etc.

Badgeville [Bad11], a gamification company created in 2010 with clients like Oracle, Microsoft and Samsung, created a collaborative wiki in 2011 to list and to describe the most commonly used game elements, composed by 7 game features and 24 game mechanics. This list was organized in order to help external agents to understand each one of these

components. Each game element is composed by a description and discussion, a categorization, which are the benefits of using them, an example, and the game personality types that it could affect. The list of these 31 game elements of Badgeville, which is the basis of this work, will be explored on Section 2.3.

Gamification became recently popular in the Marketing area [Ste14a], Education [BT13] [IDSDK14] and in Health Care [LWC+14] [JMW14]. Because of that, business companies are seeking gamification as a tool to motivate and engage employees in activities and tasks [TSJG13] [AVSM12], to achieve goals [Nee12], and to change behaviors [SS12].

Walmart, for example, started using it in 2012 as a safety training tool, using game options like 'Quiz Show' and 'Simon Says' to engage employees and help them retain the safety information they are provided [May15]. Deloitte, a global consulting company, reinvented its training program with Deloitte Leadership Academy [Mei13b], where trainees learn about leadership. Before learners even begin the online learning programs they must complete their first mission: they watch a 3-minute video, which explains how to use the website, and in the process of watching the video, they are instructed to personalize the site to their learning priorities.

Companies are using gamification because of its specific focus on business goals of the company, and how to keep people engaged in their work [WC13]. Specially in software development organizations, gamification can help to create a better environment that can impact directly on productivity and software quality. Indeed software design and development is intrinsically a human-centric and brain-intensive activity in which the experience, motivation, and discipline of developers represent crucial ingredients [DT13].

Researchers also found evidence for the impact of the use of gamification in software development environments. Singer and Schneider [SS12] proposed the gamification of a version control system to encourage Computer Science students to make more frequent commits. The results of the experiment revealed good practices and pointed to improvements that may help to achieve even better results. Lotufo, Passos and Czarnecki [LPC12] proposed a work to improve bug tracking systems using game mechanisms, to encourage teams to increase the frequency and the quality of their contributions. As a result, they concluded that by applying a reputation and reward system, the improvements are readily accessible.

Moccozet et al. [MTOL13] did not focus on software development, but their work was one of the first studies that tried to understand how gamification and collaboration could work together. They created a gamified online community for students to improve the group work among them. In their work they describe how they gamified the platform and stated how it encouraged students to contribute and collaborate more. Pedreira et al. [PGBP15] created a systematic literature review focusing on gamification in software engineering. They found 29 primary studies, most of them focuses on software development and to a lesser extent on requirements, project management, and other supporting areas.

Besides all this trends, gamification is not a silver bullet and may produce some side effects. A common criticism gave birth to a new expression, named "pointfication" (or "badgefication") [Pen14] that describes the act of creating rewards as points or achievements (badges) without strategy or true meaning for the players. A good example is the social media blog application Tumblr [Alf11] that tried to engage its users by rewarding those who post more with points and leaderboards, in a system called "Tumblarity". This gamification process lead to an increase of pointless blogging by users, in order to earn points, and made users heavily criticize the gamification process. Months later, the company decided to shut down the initiative. Deterding [Det11] pointes out common pitfalls of using gamification without planning. For example, the author states that companies are doing gamification without creating a real fun, pleasure, or challenges to players.

2.3 Game Elements

This section introduces in a detailed manner the game elements listed in the BadgeVille website [Bad11] and used to composed the proposed framework.

The list was composed by 7 game features and 24 game mechanics. Game features, also called basic game elements, are used to help create gameplay in the process of gamification. Game Mechanics are tools, techniques, and widgets that are used as building blocks for gamification [Bad11]. These two concepts are very similar, so this study assume the sum of both categories, which provide a composition of 31 game elements. This chapter will present the game elements selected for this research, and later those which are not selected (and their reasons).

Achievements

Description: Achievements are a virtual or physical representation of having accomplished something. Achievements are a way to give players a way to brag about what they've done indirectly as well as add challenge and character to a game. Badges can be earned from completing tasks/missions in gamification platforms.

Game example: In games, achievements could be medals earned by completing a set of tasks. Figure 2.8 present a set of badges for Rocket League game.

Gamification example: Engage is built to integrate with Salesforce accounts, adding points, challenges, achievements and leaderboards to working culture. IActionable, a gamification consulting company, says that its platform can: be used to increase productivity; be used as a training tool, helping to improve Salesforce adoption amongst new staff by helping them get used to the platform and encouraging old hands to use it to its full potential;

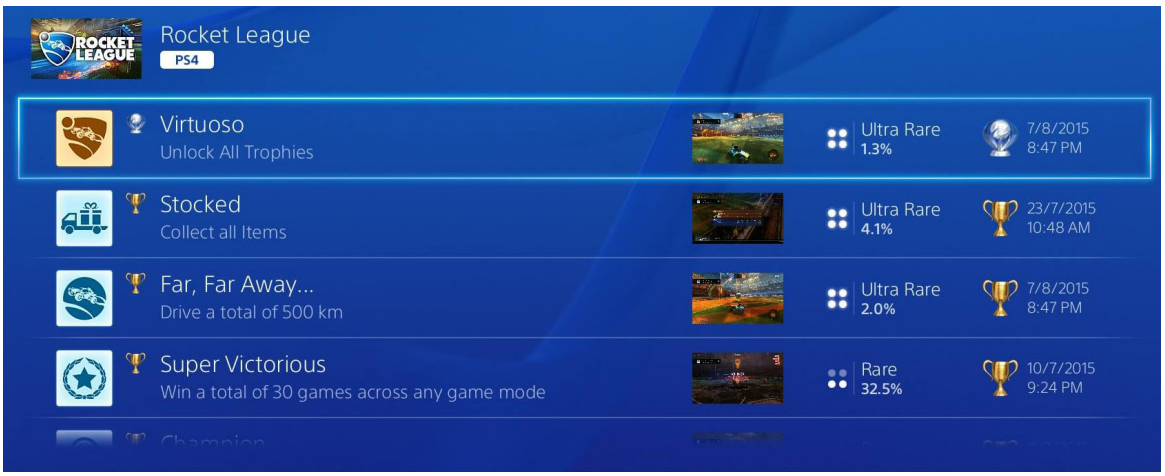

Figure 2.8: Achievements in Sony Playstation 4

help improve performance monitoring, and spur on healthy competition between employees [Bry11].

Activity Feed

Description: The Activity Feed shows players what has been taking place in the gamification system overall. This shows the user that they are not alone and can often show a user a feature or piece of engagement they were previously unaware of.

Game example: In games with multiplayer, the game notifies all users whenever someone have died, achieve something or capture a flag, for example. This motivates all players in the match to turn their attention towards the current status of what is happening.

Gamification example: Kudos Badges, a gamification platform, are being leveraged by applications such as IBM Connections. Users rise in rank through activities such as posting a status update, creating a blog, sharing a file, or having someone recommend your file. These activities are notified to all players, in order to create engagement [Don12].

Appointments

Description: Appointment is a game dynamics in which at a predetermined times or place a user must log-in or participate in game, for positive effect.

Game example: In Farmville, players are required to return to harvest their crops after a specific amount of time has passed after planting. If they do not return within the specified time period, their crops can rot and the player will not earn the value for harvesting the crop.

Gamification example: Atlassian, an global software development company, designed an activity called Ship It, an event that takes place in a specific day, where employees

could join teams and will have 24 hours to work in an innovation project, by themselves. This activity energize the company, with a sense of autonomy and fun [LaB12].

Avatars

Description: Avatars are unique representations for a player. Avatars usually represent a customizable picture or virtual character to represent the player in many visual ways across a website. Games that use Avatars show a high emotional attachment between the player and the game.

Game example: In World of Warcraft players have an Avatar that represents them on the screen. Without this visual representation, the player could easily get lost in all the activity they see.

Gamification example: Second Life, a virtual world that became a success in 2010, uses some game elements. But most basically uses avatars that represent their users. Second Life was used by companies like IBM to foster virtual meetings [Gan12]. Figure 2.9 illustrate the virtual meetings using avatars.

Figure 2.9: Avatars for Virtual Meetings by IBM [Gan12]

Bonuses

Description: Bonuses are a reward after having completed a series of challenges or core functions, and can be rewarded from completing a Combo or just for a specific special task, like finishing a game in a specific time frame or without losing points.

Game example: In game Bejeweled, if you complete a sequence of 5 tiles of same colour, you get a special bonus (like points multipliers) for this.

Gamification example: Nokia, a global mobile company, has begun incorporating "gamification" into its developer community in a bid to motivate amateurs and professionals to create apps for Microsoft's Windows Phone 8 ecosystem. If a developer build an app and include in-app advertising, he will get a number of points. By publishing it to particular markets, he will get considering more points [Loh13].

Cascading Information Theory

Description: The concept of Cascading Information Theory is that information should be released in the minimum possible snippets to gain the appropriate level of understanding at each point during a game narrative.

Game example: Almost every game starts with a mini-tutorial so the player could learn the basis and mechanics of it. First person shooters, like Battlefield for example, start by making the player explore the features of the physics (jump, crouch, run) and the artifacts (guns, explosives, environment objects).

Gamification example: Deloitte, a global consulting company, has a digital training program for 50,000+ senior executives in companies around the world. It inserted gaming elements into its online leadership development portal,where trainees get a feeling of accomplishment when they participate, submit comments and ideas, and complete course modules in the program because of the badges, leaderboard rankings, and rewards they receive. They start with easy tasks which later became more complex. [Mei13b].

Combos

Description: Combos are used often in games to reward skill through doing a combination of things. This also can add excitement or incentivize doing another action after already having completed one. The successful completion of a combo usually comes with the reward of a bonus.

Game example: Fight games uses the concept of combos a lot. Hitting your opponent with a sequel of movements or striking a specific combination of buttons rewards the player with points, for example.

Gamification example: You could give people bonuses for completing a combination of actions or achievements. For example, Goji Play, a fitness gamification system, designed custom gamification solutions to take the motion coming from the sensor and incorporate it into gameplay as speed on a bike or stamina on a boxer, you just need to hit the buttons on the controllers to dodge obstacles or send some jab, jab, hook combos to your opponent. [Mar14].

Community Collaboration

Description: Community Collaboration takes place as a game dynamic wherein an entire community is rallied to work together to solve a riddle, a problem or a challenge. Immensely viral and very fun.

Game example: Black Stories is a board riddle game where players must ask questions to the master in order to solve the puzzle. The players must work together in order to ask proper questions.

Gamification example: Quora is community based question-and-answer website. Users can ask questions for other community members to answer. Since the content of the site is entirely created and managed by its users, a dedicated user-base is essential. To do this, Quora implements a subtle gamification strategy. Users earn and spend credits as they post questions and provide answers. [Tur13]. Figure 2.10 presents the interface of the web application.

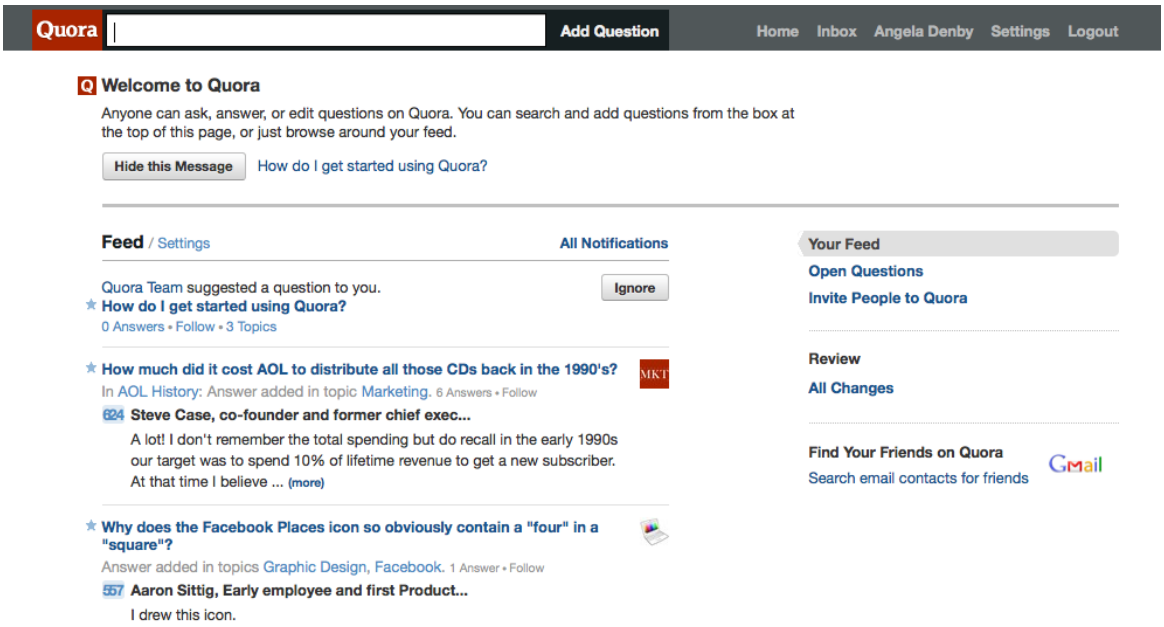

Figure 2.10: Community Collaboration in Quora

Countdown

Description: Countdown is a dynamic in which players are only given a certain amount of time to do something. This will create an activity graph that causes increased initial activity increasing frenetically until time runs out, which is a forced extinction.

Game example: One of the most common challenges in games are time pressure. In Super Mario, for example, you had a specific time (99 seconds) to complete each level. Puzzle games, like Bejeweled Blitz, also work with a countdown timer.

Gamification example: Kickstarter is one of the most famous crowdfunding websites. They are responsible for funding some great ideas and products, by giving the opportunity to owners show their project to the crowd. The projects have specific time limit to achieve 100% of funding, in order to receive the money. Time pressure works very well in this case, engaging people to donate [Mar13b].

Discovery

Description: Also called Exploration, this dynamics assumes that players love to discover something, to be surprised. Discovery encourages players to discover new pages within a website, explore a virtual world or seek for new ways to complete a mission.

Game example: Grand Theft Auto, one of the most acclaim game series, is commonly classified as a sandbox game, where you have freedom to do what you want to. Because of that, players spent dozen of hours wandering around, without accomplish the game missions.

Gamification example: SCVNGR is a fun game platform that sends users to places they'd frequent anyway, where they complete challenges, accumulate points, and earn rewards. For example, a thread in the community help desk forum suggests that SCVNGR could be used at a conference as a method for getting attendees to engage with vendors by visiting vendor booths and participating in challenges in exchange for a reward [Sta14]. Figure 2.11 presents the interface of the application.

Epic Meaning

Description: Epic Meaning assumes that players will be highly motivated if they believe they are working to achieve something great, something awe-inspiring, something bigger than themselves. The main idea here is to give a big purpose for the players, in order to create engagement.

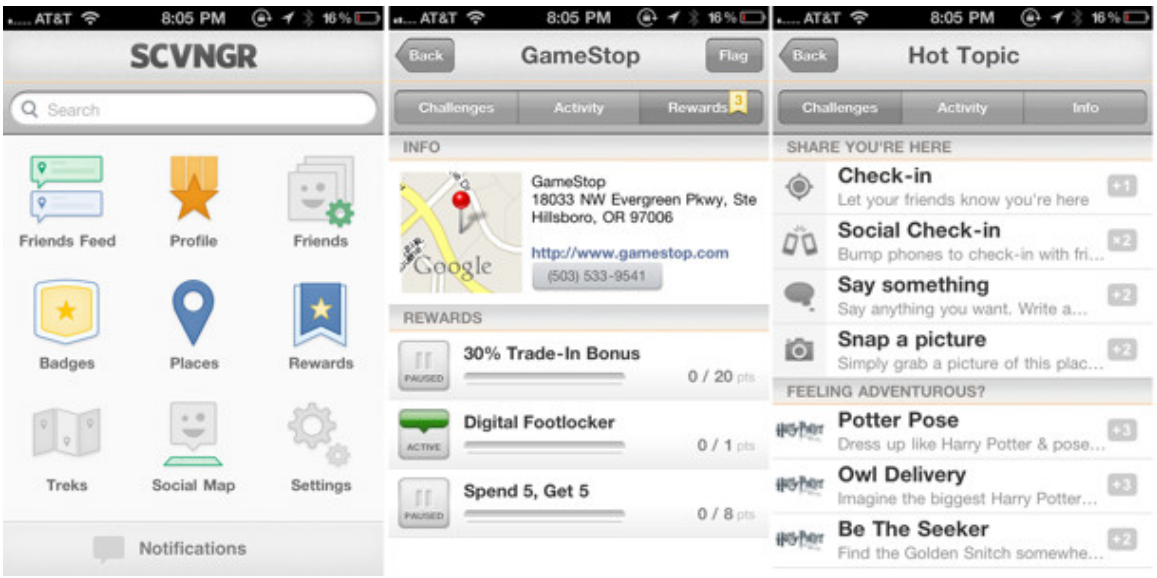

Figure 2.11: Discovery in SCVNGR application

Game example: Sony Playstation game "Last of Us" was widely awarded by its fantastic screenplay, making players feel connected with the story. The epic meaning here was to complete the main mission, because players feels like they are part of the game.

Gamification example: Free Rice is an example that utilizes the Humanity Hero technique. The website donates 10 grains of rice for every correct answer on the educational questions they have on their site. The funding comes from the ads and the number of page views they generate from question and answers played by users. People tend to use the website, because of the (social) epic meaning involved. [Cho13a].

Free Lunch

Description: Free Lunch is a dynamic in which a player feels that they are getting something for free due to someone else having done work. It's critical that work is perceived to have been done (just not by the player in question) to avoid breaching trust in the scenario. The player must feel that they've 'lucked' into something.

Game example: Golf Star, a golf game for playing alone or with multiplayer, allow players to join Guilds, where they keep playing and with the sum of all their points, each player receive extra rewards for it.

Gamification example: Groupon, a coupon reseller website, uses this concept in their system. By virtue of 100 other people having bought the deal, you get it for cheap. There is no sketchiness because you recognize work has been done (100 people are spending money) but you yourself did not have to do it. [Bou12].

Instances

Description: Instances are created for players to have a unique experience that is outside the normal experience. When a player creates a special unique page experience that allows to log into and view their unique content an instance has been created.

Game example: Mass Effect is a Role Playing Game where player have a mission to accomplish, but he can decided different paths for it. Being evil or altruist, for example. These paths will create unique instances of the same game, making the decisions affect the game. Figure 2.12 presents a sample of these dialogs that create unique experiences (in red and blue).

Gamification example: PwC, a global consulting company, created an Human Resources' Gamification system. Multipoly is going to be an even more realistic experience for everyone who wants to try what it's like to work at company. The game starts with a job interview, which is followed by 4 grades where the players can try themselves out: Intern, Consultant, Senior Consultant, Manager. These levels are built on each other in a hierarchical order, and each one of them has a unique gameplay. [Ven15].

Leaderboards

Description: Leaderboards are a means by which users can track their performance, subjective to others. Leaderboards visually display where a user stands in regards to other users. Leaderboards can be broken down into several subcategories such as: Global, Friends, etc. A Global Leaderboard shows where the player is in relation to everyone on the site. Leaderboards often compete over points.

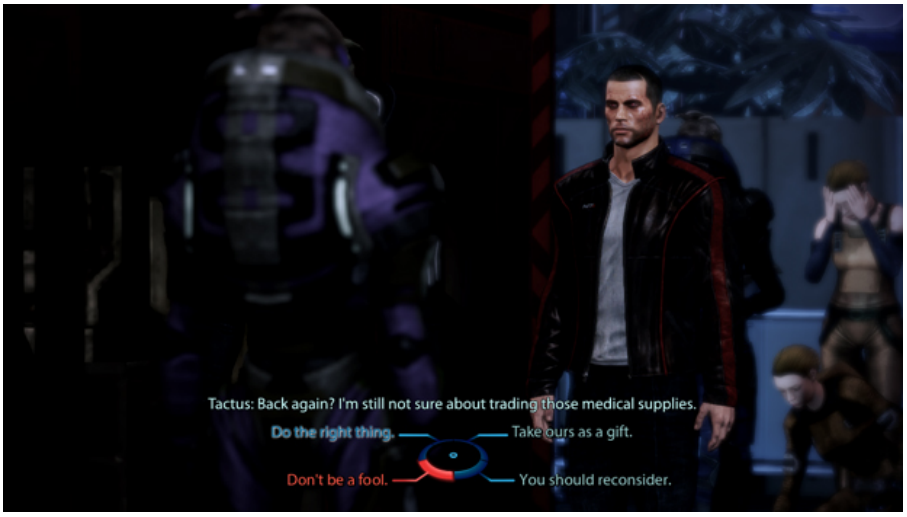

Figure 2.12: Instances in Mass Effect game

Game example: Diamond Dash is a social puzzle game where you need to combine stones in order to earn points. The social effect of the friend based leaderboard keeps players playing in order to overcome their friends, creating a fun competitions between people.

Gamification example: Bluewolf, a global tech company, began a program called Going Social, which consisted of three prongs: a portal, “pack profiles” and the gamification piece. Employees can earn points for building and maintaining their pack profiles, sharing Bluewolf content on social sites, uploading content, etc. The more you do, the higher your ranking on the Bluewolf leaderboard, which is reset every quarter so everyone, including newer employees, has a chance to make it to the top of the 12-level board. [Ban12]. The Figure 2.13 shows the leaderboard at Bluewolf company.

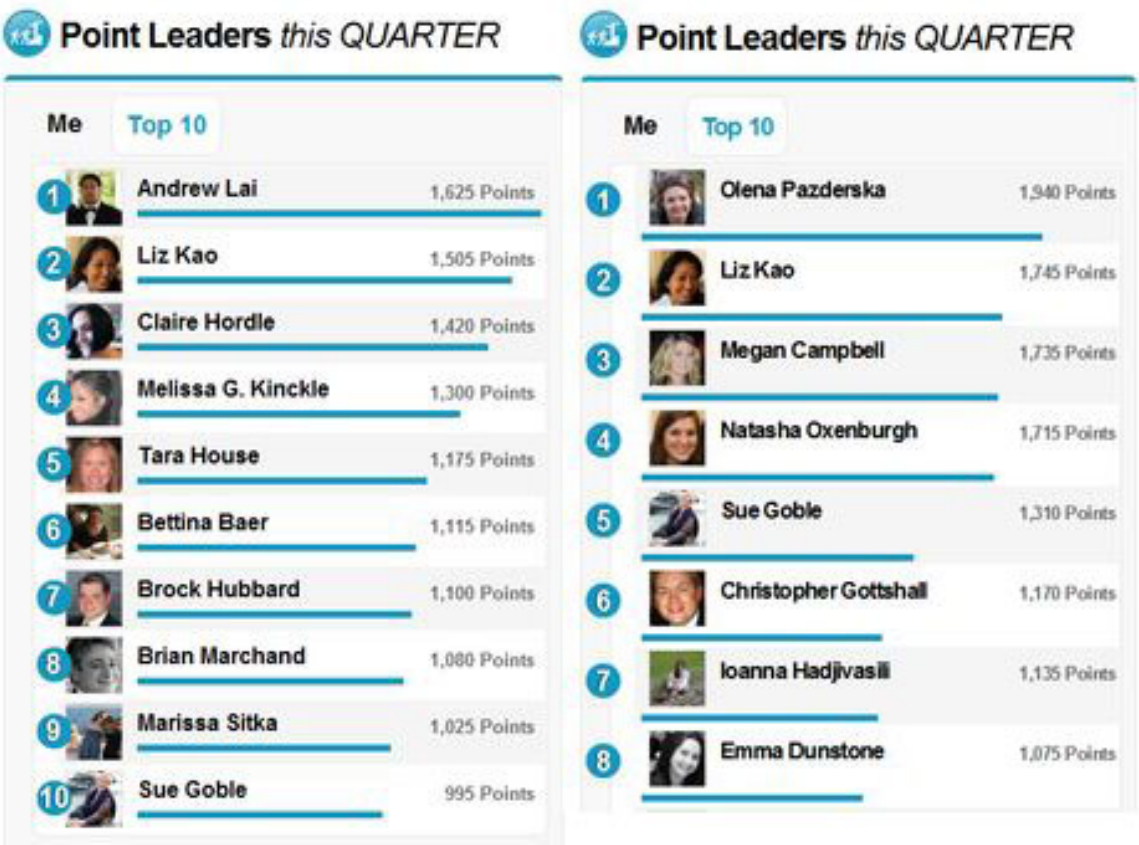

Figure 2.13: Leaderboard at Bluewolf

Levels

Description: Levels are a system by which players are rewarded an increasing value for a accumulation of points or other metrics. Often use to let features or abilities be unlocked as players progress to higher levels. Leveling is one of the highest components of motivation for gamers.

Game example: Massively Multiplayer Online Role-Playing Games, like World of Warcraft, uses levels to as one of the most important game elements. You do missions, submissions, kill enemies and solve puzzles in order to gain experience points, to upgrade your avatar, learn new skills and receive new weapons.

Gamification example: Cisco, a global tech company, had invested in a global social media training program for its employees and contractors to build and leverage their social media skillset. The company introduced three levels of certification for the social media training program: Specialist, Strategist and Master, as well as four sub-certification levels for HR, external communications, sales and internal partner teams. It also mixed in team challenges to incorporate a healthy dose of competition and collaboration into earning social media certifications. Since gamifying its social media training program, more than 650 Cisco employees have been certified with over 13,000 courses taken [Coy15].

Loss Aversion

Description: Loss Aversion influence the player behavior not through reward, but by avoiding punishment, varying punishments through status, access, power, loss of resources or being downgraded. In other words, players do things to avoid losing something that is already achieved.

Game example: Social and casual games uses the concept of loss aversion to keep players playing the game. If you do not log in every week, you might lose some bonus or rewards.

Gamification example: Duolingo is a massive online collaboration which combines a free language-learning website with a paid crowdsourced text translation platform. Incorrect answers result in a loss of points and “lives”, as well as the delay of leveling up. Also, if you do not continue your training, you will need to repeat the same classes that you already done [Cho13b].

Lottery

Description: Lottery is a game dynamic in which the winner is determined solely by chance. This creates a high level of anticipation.

Game example: Casual games, like 8-Ball Pool, uses lottery (slot machine) to engage players by making them winning a prize everyday he log in the system.

Gamification example: Volkswagen created an experience called The Speed Camera Lottery, that would reward those who obey the speed limit with the money raised through fining those whose exceed the limit. The concept was put into action in Stockholm as Hastighets Lotteriet, in collaboration with NTF, the Swedish road transport authority. Drivers

who obeyed the speed limit got a thumbs up, those who were going too fast got a thumbs down [Mac11].

Notifier

Description: The Notifier is a direct way to give the user direct feedback about their progress, change of status in the gameplay experience etc. Though the visual representation of a Notification varies, the notifier always conveys information to the player based on an action they performed or a change that the player requested to be notified about.

Game example: Whenever a player does damage to an enemy in World of Warcraft, the damage is recorded, viewable, and notified on screen.

Gamification example: The retailer Target has been successful in motivating its cashiers to improve the speed of their scanning through a simple form of gamification. Cashiers receive a green, yellow, or red rating on their register screen after each checkout, depending on their speed. The immediacy of the feedback evokes a game-like experience, encouraging them to scan items faster the next time in order to get the highest rating [Kin11]

Ownership

Description: Ownership (or possession), is based on the principle that because you own something, you want to improve it, protect it, and get more of it. A powerful game dynamic that creates loyalty on players.

Game example: Club Penguin Puffles and other pet ownerships within games create an emotive response from the player to want to protect and look after their animals.

Gamification example: CrowdFlower is a crowdsourcing that taps a vast global workforce of people to perform tasks 24/7 cheaply and flexibly. By creating an account there, you try to keep your profile as good as you can, in order to be able to get some tasks to do [Mei13a].

Points

Description: Points are a running numerical value given for any single action or combination of actions Points are received for certain activities or combinations of activities. Reaching a certain amount of points may give additional rewards, like more power, access to the next level, a badge, a virtual item and so on.

Game example: Almost every game reward the player with points. Tetris, for example, reward players everytime he complete a full line of tiles, in the game. The more tiles you fill at time, the more points you receive.

Gamification example: Through the "My Work Community" portal, Live Ops, a digital company, was able to train, incentive, and grow its workforce with remarkable effectiveness. This community featured missions for people to complete around skills and how much time it takes to complete a call, as well as training and customer satisfaction. All this works with incentives, and the incentives are simple: People with more points get more jobs, and therefore make more money [Bou12].

Progression

Description: Progression is a dynamic in which success is granularly displayed and measured through the process of completing itemized tasks. By this game element, you can see where you are, what have you passed by, and where should you go.

Game example: Super Mario was one of the most successful Nintendo games all time. In the third game, players could track their progress by a map of each stage and game levels, letting them know their evolution. Figure 2.14 presents the game's map.

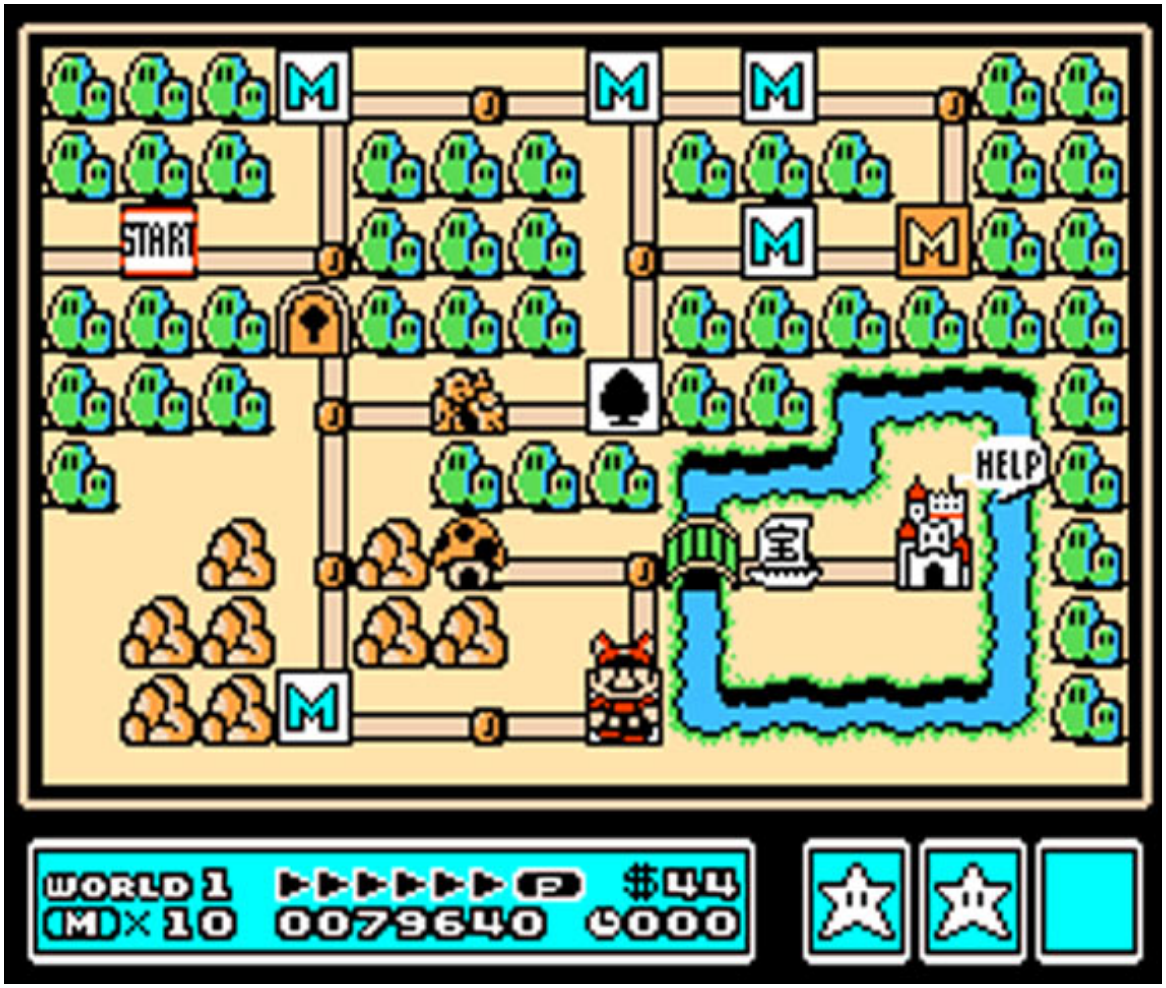

Figure 2.14: Progression map of Super Mario

Gamification example: With Duolingo for Schools, students can share their language learning progress directly from the app with their teachers, who can then track their progress through a dedicated dashboard. And by being able to tracks their students' progress, teachers can plan lessons, assign Duolingo skills as homework, and award extra credit points accordingly [Cal15].

Quests

Description: Quests, or mission, is usually defined as a journey of obstacles a player must overcome in order to achieve a goal or objective.

Game example: Role Playing Games are based on the conclusion of quests, by earning rewards, points or special items. Players needs to accomplish a set of tasks in order to complete the quest.

Gamification example: The San Francisco-based company licenses its platform to businesses, whose employees form teams and earn points for completing different quests or challenges, that involves tasks like meditating or walking to a meeting or taking a health quiz [Nie13].

Rewards Schedules

Description: Rewards Schedules are like an agenda, a timeframe and delivery mechanisms through which rewards (points, prizes, level ups) are delivered. Players must be aware of how this works.

Game example: Getting a level up for killing 10 orcs, clearing a row in Tetris or getting fresh crops in Farmville: all these are rewards schedules that players are aware on playing the game.

Gamification example: The digital training program of Deloitte has inserted gaming elements into its online leadership development portal. Trainees get a feeling of accomplishment when they participate, submit comments and ideas, and complete course modules in the program because of the badges, leaderboard rankings, and rewards they receive. These rewards are shown to players in order to make them aware of how to win [Mei13b].

Status

Description: Status is the rank or level of a player. Players are often motivated by trying to reach a higher level or status.

Game example: Role Playing Games creates the sense of status for players, because the higher the level they get, more exclusive items they will receive. Other players also seek for higher ranks to play in cooperation.

Gamification example: Stack Overflow have a system with points and privileges system. Users get points on Stack Overflow for getting questions and answers voted up. People care about points because of reputation, but there are other reasons Stack Overflow users want to accrue points. Stack Overflow has different types of privileges based on the points a user has earned. [Goo13]. Figure 2.15 presents an overview about the reputation score at Stack Overflow.

User Profile

Description: User Profile displays a User's data about their activity on a website and can be used to tell the world and a community on the internet who they are.

Game example: Social games usually presents a user profile for the players. Users can find information about them, and also send messages or requests.

Gamification example: Linkedin is a professional social media focused on building connections with partners and companies. To make the professional network valuable for all members, information about each member is needed. The more a user enters, the more valuable for the overall network [Her13].

Virality

Description: Virality is a game element that requires multiple people to play (or that can be played better with multiple people).

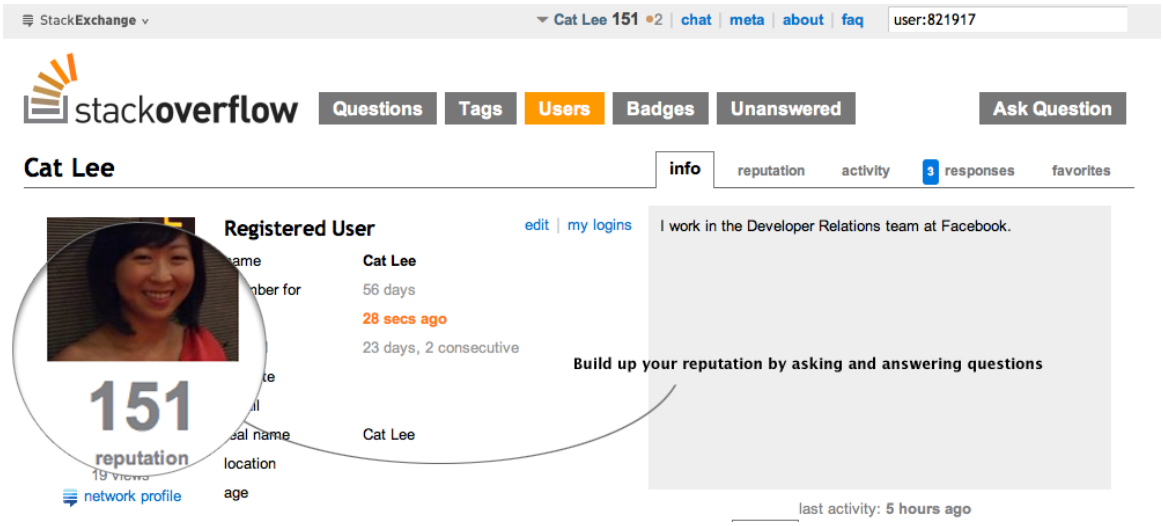

Figure 2.15: Status and reputation at Stack Overflow

Game example: Social games like Farmville makes players more successful in the game if they invite friends. This is called the social check-in.

Gamification example: DevHub is a site that lets users create their own blogs and web sites. Too often, early users created only basic, skeletal sites. DevHub fixed that by creating a step-by-step process where you can level up with each new addition that you complete. Each step is like completing a mission in a game. One recent new feature is “build a site with a friend,” which makes the process more social [Tak10].

Behavioral Momentum

Description: Behavioral Momentum is the tendency of players to keep doing what they have been doing during a gameplay.

Blissful Productivity

Description: Blissful Productivity is the idea that playing in a game makes you happier working hard, than you would be relaxing. Essentially, we’re optimized as human beings by working hard, and doing meaningful and rewarding work.

Easter Eggs

Description: Easter Eggs are artifacts, trivias or fun facts that hidden in a game, in order to make jokes or create a little fun for players. They should seek and explore the game in order to find them.

Infinite Gameplay

Description: Infinite gameplay are specific for games that do not have an explicit end. Most applicable to casual games that can refresh their content or games where a static (but positive) state is a reward of its own.

Urgent Optimism

Description: Urgent Optimism is the desire to act immediately to tackle an obstacle combined with the belief that we have a reasonable hope of success.

3. RELATED WORK

Gamification has become popular in the last years, with several research studies trying to identify its impact in productivity, teams, and behavior change. The areas that gamification have more impact on are the Marketing, Education and Health Care. This chapter introduces the most relevant studies related to this research on gamification applied to work environment and software development identified in literature.

Sheth, Bell and Kaiser [SBK11] did not use the gamification term. They proposed the use of game elements of Massively Multiplayer Online Games (MMOGs) as an approach to software engineering process called HALO (Highly Addictive, Socially Optimized). They envisioned HALO as a simple plugin to software development tools, such as Eclipse or Microsoft Visual Studio. Their proposal was that HALO should represent everyday tasks as quests, which can range from something simple (such as closing a bug) to something complex (as porting the code to a different system). They stated that sometimes a quest may be too difficult for a single player to undertake on their own. In this case, they will be forced to create a group of other players - a party, highlighting the collaborative nature of these quests.

Smith [Smi11] stated that the future of work is based on playing-based activities, suggesting the rise of productivity games at work. He presented that several Microsoft teams have deployed game elements and mechanisms to improve software engineering and business processes. An example was a productivity game called "Communicate Hope", which main idea was to motivate participants to complete beta feedback tasks and earn points for completing those activities. Upon conclusion of the program, 97% of the participants (volunteers) said they would participate in another beta program, a success compared to similar projects whose numbers range from 50-75%. He discusses, in conclusion, about global shifts that would result in the adoption of gamification by the companies. And states that global shifts indicate clearly that the prevalence of games will continue to grow.

One year later, in 2012, Neeli [Nee12] proposed a method to engage employees of the Business Process Outsourcing Industry, focusing in motivation, talent retention, and job related issues. First, he identified the challenges faced by employees in the BPO industry, such as demand for quality, recruiting and retaining talents and information infrastructure. He identified factors that motivate employees in the BPO industry, such as connection, career possibilities, collaboration and autonomy. He proposed the application of game elements (using BadgeVille's list [Bad11]) to increase the engagement of the employees. He designed the challenges, motivation for the work and the method that needed to be followed by the game design phase and, later, evaluated by the users. For example, to foster team work and participation, he suggested the use of community collaboration and epic meaning, because these game elements allow employees to see beyond personal achievements and look for

the whole team and company. As future work, he suggests the evaluation of the model, development of metrics and analytics and implementation of frameworks to effectively use gamification techniques in service industry.

Aparício et al. [AVSM12] presented a simple method for analysis and application of gamification as a tool to assist the participation and motivation of people in carrying out tasks and activities. The method can be defined by an iterative sequence of activities that can be repeated for each of the goals or tasks that define the specific business model where one wants to perform the process of gamification. It is composed of 4 steps, namely: identification of the main objective; identification of the transversal objective; selection of game mechanics (that match the objective); and analysis of the effectiveness (of the implementation of gamification based on fun).

Dorling and McCaffery [DM12] stated that Software Process Improvement (SPI) initiatives has been used for decades as a means to improve work experience and processes. To motivate such initiatives to be more efficient, they suggest the use of gamification as a solution to user engagement, feedback and sense of progression for indicators. They focus their proposal on the ISO 15504 (SPICE) model. Using BadgeVille's list of game elements [Bad11]), they suggest the use of some dynamics to engage users and employees. They did not proposed a method or framework, just pointed their suggestions for this subject.

As previously mentioned, studying ways to improve the adoption of software engineering practices for developers, Singer and Schneider [SS12] proposed the gamification of a version control system. The idea was to encourage Computer Science students to make more frequent commits, using social software application with game elements. Their experience was with a web-based newsfeed called Teamfeed, which presents a feed for each team's commits, featuring a leaderboard that shows the commit count for each team member. Also, the tool sent out a weekly digest for each student, with a summary of how many commits were made in the past week, and also information by the team members. They conducted an experiment with 37 students and concluded that the experiment revealed some interesting insights on gamification in improving software engineering practices, but the adopted process could be improved to achieve even better results. In the other side, they stated that students claimed that the metric used – number of commits by a person – was often said to be too simplistic and useless.

Lotufo, Passos and Czarnecki [LPC12] proposed a work to improve bug tracking systems using game mechanisms from Stack Overflow, to encourage team members to increase the frequency and the quality of their contributions. They investigated the Stack Overflow system to identify the game elements and tried to apply them in their study, which were rewarding reputation for good contributions, reducing reputation for poor contributions, and awarding privileges to users as they reach reputation levels. They concluded that when mapping these mechanisms to bug tracking systems, by applying a formal reputation and rewards system to current open-source bug tracking systems, the benefits of increasing

contribution frequency, of improving contribution quality, and of moderation should be readily accessible.

One interesting study was conducted by Moccozet et al. [MTOL13]. It is not directly involved with software development, but it is one of the first studies that tried to understand how gamification and collaboration could work together. They created a gamified online community for students to improve the group work among them. In this model, a learning activity is conceptually represented by a shared space (a group in our implementation) that integrates people, resources and applications (and eventually sub-groups). To achieve a common goal (a learning activity), people share content resources and applications in a space and use them to achieve their goal. Each group has its own workspace and toolbox (the toolbox integrates wiki, blog, forums, question/answer, brainstorming tool). All the possible actions on the platform are ranked and receive points. They analyzed the results of 2012, when 244 students worked on the platform. As a result, stated how it encouraged students to contribute and collaborate more. They expect to improve the user points system as a future work.

Later, Webb [Web13] presented some studies about in which situation gamification works and in which it does not work. Webb discussed that there are circumstances where gamification can be successful and others in which it can fail. She states, for example, that games have goals that are specific, measurable, achievable, realistic, and time bound. She also argues that, in some cases, companies tried to gamify the work without considering this. So she proposed factors that make gamification appliance successful: understand the business goals behind gamification; measure the progress; understand the users involved; bring business goals and user considerations together, to make sure that they are motivated; and test and iterate the gamification project. She concluded that a gamified user experience should be reviewed, evaluated, and updated regularly to ensure that it continues to meet the goals of both the users and the companies.

The way that gamification is perceived by the employees at work is the subject of the study of Meder, Plumbaum and Hopfgartner [MPH13], producing an interesting research. They presented the outcome of an online survey where they analyzed the users opinion about gamification in the workplace. They first questioned if the employees contribute to Wikis or Enterprise CMS: the results shown that only a few individuals do this kind of contribution. The second question was about knowledge of gamification, that the employees had: in this case, they stated that people are aware of the concepts of gamification. They asked the attitude of the employees towards gamification: most of employees are undecided if gamification could be applied in enterprise environments. Next, they asked if employees agree if game elements have positive effects in work environment: the distribution of judgements seems to indicate that the majority of participants have a rather positive perception of gamification principles. Finally, they asked about negative effects: this conclusion was unclear, due the distribution of the answers.

In their next step, they analyzed the logs of a re-designed gamified enterprise system (using points, badges and leaderboards) based on social bookmarking, to compare the employees' subjective perception of the concept. Using some metrics and measuring the before and after gamification, they stated that there is a relationship between the perception and the interaction of the employees with the gamification since those who gave positive answers in the survey also had more interaction with the gamified system. Therefore, the authors concluded that there was a relationship between the perceived and the actual role of gamification principles in a workplace environment.

Knaving and Björk [KB13] made suggestions on how to approach gamification, and how to avoid some possible issues with the more common gamification designs. Two guidelines were suggested for this: first, in order to make activities more fun and engaging, they suggest the preservation of focus on the activities themselves; second, they suggest to take into account the playful aspects of games that gamification seeks to emulate. For each one of the guidelines, they pointed possible issues (for example, how to deal with mandatory activities) and design suggestions (in the example, create a meaningfulness to these kind of activities). They stated that their paper should help in the application of gamification at work.

Kumar [Kum13] explained what is gamification, how it can be used in the workplace, and presented a collection of best practices based upon the Player Centered Design Process, that can increase the chance of success of enterprise gamification efforts. The process puts the player at the center of the design and development process and is composed by the following concepts: understand the player, understand the mission, understand human motivation, apply game mechanics, set the rules, create the engagement loop (positive reinforcement and feedback loops that keeps the player engaged in the game), and manage the program. Finally, the author recommend to start gamification with small projects to close monitor their progress.

Dubois and Tamburrelli [DT13] outlined the idea of the adoption of gamification techniques to engage, train, monitor, and motivate members of a software team engaged in developing a software product. They proposed a research strategy based on three different sets of complementary activities. First, the analysis activities, which analyze different gamification approaches and identify the most appropriate mechanisms to be applied to the different phases of the software development process to understand how the principles of game mechanisms may be successfully applied to the software development process. The second set is integration activities, which integrate the identified mechanisms into the existing software development tools through ad-hoc modules/plugins. Finally, the third is the set of evaluation activities, which evaluate the identified solutions.

They describe their case study with undergraduate students in Computer Science, which they used their approach to set a tool of code analysis and report called Hudson/Sonar. By using this software students would receive a report every time they submit some code modifications. Using their rules and goals, clear to every participant, they stated as prelim-

inary results that the quality of the software produced has increased. In conclusion, they stated that integrating gamification in a software development process is a relatively easy task, developing a gamification method and predicting its effect is much more difficult.

Hamari, Koivisto and Sarsa [HKS14] investigated peer-reviewed empirical studies on gamification, covering results, independent variables (examined motivational affordances), dependent variables (examined psychological/behavioral outcomes from gamification), the contexts of gamification, and types of studies performed on the gamified systems. The study examines the state of current research on the topic and points out gaps in existing literature, and concludes that gamification provides positive effects, however, the effects are greatly dependent on the context in which the gamification is being implemented as well as on the users using it.

Snipes, Nair and Murphy-Hill [SNM14] conducted their study based upon the software development practices and tools that, as they noted, are constantly evolving (e.g., frameworks and programming tools). They purposed an idea by adding game-like feedback to the development environment to help to improve adoption of tools and practices for code navigation. They applied a survey with 130 developers and later they created an experiment with a team of six developers. They identified that most of the developers are interested in gamification, despite some strong negative opinions, as per the experiment, they found that only two of the six developers in fact adjusted their practices when presented with game elements.

The gamification applied to software process improvement initiatives was also subject of study by Herranz et al. [HPSY14]. They proposed a framework that tries to take advantage of the transverse nature of gamification in order to apply its success factors to the organizational change management of an SPI. Their proposal aims to increase motivation and commitment of the people involved, so they create a two step approach: a high-level gamification proposal, introduced and adapted to the most general aspects of the people involved, the organization as a whole, its culture, and the main tasks of the SPI initiative. The aim of this proposal is to trace, in general terms, the gamification application that will subsequently be adapted to each of the groups of software professionals. Once this high-level proposal is completed, the next step would be to design a detailed one at a lower level, focusing on the principal motivational factors (motivators and demotivators) of each of the software professionals groups.

Their framework was based on incremental iterations that allow the groups involved to deal with resistance to change. It was divided in seven stages: the first phase of the framework considers the feasibility of implementing gamification in a software organization; in the second phase some business objectives are established to determine whether gamification is feasible; the third phase explores all the professionals groups' motivations and profiles; later, in the fourth phase, the activities to gamify are identified and discussed, and some of the essential aspects of the SPI proposal are considered; the fifth phase is the core

in which the gamification framework is developed and metrics and assessment techniques and feedback processes are established; in the next phase the implementation of the gamification proposal is issued; the gamification framework ends with the analysis of outcomes and objectives achieved.

The validation consisted in two qualitative methods: a focus group and a Delphi method. Both aimed to determine the theoretical validity of the framework, based upon the 14 success factors identified by the authors (for example: executive commitment, monitoring and feedback, pilot implementation, etc). The first stage was to validate the success factors through a focus group with a panel of experts. The result of this stage was a list of the valid success factors. In the next stage, on the basis of these validated success factors, the Delphi method is used, with another group of experts, to know the relative importance of these success factors and be able to determine priorities and focus efforts. Gamification can be applied in SPI using their framework; however, they claim that additional empirical evidence is needed.

In his paper, Vasilescu [Vas14] tried to raise the understandings of how human aspects, gamification and social media impact distributed collaboration in open source software development. He checked historical activities in version control systems, issue trackers, mailing lists and systems like GitHub and Stack Overflow. Preliminary results indicated that developers are indeed attracted by gamified social environments such as the one offered by Stack Overflow. The access to expert knowledge has a positive influence on their productivity in open source development.

Oprescu, Jones and Katsikitis [OJK14] conducted a research literature across disciplines in combination with expert opinion to propose ten principles for transforming work processes through gamification: orientation, persuasive elements, learning orientation, achievement-based rewards, Y generation adaptable, amusement factors, transformative, well-being oriented, research generating, and knowledge-based. Those ten principles are explained and grounded. For example, they presented evidences in literature that the factor "achievement based rewards" could be used to increase adoption of new initiatives and build relationships between employees. They stated that their principles could be used in the future to foster and study productivity, health promotion, psychological benefits and human computer interaction, all these in the gamified workplace. Most of those ten principles presented in the study were used as reference for this research.

Amir and Ralph [AR14] proposed a theory that gamification success depends on the game elements that are employed and their effects on user motivation and immersion. They presented a framework for understanding gamification effectiveness, with four main drivers of effectiveness: intrinsic and extrinsic motivation, game mechanics and immersive dynamics. Their idea of immersive dynamics are based upon factors that affect the player's immersion in the activity. For example, a story (the narration of the player's progress) or

aesthetics (the emotions engendered in a player by a system). They conclude that their framework should be evaluated by empirical testing it in future.

Moradian et al. [MNL+14] designed a system with game elements to incentive participation in a collaborative creative idea generation processes of brainstorming. During the brainstorming activity, participants generate ideas anonymously and synchronously in parallel. Submitted ideas are displayed immediately to peers. Each team member receives a Segmented List of Ideas and is asked to select one idea. After all team members have done this, they must discuss each of the selected ideas in turn by posting comments, during which the team must agree on a final phrasing of the idea and decide whether to add it to the Final List of Ideas. After each selected idea has been discussed, the process iterates, repeating the same process. They used some game elements like progression, achievements, points and leaderboard in order to increase the system. In conclusion, the authors found that game elements increased idea generation in the brainstorming activity and may also have increased the amount of discussion and number of ideas selected during the convergence activity.

Ribeiro et al. [RFPS14] proposed gamifying the requirement elicitation process. They stated that communication is an important factor for successful requirements elicitation, and that implies that tools must also take this aspect into account by allowing stakeholders to express their needs collaboratively. In this context, gamification concepts may provide a potential solution to this process, by increasing collaboration and communication through engagement and motivation promoted by the competitive environment. They used an web-based gamified environment called iThink, for supporting collaborative requirement elicitation. The system also used a technique called Six Thinking Hats, a method that helps in discussing requirements of a project. Two case studies were used: one regular focus group and a web-based focus group. These case studies were successful in promoting discussion of stakeholders towards requirements. Moreover, the results demonstrate a good number of contributions and that this approach may enhance the user involvement in requirements elicitation.

Thiebes, Lins and Basten [TLB14] conducted a systematic literature review to identify game elements used in gamification, in order to understand how gamification could be applied to information systems to increase end-user motivation and engagement. Their results in the systematic review resulted in creation of a group of five clusters: system design (game elements that motivate users), challenges (game elements that support the development of goals), rewards (game elements that motivate users by providing rewards, like points), social influences (game elements that influences social aspects, like competition) and user specifics (game elements that influence individual personality, like promotion).

Their next step was to analyze those game elements and how they could be applied to information systems. Although they identified a positive influence of most game elements on the motivation of employees, they stated that an arbitrary selection and application of

gamification is not expedient. They stated that gamification should predominantly be applied to newly developed information systems. The application of gamification to existing IS bears the risk of employees rejecting the new gamified aspects due to their habits and the effort required for initial trainings. They identified some risks of gamification, like the quality of tasks which may suffer if gamified elements distract from the information systems main purpose of activities. They conclude that their main contribution was the synthesis of the game elements, in their 5 cluster proposition and suggest that future work should focus on investigate their research in empirical studies.

Finally, Pedreira et al. [PGBP15] conducted a systematic mapping of literature based on the topic of gamification in software engineering, trying to characterize the state of the art of the subject. As a result of their study, they identified 29 primary studies published between 2011 and 2014, most focused on software development, and to a lesser extent, in requirements, project management and other supporting areas. The authors stated that this systematic mapping shows up an important gap in the field, since many important software process areas have not been studied to their full extent and have not empirical evidences. Another interesting conclusion is that according to the results, many of the studies consider only the simplest gamification elements, namely rewarding user's behaviors with points, which could be called "pointification", instead of gamification, which they pointed that could be dangerous for the future of gamification. The studies identified by Pedreira et al. overlap with those found in the literature review I conducted for this thesis work (described in details in Chapter 4). Most of them have been cited in this Chapter.

Gamification is been study as a motivator for people for some years. As seen, it is possible to find evidences in literature relating software development teams, collaboration and motivation with gamification as a promising topic of research. But there is not a body of knowledge for using gamification to foster collaboration in software development teams. Because of that, it is hard to have a comprehensive understanding about the subject in such scenario. The framework proposed on this research can reduce this effort by consolidating information and proposing ideas that will jump start collaboration behaviors on software teams.

4. RESEARCH METHODOLOGY

Despite the fact that gamification became a trend in software engineering research in the last years, there is not a body of knowledge of how to foster collaboration using gamification. Therefore, I posed as my goal *to understand which are the most common collaboration issues in software development and how game elements could help to mitigate these issues by jump starting behavior change*.

My research can be characterized as an *exploratory study*, and its design is based on four main phases as follows: literature review, exploratory, framework development, and framework evaluation, as shown in Figure 4.1. The phases and their respective activities are described next.

4.1 Phase 1: Literature Review

In the first phase, I focused on establishing an understanding of the state of art and on characterizing the subjects of this work: gamification, collaboration, and motivation.

The first step was to conduct a literature review on the topic of gamification, aiming to identify how mature the subject is, which papers, authors, and keywords are relevant and also which areas of application are researching the subject the most. Creswell [Cre09] states a literature review means locating and summarizing the studies about a topic. He also observes that there is no single way to conduct a literature review. The author of the study should decide on the strategy that suits best its study goal and needs.

My two main objectives in the literature review for gamification was to identify those papers that are relevant to the topic of gamification applied to software development or to motivate people at work.

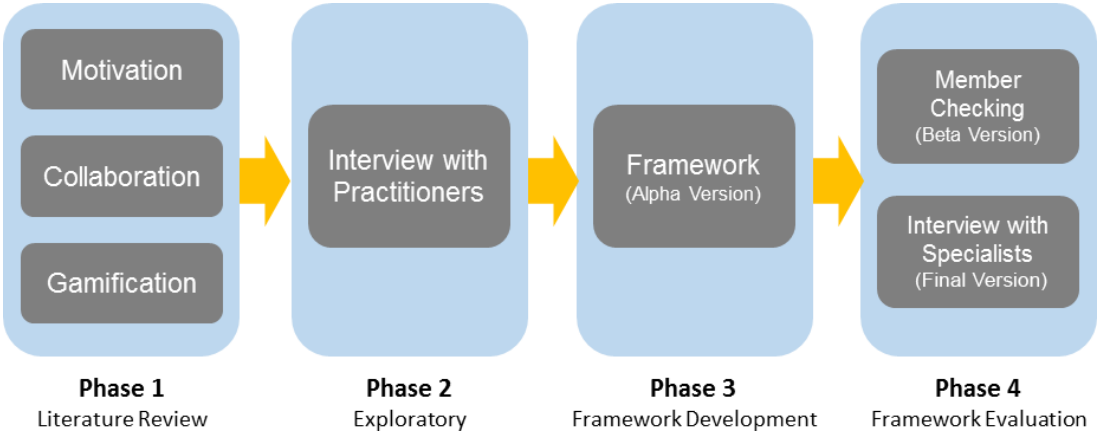

Figure 4.1: Research Design

I organized my literature review of gamification by the following steps: a first web search using the wider keyword about the topic ("gamification", for example) to identify the most common keywords associated; having other keywords, the next step was to create a query of search using an inclusion and exclusion criteria, in order to select the candidate papers for the review. Finally, I read the candidate papers in order to identify which were the most relevant for the subject of my study.

The web-based search engine Scopus was used for this task. Scopus is an Elsevier project that indexes contents from most used digital libraries from Computer Science like ACM, IEEE and Science Direct, and also index papers from other areas like Psychology, Engineering and Medicine. At first, I used the following keywords to create my query:

gamification Keywords
gamification OR Gamified OR
Gamify OR Game elements

Using Scopus features, I also could limit the results to the following subject areas:

Subject Areas Limited
Computer Science OR
Business, Management and Accounting

The query resulted in 866 papers: 832 associated to Computer Science and 53 to Business area. Most of documents indexed were conference papers (655), followed by articles (124), conference reviews (52), and book chapters (15).

Each paper was reviewed using its title and abstract, seeking for relevance both with software development and work environment areas. This first analysis helped me to identify some exclusion criteria that should be used in order to get more relevant results for a more detailed analysis.

Many of the studies analyzed were directly associated to health care and game development, which are out of the scope of this study. Studies associated to game development had the focus in discussing the creation process of games (like videogames) and are not specific about how to engage people or in work activities.

Another exclusion criteria applied was the publication date of the paper. Gamification is a concept that started to be widely spread starting in 2010, as seen in Chapter 2. Based on that, I decided to exclude studies that had been published before that. At first, there was no restriction based on the data, but once a first round of search was made and I skimmed through the papers, I noticed it was reliable to apply this exclusion rule. From the inspection of paper titles and abstracts, no single paper before this date has been published that was of use to my research.

Finally, I could identify some keywords associated to some papers that should be excluded, in order to maintain the goal of this research: "algorithm", "wireless" and "sensors", for example, were associated somehow to the search previous presented, in the web-search results at Scopus. So, I added them to the exclusion criteria dataset in order to obtain a more consistent result.

Based on the above, the final version of the exclusion criteria query was as follows:

Exclusion criteria
Game Industry OR Game Development OR
Health OR Healtcare OR Medicine OR
Algorithm OR Wireless OR Sensors OR
previous to 2010

The first review also helped me to set some control papers, in order to check if the new search would shown then. These papers were selected based upon indication from researchers and by being referenced in most of the read papers up to the moment.

The control papers selected were Dubois and Tamburrelli [DT13], that outlined the idea of the adoption of gamification techniques to engage, train, monitor, and motivate members of a software team engaged in developing a software product; Singer and Schneider [SS12], that created a process of gamification in a software activity; Amir and Ralph [AR14] that created a theory that gamification success depends on the game elements that are employed and their effects on user motivation and immersion; and Deterding et al. [DDKN11], that defined the basis of the concept of gamification.

Combining these inclusion and exclusion criteria, I finally produced the following Scopus associated query:

Final Query for gamification in Scopus
(TITLE-ABS-KEY ("gamification") OR
TITLE-ABS-KEY ("Gamified") OR
TITLE-ABS-KEY ("Gamify") OR
TITLE-ABS-KEY ("Game Elements") AND NOT
TITLE-ABS-KEY ("Game Industry") AND NOT
TITLE-ABS-KEY ("Game Development") AND NOT
TITLE-ABS-KEY ("Health") AND NOT
TITLE-ABS-KEY ("Healthcare") AND NOT
TITLE-ABS-KEY ("Medicine") AND NOT
TITLE-ABS-KEY ("Algorithm") AND NOT
TITLE-ABS-KEY ("Wireless") AND NOT

```
TITLE-ABS-KEY ("Sensors") ) AND
(LIMIT-TO (PUBYEAR, 2014) OR
LIMIT-TO (PUBYEAR, 2013) OR
LIMIT-TO (PUBYEAR, 2012) OR
LIMIT-TO (PUBYEAR, 2011) OR
LIMIT-TO (PUBYEAR, 2010)) AND
(LIMIT-TO (SUBJAREA, "COMP") OR
LIMIT-TO (SUBJAREA, "BUSI"))
```

The query resulted in 680 papers: 654 associated to Computer Science and 43 to Business area. Most of the indexed documents were conference papers (520), followed by articles (101), conference reviews (28), and book chapters (12).

Also important, all four control papers were related in the final results list.

By inspecting the paper title and its abstract, I selected the candidate papers that discuss gamification related to software development and to work environments, were marked as candidates. This analysis resulted in 78 papers candidates, most of them, were used as reference for this study.

Those papers were read, studied and finally those studies that are specific related to this work, presenting clear evidences of the use of gamification in software development process and as a motivator for employees, were selected. This process resulted in 24 papers selected. These papers were briefly presented in Chapter 3.

Two systematic literature reviews were made available after the literature review has been conducted [HKS14] [PGBP15]. Most of my review findings have been cited by both studies.

One of the important points that I am looking for, with the literature review, was to identify which were the most used game elements. I found that authors often cited the use of game elements such as Points, Badges and Leaderboard [Kum13] [MPH13], which are stated to be too simple for my research [PGBP15]. Other authors like Zichermann [ZC11], Hamari [HKS14], Dale [Dal14], and Pedreira [PGBP15] provide lists of game elements which are not available for quick references or do not have enough detailed information. For instance, they identify the game element name and a brief definition of it. Therefore, I considered the BadgeVille list of 31 game elements [Bad11] as reference to my work.

BadgeVille provides additional information, examples, and other useful information. BadgeVille is a gamification company that created a collaborative wiki to discuss gamification with the community. In their wiki, I can find the list of these game elements (composed by 7 game features and 24 game mechanics). Their list was mentioned in studies by Neeli [Nee12], Dorling and McCaffery [DM12], Conaway and Garay [CG14], and Uskov and Sekar

[US14], which suggests that the list is well accepted in the academic community and proper to use in academy studies.

For collaboration, my objective was to identify which studies could provide data about collaboration issues in software development. For that, I needed first to define what is collaboration and then seek for studies that provided evidences about factors, challenges or issues that affects collaboration in software teams.

I based my concept of collaboration in the study of Fuks et al [FRGL05]. They defined collaboration as a combination of communication, coordination and cooperation. The concept was originally proposed by Ellis et al [EGR91] and later extended by Fuks et al [FRGL05], is used to model and develop Computer Supported Cooperative Work (CSCW) tools and components based on these three dimensions. Vivacqua and Garcia [VG12] included another dimension to their ontologies about collaboration: group formation. I finally observed that awareness was an recurrent concept that tangent most of these dimensions.

Having collaboration defined, I now could seek for evidences of issues that could affect activities involving communication, coordination, cooperation, group formation, and awareness. I either aimed to find a direct statement of a collaboration issue or to find success factors that promote collaboration, assuming that the lack of this factor promotes an issue in a software team.

Clear evidences of issues are those studies which published statements or consolidated lists regarding factors that affect collaboration in software teams. For example, Moe, Dingsøyr and Dybå [MDD09] stated in their study that "the main reason for this low team-level commitment was specialization". Treude, Storey and Weber [TSW09] states that "Lack of informal communication could dimished awareness of local working context". Santos et al. [SBTZ11] presented a comprehensive list of challenges that affects software teams.

Most of the identified studies are oriented to factors of success in collaboration, thus I extracted the success factor to collaboration and by considering its opposite I generated the corresponding issue. For instance, Patel, Pettitt and Wilson [PPW12] defined a comprehensive list of factors that affect collaborative work that were reported in my study by stating their opposite perspective. For example, they stated that "Co-located work facilitates informal communication, the maintenance of shared awareness and mental models which can facilitate group effectiveness", thus I indicated that the opposite would be that lack of co-located work would difficult informal communication and awareness. Sanz and Misra [FSM11] stated that "the education and abilities of a developer represents an important part in the ultimate quality of their developed software", so I inferred that lack of background would affect the quality of the work.

So, my next step was to conduct a literature review to search for common collaboration issues that affect software development teams. I again used the Scopus web-based search engine.

I first created my inclusion criteria, in order to seek for the desired topic of interest in my study. Since I am seeking for collaboration in software development context, I created the following inclusion criteria:

Software Development Keywords
Software Development OR Software Project OR
Software Engineering OR Software Teams OR
Developers OR Software Engineers

Collaboration Keywords
Collaboration OR Communication OR
Cooperation OR Coordination OR
Group Formation OR Awareness

The query resulted in more than 20,000 papers, which was a large list to analyze. So, I decided to extend the proposed query in order to seek for keywords that are more relevant to my research, and also limit the results to no longer than the year of 1994, having 20 years of papers to analyze, and finally to the Computer Science area. The extension of the inclusion criteria was created to include terms that could help in the searching for those collaboration issues. So, I proposed:

Issues OR Problems OR
Challenges OR Impact OR
Analysis OR Failure OR
Factors OR Criteria OR
Mistakes AND
newer than 1995 AND
strict to Computer Science area

This query resulted in 7,099 papers. Using a feature presented by Scopus, I could be able to sort the results based on their relevance to the search. This selection helped search only for the studies most relevant to my goal.

My next step was to read the titles and abstracts of the relevant studies to sort out candidate papers for selection. As a result of this selection of candidate papers, I collected 152 studies. As mentioned in Chapter 1, my work was defined to be limited to co-location teams. So, I decided to include papers that discuss collaboration issues in distributed or global teams only when these could suggest that these issues were also common to co-located teams.

Year	1st Author	Paper Name	Text	(Possible) Issue
			On the other hand, if the individual had difficulty shutting-out the noise, the individual found the environment unacceptable.	Noisy environment
2000	Rajlich, Václav	Perceptions of Contribution in Software Teams	The survey revealed that there is a statistically significant gap between the way team members perceived their own contribution towards the goals of the project, and the way their contribuion was perceived by others. This could create tension within the team and disrupting the cooperation.	Gap between perception of contribution at work
			but by a failure of interpersonal skills in the team.	No common ground
			The analysis of the results showed that most of the students considered their individual project contribution to be signi©cantly higher than that of their colleagues, or to put it dierently	Individual over teams
2002	Barthelmess Paulo	Collaboration and Coordination in Process-Centered Software Development Environment: review of the literature	Large development teams are plagued by that Brooks called the "Tar-Pit" Effect. As team sizes grow linearly, the time spent by team members to align perspectives and to keep aware of the actions of others might grow exponentially.	Team is to big to manage
			In other words, after a while all resources are spent in communication and none in the actual work.	Overload of communication
2003	McChesney Ian R.	Communication and coordination practices in software engineering projects	Shared Resources	Lack of shared resources
			Producer / Consumer relationships	Relation stake
			Tasks/Subtasks dependencies	Dependency of others
			Within the project, the practice of copying or cc-ing email communications to team members was referred to as keeping people in the loop.	Lack of awareness of progression

Figure 4.2: Excerpt from Data to Identify Possible Issues

From those 152 candidates, only 38 of them were relevant to my study. This final selection were executed by reading the introduction and conclusion of each candidate paper. This selection excluded most papers which were studies in groupware tools, for collaboration.

In one of this studies, the authors Steinmacher, Chaves and Gerosa [SCG10] conducted a systematic review about awareness support in Global Software Development, using the 3C Collaboration Model as reference for the research. In order to include more papers regarding the awareness subject, I used the snowballing review [JW12] to be sure that the this dimension was properly analyzed. Snowballing is a complementary process of literature review in which one searches for additional studies based on the list of papers cited by the previously identified papers. In this case, I used Steinmacher, Chaves and Gerosa [SCG10] work and could add more 13 additional relevant papers to my literature review.

Having now a total of 51 papers, I started to analyze their content to seek for evidences of collaboration issues. First, I identified in the studies possible statements that pointed to an issue or a success factor and related them to possible issues (Figure 4.2 illustrates this process). Later, I refined this raw list, grouping the issues that are similar (Figure 4.3) in order to create a more comprehensive list.

This process created my first version of the list of common collaboration issues in software development. This list was composed of 42 issues. The resulted list can be seen in Table 4.1.

	A	B	C	D	E	F
1	1	2	3	4	5	6
2	No relationship between team members	No relationship with stakeholders	Lack of diversity in team	Excessive diversity in team	No clear goals	No clear tasks
3	Lack of relations with members	Lack of relations with users	Lack of diversity	Much of diversity	No clear goals between teams	Task not properly defined
4	Lack of relationship with team members that work remotely	Lack of communication with costumer	Lack of variety	Excessive specialization	No clear goals between teams	Lack of definition of done for tasks and modules
5	Lack of cohesion on team	Lack of negotiation with customer			No clear goals	Team members not working in the same tasks
6	Not asking for help in problems	Diversity in customer culture and business			No organizational goals	

Figure 4.3: Excerpt from Data to Group Possible Issues

Table 4.1: List of Most Common Collaboration Issues (Initially Proposed)

Id	Collaboration Issue	Description	Identified in
1	No Relationship Between Team Members	Team members working alone, not talking to each other, not collaborating.	[HP04] [MM06] [MSL06] [SR08] [AGJ09] [TB08] [Moe10] [PPW12] [TSW09] [SBTZ11] [MMO12] [BBH+08] [BSB+07]
2	No Relationship With Stakeholders	Team members do not have access to users, clients and stakeholders.	[JMT05] [ABKJ06] [MM06] [MSL06] [SR08] [Whi07] [MDD09] [TSW09] [GM12] [MMO12] [LMV+14]
3	Lack of Diversity of Team	Teams do not have technical diversity, do not have background diversity, do not have cultural diversity.	[Whi07] [TSW09] [SFP11] [BBH+08] [AFH+05]
4	Excessive Diversity of Team	Teams have much specialization, making team members working in individual modules.	[MDD09] [SFP11] [AF06]
5	No Clear Goals	No clear goals and objectives about the work to be done.	[GF98] [Lin99] [UA04] [MSL06] [SR08] [TB08] [Moe10] [PPW12] [TSW09] [SBTZ11] [MMO12] [BBH+08] [AF06]
6	No Clear Tasks	No clear tasks about the work to be done.	[GF98] [JMT05] [SR08] [Whi07] [Moe10] [MDD09] [PPW12] [GM12] [LMV+14] [JPV09]
7	Unrealistic Plan	Unrealistic schedules, milestones, goals, estimates, etc.	[Lin99] [PPW12] [TSW09] [SBTZ11] [FSM11] [GM12] [BBH+08]

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Id	Collaboration Issue	Description	Identified in
8	No Common Ground Between Team Members	Team members do not have common ground, alignment, compromise, motivation, etc.	[GF98] [Lin99] [RSM00] [UA04] [HP04] [ABKJ06] [MSL06] [WCD07] [Whi07] [TB08] [ACB09] [Moe10] [PPW12] [TSW09] [SBTZ11] [FSM11] [GM12] [LMV+14] [SCG10] [BTSY02] [JPV09] [BBH+08] [AFH+05]
9	Individuals over Teams	When individual goals are more important than the team goals.	[RSM00] [AGJ09] [Moe10] [MDD09] [PPW12] [TSW09]
10	No Clear Roles	Team members do not know or are not satisfied about their roles in the project.	[GF98] [UA04] [JMT05] [TB08] [PPW12] [TSW09] [SBTZ11] [BBH+08]
11	Lack of Support for New Members	Newcomers do not have specific support from team members.	[Lin99] [MSL06] [ACB09]
12	Turnover of Members	Members of the team quit from the project or organization.	[MM06] [MSL06]
13	Bad Team Formation	Members of the team have lack of knowledge or competences for the work.	[Lin99] [MSL06]
14	Lack of Trust	Team members do not trust each other.	[MSL06] [PPW12] [TSW09] [SBTZ11] [GM12] [OFRW09] [BBH+08] [BSB+07]
15	Lack of Involvement from Managers	Managers do not support the team members.	[Lin99] [TB08] [Moe10] [PPW12] [TSW09] [BBH+08] [BSB+07]
16	Excessive Workload	Team members work many extra hours in tasks.	[Fra98] [Lin99] [MM06] [MDD09] [PPW12]
17	Lack of Tools and Resources	Tools to facilitate the collaboration are not available or are not appropriated.	[Lin99] [MG04] [LB06] [MSL06] [SR08] [Whi07] [MGHW10] [PPW12] [TSW09] [SBTZ11] [GM12] [MMO12] [LMV+14] [SCG10] [BTSY02] [JSU03] [BCSR07] [HW08] [JPV09] [BBH+08] [AFH+05]
18	No Shared Work Space	Team members do not have a physical space to share.	[HP04] [Whi07] [TB08] [PPW12] [TSW09] [SCG10] [EGR91] [Far01] [GRF+01] [JSU03] [BCSR07] [CE07] [BSB+07]
19	Noisy Work Space	Too much distractions or noisy environment for team members.	[Fra98] [Lin99] [GdSG11] [MMO12]
20	Excessive Changes in Plan or Process	Planning and processes (like methodology) change frequently.	[Lin99] [JMT05] [LB06] [MDD09] [PPW12] [GM12] [LMV+14] [SCG10] [JPV09]
21	Lack of Challenges or Purpose	The project do not represent a meaningful motivation for team members.	[MM06] [PPW12] [BBH+08] [BSB+07]

Continued on next page

Id	Collaboration Issue	Description	Identified in
22	Lack of Incentives	There is no extrinsic motivation for team members.	[Fra98] [UA04] [MM06] [PPW12] [BBH+08] [BSB+07]
23	Lack of Autonomy	Team members do not have autonomy to work.	[Lin99] [MG04] [UA04] [JMT05] [LB06] [MM06] [PPW12] [TSW09] [BBH+08]
24	Excessive Conflicts Between Team Members	Conflict between team members happens frequently.	[Lin99] [UA04] [AGJ09] [PPW12] [TSW09] [SBTZ11] [GM12] [SCG10] [EGR91]
25	Big Size Teams	Teams are too big to manage.	[Bar03] [HP04] [SFP11] [MMO12] [JPV09]
26	Small Size Teams	Teams are too small to work.	[HP04] [SFP11]
27	Excessive Communication	Overload of information and communication.	[Bar03] [MDD09] [TSW09] [SBTZ11] [MMO12] [HW08]
28	Bureaucracy	Policies and rules delay the work of teams.	[MG04] [MSL06]
29	Ineffective Communication	There is no common ground between team members and this affect the quality of communication.	[UA04] [HP04] [JMT05] [MSL06] [Beg08] [ACB09] [PPW12] [TSW09] [SBTZ11] [GM12] [LMV+14] [SCG10] [GPS04] [JPV09] [BBH+08] [AFH+05] [AF06] [BSB+07]
30	Lack of Focus in Meetings	Too much distraction in meetings cause loss of information and impacts decisions.	[ABKJ06] [MSL06] [Moe10] [TSW09] [AF06]
31	No Meetings	There is no meetings for the team members.	[Fra98] [MSL06] [SR08] [WCD07] [Whi07] [Beg08] [PPW12] [TSW09] [GRF+01] [JSU03]
32	No Technical Discussions	Team members do not discuss about technical information.	[SR08] [MGHW10] [Moe10] [GdSG11] [SBTZ11] [GRF+01]
33	Lack of Social Events	Team members do not have social events or spaces to build relationship.	[MSL06] [PPW12] [BBH+08]
34	Lack of Informal Communication	There is no Informal communication (not involving work) or adhoc communication (not formal).	[Whi07] [MGHW10] [PPW12] [TSW09] [GM12] [SCG10] [Far01] [JSU03] [GPS04] [CE07] [AFH+05] [AF06]
35	Lack of Face to Face Communication	Team members do not have rich face-to-face communication.	[ABKJ06] [WCD07] [Ten08] [MGHW10] [PPW12]
36	Lack of Feedback	Team members do not give or receive feedback to each other.	[Lin99] [Moe10] [MDD09] [PPW12] [GM12] [GPS04] [SvG05] [BCSR07] [JPV09] [BBH+08]
37	Lack of Monitoring	There is no monitoring from managers or team members in the work.	[Ten08] [LMV+14] [JPV09] [OFRW09] [BBH+08]

Continued on next page

Id	Collaboration Issue	Description	Identified in
38	Lack of Knowledge Sharing	Knowledge do not flow in the team due lack of moments and artifacts for knowledge sharing.	[JMT05] [SR08] [Whi07] [TB08] [Moe10] [PPW12] [TSW09] [GM12] [SCG10] [EGR91]
39	Lack of Training	Team members do not have training for the work to be done.	[PPW12] [FSM11] [AFH+05]
40	Lack of Perception of Work in Progress	Team members do not have the perception of status, who is working on specific tasks, who to report, etc.	[RSM00] [MG04] [MSL06] [SR08] [WCD07] [Beg08] [TB08] [Moe10] [MDD09] [PPW12] [TSW09] [GdSG11] [GM12] [SCG10] [JSP02] [JSU03] [GPS04] [SvG05] [BCSR07] [CE07] [HW08] [JPV09] [OFRW09]
41	Lack of Perception of Team Availability	Team members do not have the perception about team members availability or status.	[PPW12] [TSW09] [SCG10] [GRF+01] [JSP02]
42	Lack of Sources to Help Awareness	There is no artifacts, documents or tools to help team to maintain awareness.	[SR08] [PPW12] [TSW09] [LMV+14] [SCG10] [JSP02] [BCSR07]

Finally, for motivation I opted to read two studies that have consolidated the concept of motivation applied in software engineering, which are: "Models of Motivation in Software Engineering" from Sharp et al. [SBB+09] and "Motivation in Software Engineering: A systematic literature review" from Beecham et al. [BBH+08]. These papers were meant to contextualize my understanding of the topic of motivation in software development teams, specially focusing on the differences between intrinsic and extrinsic motivation.

4.2 Phase 2: Exploratory

This second phase was called Exploratory, and its main objectives were to evaluate the list of issues proposed and classify them into the five dimensions of collaboration (communication, coordination, cooperation, group formation, and awareness).

To set up the activity, I created 42 paper cards each containing information about each one of the issues. The cards were designed to highlight the id number, the name of the issue, and its description. Also, five extra cards were created to represent each one of the five collaboration dimensions. These cards had the name of dimension in highlight, and a brief explanation about its nature.

The activity was organized in three stages. In the first stage, the practitioners were interviewed about their background and were presented with a brief explanation about the objectives of the work, the collaboration concept based on the 3C Model, and the list of

collaboration issues. In the second stage, the practitioners were asked to read all 42 cards containing the collaboration issues. After that, they choose three of the collaboration issues cards they considered the most relevant issues in a software development project. The selection should be made based on their personal opinion. They were also asked to include any additional collaboration issue they believe should be part of the list for further consideration. Finally, they were asked to indicate wether they agreed with the 42 collaboration issues presented to them.

In the third and final stage, the practitioners were then asked to classify each one of those 42 issues in one of the five dimensions presented. The five dimensions were put side by side and the practitioner was instructed to move the collaboration issue card to the column of the respective collaboration dimension she considered more fit to classify the issue. The practitioner was asked to think out loud and explain the rationale for the classification of each of the 42 collaboration issues during the sorting out process. At the end, their were asked about their perceptions about the activity.

As a pre-game, me and my supervisor executed the same activity in order to classify the issues based on our knowledge and discussion. Our analysis would be further compared with the practitioners.

For sorting out the cards, the practitioner was also instructed to decide on the most relevant dimension in case she considered an issue could be placed in two or more dimensions. If the practitioner considered that one issue could be in two or more dimensions, she was asked to select the one in which she thinks the most relevant. Also, if the practitioner did not think that an issue should be part of any of the dimension, he was asked to keep that issue outside the activity. In this case, the objective was to evaluate if any issue should not be part of the list.

The interview was planned to be from 45 minutes to 1 hour long and to take place in person in a meeting room booked for this purpose. A structured qualitative interview script was designed to guide the interview. The script can be found in Appendix A. Figure 4.4 illustrates one of the activity' sessions.

Three experts in software development were selected for this activity, based on their experience and proximity with the author. Interviewee 1 (I1) is a IT director of a mid-size company and adjunct teacher at PUCRS. He has 15 years of experience in software development, and 8 years in team management. He is also an entrepreneur and had experience with developing new products, and 4 years of experience in education. Interviewee 2 (I2) is an adjunct teacher at a local private University in Porto Alegre, and is currently working on her PhD thesis in crowdsourcing. She had previous experience in software development as a project manager in a global web-based company. She has 15 years of experience in software development, 6 years working as project manager and also 12 years in education. Interviewee 3 (I3) is a developer at a global company and is currently working on his Master's

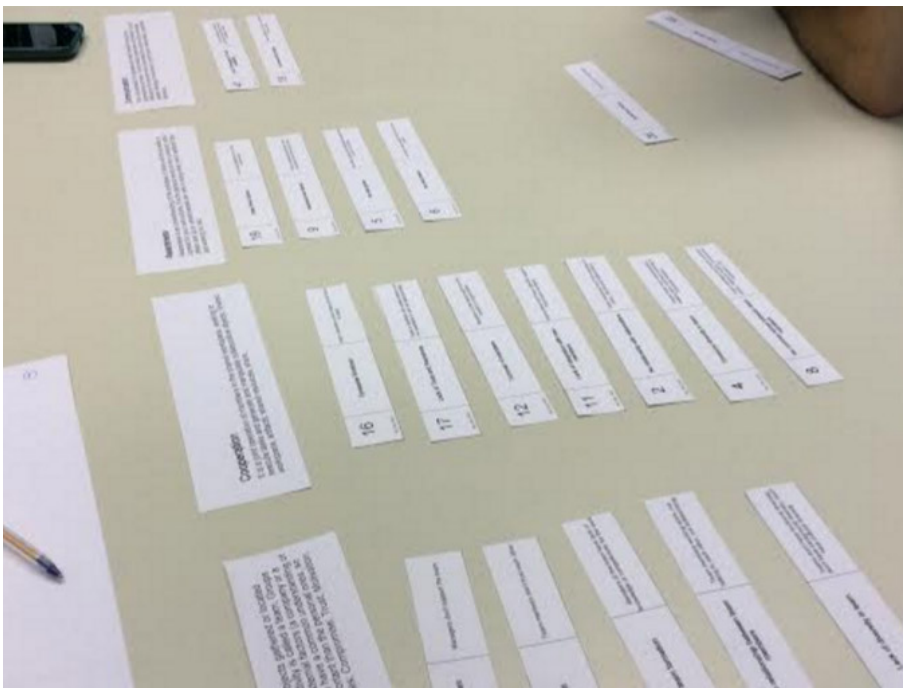

Figure 4.4: Interview with Practitioners Sample

thesis. He has 5 years of experience in software development, and about 2 years working as a tech leader in his team.

The second stage had some interesting findings. All three interviewees stated that the list appear to have most of the issues that they could remember. I1 mentioned that "*he could remember experienced most of the issues listed*", so as I2, that mentioned "*some of that issues they could remember as happening with her students, during classes*".

When asked to cite 3 of the most relevant issues, "lack of feedback" was most mentioned; I1 selected "no clear roles", "lack of feedback" and "unrealistic plan"; I2 choose "no clear goals", "lack of feedback" and "Ineffective communication". And I3 selected "No training", "No common ground between team members" and "Lack of autonomy".

Next, they were asked if they could add other issues based on their experience: I1 did not mentioned any other, while I2 argued about "cultural differences", stating that she remember experiencing something like that in her experience at a global company. I3 mentioned issues related to global software development, as "cultural differences", "timezone" and "different languages". All these issues were not considered for this work, since they are not common to co-located teams.

As for the third stage, some issues appeared to be applied to two or more dimensions. As I1 stated, "*I am not sure if 'No technical discussions' should be an issue of cooperation or communication*". After considering for a few minutes, he decided to classify it in cooperation. I3 already stated something similar: he mentioned that "*no meetings is a very common issue, but I can see it both as a coordination issue, as a communication*

issue". He decided to keep it in communication. In all cases, they decided by a dimension that they believed was more relevant for the issue.

Some evidences pointed that not all of these 42 issues should be used. I1 questioned about two issues called "Big Size Teams" and "Small Size Teams". He pointed that both issues were created before the team members could have control of it. So, in this case, they would not have control to add or exclude team members. He also pointed out that same reason for "Bad Team Formation", stating that these formation of teams usually came from executives and managers. I2 argued that "Noisy Work Space" and "No Shared Work Space" should not be part of the list. She stated that these issues are not in control of the team members and, therefore, they would not have control in order to change them. She also stated the same for "Bureaucracy", since it was based on company policies and rules, and are not decided by the team.

And finally, I3 stated that "Turnover of Members" is a consequence of a collaboration problem, and not particularly an issue. I3 also stated that, in his vision, "Lack of Diversity on Team" and "Excessive Diversity on Team" either should not be considered an collaboration issue, argued that he can not see these ones as relevant to the subject.

Once the interviews had been conducted, myself and my supervisor reviewed, independently, the findings and discussed the discrepancy among the responses of the 3 interviewed practitioners. Myself and my supervisor have more than 15 years of experience in software development and collaboration. Based on that, myself and my supervisor decided that the final classification will be selected by majority, but when it presented a draw, we will discuss to define the best classification fit. Myself and my supervisor decided to refine the list, based on suggestions given by the practitioners. Table 4.2 presents the final results for the activity.

Table 4.2: Classification of the Collaboration Issues

Id	Issue	I1	I2	I3	Author	Supervisor	Conclusion
1	No Relationship Between Team Members	G. Form.	Coop.	Coop.	Coop.	Coop.	Coop.
2	No Relationship with Stakeholders	Coop.	Coop.	Comm.	Coord.	Coop.	Coop.
3	Lack of Diversity in Team	G. Form.	G. Form.	-	-	-	-
4	Excessive Diversity in Team	G. Form.	G. Form.	-	-	-	-
5	No Clear Goals	Awaren.	G. Form.	Coord.	Coord.	Coord.	Coord.
6	No Clear Tasks	Awaren.	Comm.	Comm.	Coord.	Coord.	Coord.
7	Unrealistic Plan	Coord.	Coord.	Coord.	Coord.	Coord.	Coord.

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Id	Issue	I1	I2	I3	Author	Supervisor	Conclusion
8	No Common Ground Between Team Members	Coop.	Awaren.	Comm.	Comm.	Comm.	Comm.
9	Individuals over Teams	Awaren.	Coop.	Coop.	G. Form.	G. Form.	G. Form.
10	No Clear Roles	Coord.	Comm.	G. Form.	Coord.	Comm.	Coord.
11	Lack of Support for New Members	Coop.	Comm.	Comm.	Coord.	Comm.	Coord.
12	Turnover of Members	G. Form.	G. Form.	-	-	-	-
13	Bad Team Formation	-	G. Form.	G. Form.	-	-	-
14	Lack of Trust	G. Form.	Awaren.	G. Form.	G. Form.	G. Form.	G. Form.
15	Lack of Involvement from Managers	Coord.	G. Form.	Coord.	Coord.	Coord.	Coord.
16	Excessive Workload	Coop.	Coord.	Coord.	Coord.	Coop.	Coord.
17	Lack of Tools and Resources	Coop.	Coord.	Coop.	Coop.	Coop.	Coop.
18	No Shard Work Space	Comm.	-	Coop.	Coop.	Coop.	Coop.
19	Noisy Work Space	Awaren.	-	Coord.	-	-	-
20	Excessive Changes in Plan or Process	Coord.	Coord.	Coord.	Coord.	Coord.	Coord.
21	Lack of Challenges or Purpose	Coord.	G. Form.	Coord.	Coord.	Coord.	Coord.
22	Lack of Incentives	Coord.	G. Form.	Coord.	G. Form.	Coord.	Coord.
23	Lack of Autonomy	Coord.	G. Form.	Coord.	Coord.	Coord.	Coord.
24	Excessive Conflicts Between Team Members	Coord.	Coop.	Coop.	Comm.	Coop.	Coop.
25	Big Size Teams	-	Coord.	G. Form.	-	-	-
26	Small Size Teams	-	Coop.	G. Form.	-	-	-
27	Excessive Communication	Comm.	Comm.	Comm.	Comm.	Comm.	Comm.
28	Bureaucracy	Coord.	-	Coord.	-	-	-
29	Ineffective Communication	Comm.	Comm.	Comm.	Comm.	Coord.	Comm.
30	Lack of Focus on Meetings	Awaren.	Coord.	Comm.	G. Form.	Comm.	Comm.
31	No Meetings	G. Form.	Comm.	Comm.	Coord.	Comm.	Comm.
32	No Technical Discussions	Coop.	Comm.	Awaren.	Comm.	Comm.	Comm.
33	Lack of Social Events	G. Form.	G. Form.	Comm.	Coord.	Coord.	Coord.

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Id	Issue	I1	I2	I3	Author	Supervisor	Conclusion
34	Lack of Informal Communication	G. Form.	Awaren.	Comm.	Awaren.	Comm.	Comm.
35	Lack of Face to Face Communication	Comm.	Comm.	Comm.	Comm.	Comm.	Comm.
36	Lack of Feedback	Coord.	Comm.	Awaren.	Comm.	Coord.	Comm.
37	Lack of Monitoring	Coord.	Coord.	Awaren.	Coord.	Coord.	Coord.
38	Lack of Knowledge Sharing	Coop.	Coop.	Awaren.	Coop.	Coop.	Coop.
39	Lack of Training	Coord.	Coord.	Coord.	Coord.	Coord.	Coord.
40	Lack of Perception of Work in Progress	Awaren.	Awaren.	Awaren.	Awaren.	Awaren.	Awaren.
41	Lack of Perception of Team Availability	Comm.	Awaren.	Awaren.	Awaren.	Awaren.	Awaren.
42	Lack of Sources to Help Awareness	Coop.	Comm.	Awaren.	Awaren.	Awaren.	Awaren.

Besides "No Shared Work Space" (mentioned by I2), all other issues mentioned as not being part of the list, were discussed and finally concluded as not being collaboration issues directly associated to software develop teams.

Issues "Lack of Diversity" and "Excessive Diversity in team" were pointed by I3 as not being part of the list. Myself and my supervisor discussed and agreed that this issue is not in control of the team. So, any gamification proposal to change behavior, would not cause the positive effect; "Turnover of Members" was also mentioned by I3. His rationale, that this is a consequence of most of the other issues, was plausible and accepted. So, myself and my supervisor decided to took it off from the list.

Issues associated to team structure, like "Bad Team Formation", "Small Size Teams" and "Big Size Teams" were mentioned by I1 as issues that happens before the team had control, mostly because teams are usually formed by executives and managers. So, gamification would not jump start behavior change on this issue. Myself and my supervisor, decided to took it off.

Finally, issues "Noisy Work Space" and "Bureaucracy" were mentioned by I2 as not being part of the collaboration issues. Her justification was similar to I1: teams might not have control of these factors. So, by the same reason (gamification would not jump start behavior change), myself and my supervisor decided to exclude both issues from the list.

As a result of this activity with practitioners, a initially proposed list of collaboration issues was refined and consolidated. This refinement presented now 34 collaboration issues, all classified under the five dimensions: communication (see Table 4.3); coordination (see Table 4.4); cooperation (see Table 4.5); group formation (see Table 4.6); and awareness (see Table 4.7). The lists has been evaluated with practitioners, and collected evidences that

can conclude that I have now a most stable version of common collaboration issues. It was now ready for being attached to game elements.

Table 4.3: Communication Issues

Communication		
Id	Issue	Description
1	No common ground between team members	Team members do not have common ground, aligment, compromise, motivation, etc.
2	Excessive Communication	Overload of information and communication.
3	Ineffective Communication	There is no common ground between team members and this affects the quality of communication.
4	Lack of Focus in Meetings	Too much distraction in meetings causes loss of information and impacts decisions.
5	No Meetings	There are no meetings for the team.
6	No Technical Discussions	Team members do not discuss technical information.
7	Lack of Informal Communication	There is no Informal communication (not involving work) or ad-hoc communication.
8	Lack of face-to-face communication	Team members do not have rich face-to-face communication.
9	Lack of Feedback	Team members do not give feedback to each other.

Table 4.4: Coordination Issues

Coordination		
Id	Issue	Description
10	No clear goals	No clear goals and objectives about the work to be done.
11	No clear tasks	No clear tasks for the work to be done.
12	Unrealistic plan	Unrealistic schedules, milestones, goals, estimates, etc.
13	No clear roles	Team members do not know or are not satisfied about their roles in the project.
14	Lack of support for new members	Newcomers do not have specific support from team members.
15	Lack of involvement from managers	Managers do not support the team.
16	Excessive Workload	Team members work many extra hours on tasks.

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Coordination		
Id	Issue	Description
17	Excessive Changes in Plan or Process	Planning and processes (like methodology) change frequently.
18	Lack of Challenges or Purpose	The project does not represent a meaningful motivation for team members.
19	Lack of incentives	There is no extrinsic motivation for team members.
20	Lack of Autonomy	Team members do not have autonomy to work.
21	Lack of Social Events	Team members do not have social events or spaces to build relationship.
22	Lack of Monitoring	There is no monitoring from managers or team members in the work.
23	Lack of Training	Team members do not have training for the work to be done.

Table 4.5: Cooperation Issues

Cooperation		
Id	Issue	Description
24	No relationship between team members	Team members working alone, not talking to each other, not collaborating.
25	No relationship with stakeholders	Team members do not have access to users, clients and stakeholders.
26	Lack of Tools and Resources	Tools to facilitate the collaboration are not available or are not appropriated.
27	No Shared Work Space	Team members do not have a physical space to share.
28	Excessive Conflicts Between Team Members	Conflict between team members happens frequently.
29	Lack of Knowledge Sharing	Knowledge does not flow in the team due to lack of moments and artifacts for knowledge sharing.

Table 4.6: Group Formation Issues

Group Formation		
Id	Issue	Description
30	Individual over teams	When individual goals are more important than the team goals.
31	Lack of Trust	Team members do not trust each other.

Table 4.7: Awareness Issues

Awareness		
Id	Issue	Description
32	Lack of Perception of Work in Progress	Team members do not have the perception of status, who is working on specific tasks, who to report, etc.
33	Lack of Perception of Team Availability	Team members do not have the perception about team members' availability or status.
34	Lack of Sources to Help Awareness	There are no artifacts, documents or tools to help teams to maintain awareness.

4.3 Phase 3: Framework Development

The goal of phase 3 was to propose an initially version of the framework named "alpha version". The main goal of the framework should be to point game elements that could jump starting behavior change thus mitigating the collaboration issues identified.

I created my framework based upon my knowledge acquired in the literature review of gamification. For example, Knaving and Björk [KB13] suggested two guidelines for the use of game elements: first, in order to make activities more fun and engaging, they suggest the preservation of focus on the activities themselves; second, they suggest to take into account the playful aspects of games that gamification seeks to emulate. Also, I used some additional works from literature, as the presentation of Deterding [Det11] in which he states some potential pitfalls of using gamification. Knowing what not to do was also important in order to keep the framework proposition more attained to the reality. Oprescu, Jones and Katsikitis [OJK14] proposed ten principles for transforming work processes through gamification, which also was considered during the process.

The structure of the framework was defined by: for each issue presented, I should propose individual game elements and then justify those choices. So, I defined the strategy of the mapping process in two stages: defining a criteria and create a relation between the BadgeVille's list of game elements [Bad11].

The first stage was to define which should be the desired behaviors for each one of the issues proposed. For example, having the issue of "Lack of Focus in Meetings" described as "Too much distractions in meetings causes loss of information and impacts decisions", I defined that a desired behavior should be "improve the focus of team members in meetings

to support better decisions". Based on this, I could now create a formula criteria to define which game elements should be chosen for each issue. The formula was:

(Collaboration Issue) + (Game Element) = Desired Behavior

This formula could be interpreted by "having a collaboration issue, and already knowing what is the desired behavior, which game elements could jump start change and why?". This mapping process was conducted for each issue, in which I mapped the game elements (described in Chapter 2) that could jump start behavior change expected.

The second stage was to propose a relation between the game elements listed. By reading the BadgeVille's resource [Bad11], in which this research was based, I already could see some evidences of relation between game elements. For example, in the description of "Combos", the company states that "The successful completion of a combo usually comes with the reward of a bonus". So, I can infer that combos are only often used with bonuses. In the description of "Leaderboards", the company states that "Leaderboards often compete over points, but can be fuel for competition in many arenas". So, based on that, I can assume that leaderboards and points are related.

This was an insight that establish dependencies in game elements in the framework. So, I assumed the following logic:

Having this second stage proposed, I can now have more evidences that if I propose a "Progression" element to intervene in the collaboration issue, I should also propose a "Quest", since both had a dependency relation.

I then started the mapping process, and as a result, I finally had the preliminary framework (alpha version). This was the first version, and it was planned to be used as a first reference and to collect feedback from practitioners, in order to iterate and refine it.

If Element A is proposed,
and it depends on Element B,
then Element B must be proposed

The relations that were created between the game elements from the BadgeVille's list is presented by Table 4.8.

Table 4.8: Table of Dependency Between Game Elements

Element A	Relation	Element B	Discussion
Combos	Depends On	Bonuses	Combos rewards bonuses when a set of tasks or actions are made by the player.
Bonuses	Depends On	Reward Schedules	If you set a bonus, you must make it clear to the player.
Levels	Depends On	Points	Levels can only be used with a quantification (points).
Status	Depends On	Levels	Status only can be applied if players have a rank.
Points	Depends On	Reward Schedules	Distribution of points must be clear to the player. So, it is important to create a schedule for it.
Leaderboard	Depends On	Points	Leaderboard only makes sense if quantified by points.
Instances	Depends On	Quests	Instances are different approaches for solving the same quests or task.
Progression	Depends On	Quests	Progression only makes sense if there is a quest to accomplish.
Achievements	Depends On	Progression	A set of badges only makes sense if you can measure your statistics.
Epic Meaning	Depends On	Quests	Epic Meaning is more useful to give purposes to a quest.
Loss Aversion	Depends On	Points	Loss aversion makes sense if someone could lose something rewarded (points).

The preliminary framework was organized into the five collaboration dimensions, each one composed by one or more identified collaboration issues. Issues are identified by a singular name and description, and brings together the associated desired behaviour (what is expected), game elements and discussion (how the game elements proposed can be applied). An excerpt of the framework is presented in table 4.9.

Table 4.9: Excerpt from Preliminary Framework (Alpha Version)

Communication Issues					
Id	Issue	Description	Desired Behavior	Game Elements	Discussion
1	No common ground between team members	Team members do not have common ground, alignment, compromise, motivation, etc.	Teams must have a common ground about the expectations of the project.	Cascading Information Theory, Achievements, Quests, Notifier, Progression, User Profile	Cascading information theory can help the team to achieve the common ground of the work to be done. Quests and achievements can create a step-by-step path where team members can learn all important thing about the project. Progression will help to track the progress of these changes. Notifiers, user profile and status also may help in the situation.
2	Excessive Communication	Overload of information and communication.	Team members must know exactly who should be aware of their information.	Achievements, Appointments, Quests, Notifier, User Profile, Countdown	Achievements, appointments and quests can create and describe the team members who must be aware of the results of the accomplishment. Notifier, user profile and status can support the idea for knowing who must be informed about something. Countdown could help team members to set a timer to define their communication.

The first row set the dimensions in which the associated issues are related (in the example, "Communication Issues"). Next, 6 columns, respectly, identified the number ID of the issue, the respective issue, a brief description about it, the desired behavior expected, the list of game elements associated and the discussion justifying why those game elements were selected.

The preliminary framework was ready for the next phase in the research design: a member checking (beta version) and the interview with specialists (final version).

4.4 Phase 4: Framework Evaluation

The last phase of my research design is the Framework Evaluation. The objective was to create a set of strategies of evaluation with practitioners and specialists in software development and gamification. The first step of the evaluation was defined by a member checking, in which I presented the alpha version of the framework to the same practitioners interviewed in phase 2. Using their feedback, I refined the framework generating a newer version (beta version), which would be used in the interview with specialists, the final step of the evaluation process. As a results, it was expected that I could then have evidence to consolidate a final version of this framework.

Member Checking

For the preliminary evaluation, I used the member checking technique [Buc11]. In the member checking process, the researchers ask participants to evaluate and provide feedback about the accuracy of researchers' conclusions from the subjects who provided the data in the first place [Buc11]. Thus, I contacted the three experts that participated in the exploratory study (phase 2) and invited them to provided me with feedback about the alpha version of the framework. Also, in order to collect more feedback, two other practitioners (who did not participate in the activity in phase 2) were invited. These two practitioners were researchers who have previous experience with gamification topic, and could provide a more comprehensive feedback based on their experiences.

Interviewee 1, 2 and 3 are the same people who participated in phase 2. Interviewee 4 is an adjunct teacher at PUCRS, with 6 years of experience in the software development area. She is also taking a PhD degree in Computer Science, and has 2 years of theoretical knowledge in gamification. Interviewee 5 is an adjunct teacher at a private university, with 5 years of experience in software development area. He is also is also taking a PhD degree in Computer Science, and had 3 years researching the gamification area.

The member checking activity was planned to be a qualitative interview, based on the perceptions of these interviewees of the preliminary framework proposed. The script interview is attached in Appendix A. The activity was divided in two stages: the first one, I collected the background about the interviewees (even those who already answer it in phase 2); the second was to collect the perceptions of the framework in general and finally got suggestions for improvement. The activity was presential and individual, with an expected duration of one hour. The researcher had an script with qualitative questions that was used as a guide for the interview. The data collection was transcripted by the researcher, during the process.

For the first stage, I presented the work of this research so far, highlighting the motivation, the aspects of Gamificaton and the creation process of the framework. It was a stage to create a common ground of the subject with the practitioners.

In the second stage, I presented the preliminary framework and started the interview. I asked them to tell me their perceptions about the structure and organization of the framework (reading all the material was optional, in order to keep the activity in time). Besides that, most of the interviewees read the material and provides me with some initial perceptions about the framework. Since it has been printed in paper and presented to the practitioners, some stated about the extension (in number of pages) of the work. Interviewee 1 (I1) pointed that "*the framework looks too big to manage*". I2 stated that "*the structure looks extensive*".

Also, as their first impressions, I1 stated that "*the framework looks useful. All those issues mentioned are presented*"; I2 also stated that "*besides it's size, the structure is good*"; I3 stated that "*all issues are pertinent, and I like it the idea of the framework*"; I4 also like it the framework "*It is an interesting approach*".

I asked if they could choose some issues just to check if the proposal for them attend the goal of the framework. The objective here was to get more detailed feedback about the framework content. A recurrent feedback, in their first impressions about the selected excerpts, was the need of examples. As I1 mentioned "*Examples could make the framework more accessible*", explaining that people could read it and have an idea of how to apply in reality. I2 had a similar suggestion, stating that "*give more attention to examples, and associate it to the issues*". She also suggested to use some examples from literature. I3 also reinforce that "*examples could make it easy to learn*", and remembered that in his brief experience with gamification, he always questioned about practical examples. I4 stated that I should consider "*suggestions of application for each game element proposed*". She also stated that I should use "*examples that gives context to the proposition*". Also, I5 stated that "*an theoretical example could improve the framework*", in order to give additional information to the reader.

Based on these feedback, I marked **examples** as a top priority suggestion for future work.

Three of the practitioners suggested to publish the framework on the Internet for the community. I1 justify this proposition by "*avoiding the excessive printed material*", while I2 suggested the application in Web as a way to "*promote the promising work that you had*". I3 mentioned that this work should be published in Web "*so companies could have a resource to introduce gamification in their contexts*". I5 suggested the publication in Web, since "*the community will start to apply it and provide lessons learned*".

So, **publishing the framework in Web**, was marked as a future work.

About the game elements proposed, most of the practitioners asked about the rationale behind each excerpt analyzed. I1 asked if the reader will get an dictionary to understand each game element "*because some of them are not clear to me*". Even with the first stage of the activity focused on the presentation of the research, I5 suggested that I should "*make a better analysis of each game element proposed*", in order to give more context.

Based on this feedback, I marked as that I should **provide more information about the game elements** as a future work.

Another interesting suggestion was made by I4 asked if I will introduce an aspect of priorities in the game elements. As she stated, "*you could present to the reader which are the most useful or which you should use first*". This suggestion was also stated by I5: "*maybe you could evaluate some game elements and presents which are most important to apply. Like game element A have 5 stars, and so on*".

So, I marked as future work that I could **propose an analysis of those game elements**.

One important aspect that some of the practitioners argued was about the profile of each team member. I2 stated that "*the framework should consider which kind of motivation I should boost, because each people have different needs*". I3 also mentioned that I should "*consider the profile of the team to achieve better results*". But, in the other hand, I5 mentioned that "*profiling the team was not nothing that he would consider when reading this framework*".

Besides this two different point of view, I marked as future work **the need of profiling the team**.

Also, two practitioners mentioned that I should consider the relation between each issue. As I4 stated, "*the communication and cooperation issues, sometimes, causes the coordination ones*". In her view, if I mitigate one issue, I could be able to mitigate others related to it. I5 suggested something similar, stating that "*I could make a graph of relations between each issue*". He also suggested this because future readers could see the "chain effect" of resolving a issue, that is related to others.

Based on these feedback, I marked **a relation between issues** as a suggestion for future work.

Finally, all the practitioners mentioned that the framework could be an interesting contribution of this work for the software development area. Most of them, was interesting on seeing it in practice.

This activity of member checking ended with six suggestions to improve the framework. Based on my scope and timeframe of the research, I decided to choose the one who appears to have more importance, since was mentioned by all the practitioners: the use of examples.

The examples were created based upon some ideas, cases and suggestions collected in informal literature. Most of these examples were used to explain each game element in Chapter 2. So, based upon this knowledge and my own experiences, I proposed examples and suggestions for each game element, in order to mitigate the issue analyzed.

So, I iterate the framework by adding a new column where an example of use will be presented. Besides that, I decided to improve the organization of the framework, by subdividing each game element, in order to make the framework more comprehensive to readers. So, I could improve the discussion and also add an example, based on each one of the game elements. Table 4.10 presents an example of the new structure proposed.

Table 4.10: Excerpt from the Framework (Beta Version)

Lack of Autonomy		
Dimension:	Coordination	
Description:	Team members do not have autonomy to work.	
Desired Behavior:	Team members must have autonomy to decide the best way to work on the problems.	
Game Element	Discussion	Example
Discovery	Discovery could give team members the feeling that they need to explore their objectives in order to better achieve them.	When you create the plans or quests, set some open tasks where team members will decide the best way to explore the best actions to achieve results.
Ownership	Ownership could help team members to see the project as something they own and care about, having the feeling that their participation are important for achieving success.	When creating a quest, you can encourage a specific team member to be responsible for the the creation of it. This "ownership" feeling will make them more happy to decide the best ways to achieve that.
Quests	Quests could be created by the team members, so they will have more empowerment in the decisions.	Leave the creation of the quests for your team members. They will have autonomy to decide the best ways to achieve the objectives.

This new framework (beta version) was now able to be evaluated in the final step of it: interview with specialists.

Interview with Specialists

The final evaluation of this research was qualitative interview with specialists.

Creswell [Cre09] mentioned that a qualitative interview should be conducted face-to-face or via telephone, in order to capture their reactions. The author suggests to have an open-ended questionnaire intended to elicit views and opinions from the participants. I planned this activity to collect evidences of applicability of the framework, based on the specialists perceptions and thoughts. I selected specialists with background in software development, team management or gamification.

I choose specialists with a strong background in software development (at least 5 years). I also seek for specialists who had experience in research, in team leadership or gamification, to provide some different perspectives in the work. Most of specialists had a background in two or more of these topics.

From 20 specialists contacted for the activity, 11 manifested interest in collaborate. They were contacted based on convenience. This was an important asset to make the interviews easier to schedule, since some of the specialists were working and did not had time in their agenda for the activity.

All specialists interviewed are Brazilian, but 3 of them are living abroad (USA, Spain and Germany). The specialists are 4 women and 7 men, most of them working in large companies, which 5 of them were global. Also important to mention, 2 of the 11 specialists (S9 and S11) have industry experience with gamification.

Most of them were contacted via a social media network and had the possibility to choose between a face-to-face interview, or a video conference. For best fit in their schedule, 9 of the interviews were made via video conference. Same material for both methods were created. One in paper format, and other in digital format. Table 4.11 presents an overview of the specialists.

Table 4.11: Specialists's Background

Spec.	Location	Job	Org. Size	Software Exp.	Leadership Exp.	Exp. in Gamific.
S1	Porto Alegre Brazil	Software Tester Team Leader MsC in Progress	+1000	6 years	2 years	Informal Knowledge of Gamificaton
S2	San Francisco USA	Software Engineer Team Leader	+1000	12 years	2 years	Participated in Projects with Gamificaton
S3	Barcelona Spain	Product Owner	+1000	15 years	6 years	Studied gamification for Work
S4	Porto Alegre Brazil	Software Engineer Team Leader	+1000	13 years	2 years	Participated in Projects with Gamificaton
S5	Canoas Brazil	Educ. Tech Analyst PhD in Progress	+1000	7 years	2 years	Studied gamification for Research
S6	Porto Alegre Brazil	Adjunct Teacher PhD in progress Project Manager	+20	20 years	9 years	Informal Knowledge of Gamificaton
S7	Porto Alegre Brazil	Project Manager Product Owner MsC in Progress	+1000	19 years	15 years	Participated in Projects with Gamificaton
S8	Berlin Germany	Scrum Master PhD in Progress	+20	5 years	2 years	Participated in Projects with Gamificaton
S9	Porto Alegre Brazil	Entrepreneur Game Developer	+5	10 years	4 years	Works with gamification
S10	Porto Alegre Brazil	Entrepreneur Manager	+10	15 years	12 years	Informal Knowledge of Gamificaton
S11	Porto Alegre Brazil	IT Director Consultant	+20	20 years	15 years	Works with gamification

For the activity, which was planned to be taken in 1 hour, I created 34 cards with my list of collaboration issues, their dimensions and descriptions. I also created 34 cards containing the framework suggestion for each issue. I decided to provide a dictionary for game elements, in order to support the specialists. Finally, I generated a script with qualitative questions, to conduct the interview activity. The script interview is attached in Appendix A.

The main goal of the objective was to collect evidences of applicability of the framework, based on the specialists perceptions and thoughts. The activity was planned in four

stages: background, issues selection, perceptions of excerpts from the framework and final thoughts. The first stage has the objective to collect the background of the specialists prior the interview, and to explain the activity, motivation and artifacts involved. It was designed for introducing the activity and prepare the specialist.

The second stage has the objective to collect evidences about the consistency of collaboration issues list. The specialists received the 34 cards containing those issues, and were asked to select 3 of those which they most experienced at work. After that, they should justify why they choose them. In third stage, the specialists were presented the piece of the framework proposed for each one of those issues selected. The objective was to collect their perceptions about the proposal, the structure and other considerations that they want to share about it. Also, they were asked if the ideas proposed could mitigate that issue, and jump start the desired behavior.

Finally, in forth stage, the specialists were asked about their perceptions about the framework, considering the three pieces of material that they analyzed, and also suggest some future improvements. The objective here was to collect general perceptions and suggestions that could point for improvements in future work. Also, they were asked if the framework proposed had evidences that could attend those collaboration issues mentioned.

I conducted the interviews mostly by video conference. Using a qualitative approach, I drove the specialists through the questions and written down their answers. Their answers were then transcripted to an electronic sheet in order to organize the data collected. This analysis was divided in 4 steps: codification, grouping, comparison and conclusions.

The first step was to codify the data. I created a table to identify which issue were mentioned by each specialist. This organization was important to identify which issues were most mentioned, and later to compare answers of different specialists for same issues. Figure 4.5 presents an excerpt of this sheet.

Then, I coded each one of the data collected in tags, to help to contextualize each sentence. During the process, some tags were created to co-relate similar data. For example, I created a tag "[LIKES]" to identify when the specialists mentioned that liked something, "[SUG]" to identify when specialists are suggesting something, and "[WHY]" when they are

		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
1	No Common Ground Between Team Members						x				x	
3	Ineffective Communication		x			x				x		
4	Lack of Focus in Meetings			x								
9	Lack of Feedback	x		x		x			x	x		x
10	No Clear Goals			x			x			x	x	
11	No Clear Tasks										x	
12	Unrealistic Plan		x					x				
14	Lack of Support for New Members	x										
17	Excessive Changes in Plan		x									
18	Lack of Challenges or Purpose						x					x
19	Lack of Incentives											x

Figure 4.5: Issues Mentioned by Specialists

	S1	S3	S5
Lack of Feedback	[DISLIKES App - bad exemple] [REAL Consider Using at Work] [SUG Need to Set Clear] [SUG Need to Avoid Quantitative] [LIKES lottery / Achi / Combos] [DISLIKES bonus]	[LIKES lottery] [WHY process informal] [LIKES game to feedback] [LIKES progress] [WHY orient people] [LIKES Achi / Combos]	[LIKES all] [WHY all are applied] [LIKES Rew Sc] [WHY its the base for all] [SUG define focus QUALI or QUANTI]
	[YES] [REAL Consider Lottery at Work] [WHY Achi / Combos for Qualitative] [SUG avoid Quantitative] [SUG Change War Room]	[YES++] [SUG think on the process] [WHY boring could be fun and informal]	[YES] [WHY focus in managers] [DISLIKES with teams members is hard] [WHY due to maturity]

Figure 4.6: Data Codified with Tags

giving an explanation about their statements. This tagging process helped to give a better overview of the answers given by the specialists.

The second stage was to group these answers by similar issues mentioned. Having the tags mapped the data collected, I decided to group those answers with similar results. It was a process created in order to compare each answer given by the specialists and analyze them side by side, preparing for the third stage. Figure 4.6 presents an example of this procedure, with the grouping of issue "Lack of Feedback".

The third stage was the comparison of results. In this case, I review each answer, comparing with other specialists, when applicable, seeking for evidences that could help me evaluate if those specialists agree, disagree or pointed some new perspectives about the work.

Finally, forth stage was the conclusions, in which I conclude my findings and evaluate if those specialists gave me evidences to state that my research is a valid and useful research that could be applied at real collaboration issues at work.

The findings of this evaluation are detailed in Chapter 6, after the presentation of the framework.

5. FRAMEWORK

This Chapter presents the final version of the framework. This framework was evaluated by specialists, as described in Chapter 6.

The framework is presented in a table format. The structure proposed for the framework was created in order to make it accessible to researchers and practitioners. Each issue is organized by the dimension (based on 3C Model) which it makes part, a brief description of the issue and the desired behavior expected to be jump started, and the game elements suggested for fostering the collaboration. Each game element has a brief discussion for its use and a practical example as a suggestion of use. Table 5.1 presents the format of the framework.

Table 5.1: Framework Structure

Collaboration Issue Name		
Dimension:	*The collaboration dimension which this issue is related.*	
Description:	*A brief description of this collaboration issue.*	
Desired Behavior:	*A brief description of the desired behavior expected, when applying the game elements.*	
Game Element	Discussion	Example
Proposed Game Element A	*Brief discussion about why game element A was selected.*	*Practical example to illustrate how game element A could be used to mitigate the issue.*
Proposed Game Element B	*Brief discussion about why game element B was selected.*	*Practical example to illustrate how game element B could be used to mitigate the issue.*
Proposed Game Element n	*Brief discussion about why game element n was selected.*	*Practical example to illustrate how game element n could be used to mitigate the issue.*

This framework contains 34 collaboration issues, classified in 5 dimensions of collaboration named: communication, coordination, cooperation, group formation and awareness. The framework presented 215 suggestions of application of game elements composed a set of main elements as follows:. The most used was Quests (cited 33 times), Progression (21), Appointments (21), Activity Feed (17) and Reward Schedules (13), as shown in Figure 5.1. In the other side, the least used game elements was Free Lunch (1), Loss Aversion (2), Ownership (2), and Avatars (2).

The distribution of them made coordination the largest dimension with 14 collaboration issues, followed by communication (9 issues), cooperation (6 issues), awareness (3 issues) and finally, group formation (2 issues). Figure 5.2 presents this distribution.

Communication dimension had 47 suggestions of use for game elements. The most used dynamics were Quests (9), Appointments (7) and Progression (5). Most of suggestions proposed ways to foster communication in the team by creating artifacts or activities that could create situations for the team to start talking face to face.

For the dimension of coordination, the framework presented 106 suggestions of use for game elements. The most used dynamics were Quests (14), Progression (11), Reward Schedules (6), Instances (6) and Activity Feed (6). Most of the suggestions proposed ways to create a setup for a better coordination between team members, and also stakeholders of the project.

The dimension of cooperation had 34 suggestions of use for game elements. The most used dynamics were Quests (6), Appointments (5) and Activity Feed (5). Most of suggestions proposed situations or artifacts that could help team members start to cooperate between them.

Group formation was composed by 11 suggestions of use for game elements, having Quests, User Profile and Appointments, with 2 uses each, the most proposed dynamics.

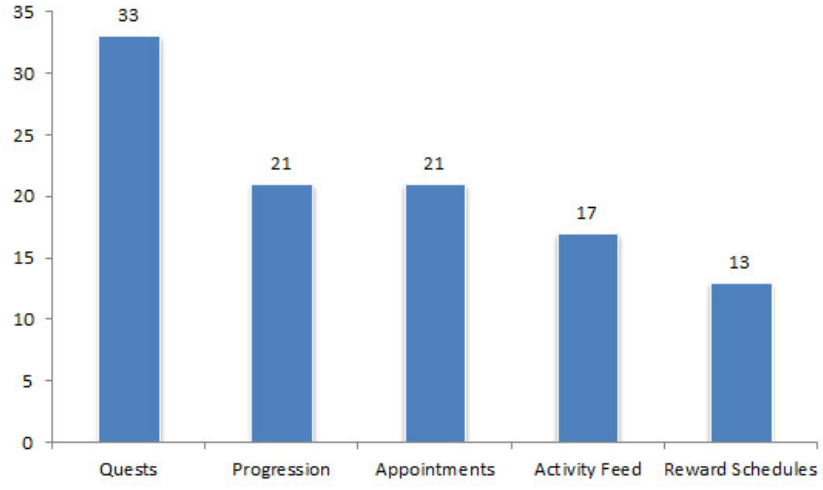

Figure 5.1: Most used Game Elements in the Framework

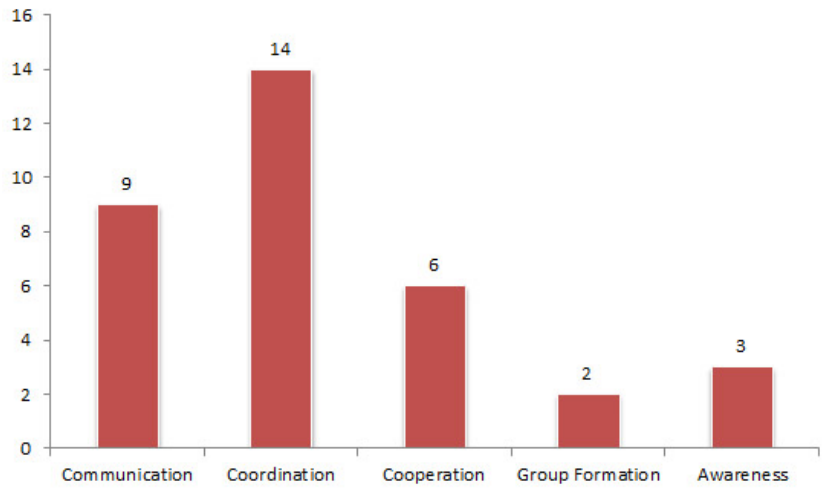

Figure 5.2: Distribution of Issues per Collaboration Dimension

Most of suggestions proposed situations to foster situations of team building, in order to create confidence and collective sense.

And finally, awareness had 17 suggestions of use for game elements, having Activity Feed (3), Quests (2), Appointments (2) and Progression (2) the most used dynamics for the issues presented. Most of suggestions proposed situations or artifacts that could help team members to have a better perception of team members and work.

Next, the framework is presented organized by its five collaboration dimensions.

5.1 Communication

No Common Ground Between Team Members

This issue was mentioned in 23 of the 51 papers of the literature review for collaboration. It was classified as a **communication** issue of collaboration. In this case, 5 game elements were proposed, as presented in Table 5.2.

Table 5.2: No Common Ground Between Team Members

No Common Ground Between Team Members		
Dimension:	Communication	
Description:	Team members do not have common ground, alignment, compromise, motivation, etc. among each other.	
Desired Behavior:	Team members must have a common ground about the expectations for the project.	
Game Element	Discussion	Example
Quests	Challenges can be created to encourage team members to execute specific tasks that could help them to create a common ground in the team.	Create a set of tasks that creates a journey for the team to achieve a quest. Focus on tasks where team members that do not have same alignment need to work together to solve the challenges.
Cascading Information Theory	Information about the project could be released in minimum snippets for the team, helping them to achieve similar level of understanding.	Very useful in the beginning of a project, you can create a presentation about the project in small chapters, where team members will go further only after completing each chapter. This will help them to check if the project satisfy their own expectations, helping creating a more unified team.
Activity Feed	Showing to all team what each member has accomplish could create awareness to help them to be motivated and align with the project.	Create a dashboard (physical or virtual) where each member have their work shown to every people involved in the project, frequently updated.
User Profile	Each member could have a profile where their progress and personal information could help the team to better understand each other.	Make the profile of each member visible to every people involved in the project. A virtual profile, similar like "Facebook", with personal information, interests and motivation, will help to increase awareness in team.
Progression	Having the team feeling the sense of progression, by completing tasks and achievements, could help them see their evolution.	Focus on creating graphic progression, like the agile Burndown Chart, where team members must work together to progress.

Excessive Communication

This issue was mentioned in 6 of the 51 papers of the literature review for collaboration. It was classified as a **communication** issue of collaboration. In this case, 6 game elements were proposed, as presented in Table 5.3.

Table 5.3: Excessive Communication

Excessive Communication		
Dimension:	Communication	
Description:	Overload of information and communication in work space.	
Desired Behavior:	Team members must know exactly who should be aware of their information.	
Game Element	Discussion	Example
Appointments	The members could have predetermined meetings where they could talk about information that need to be discussed.	Define a specific time and place where team members must gather in order to discuss something. Those who attend to the meeting, in the exact time, could receive some nice rewards (chocolate, etc).
Countdown	Countdown could be useful to define a specific time frame where people must communicate.	Define for each meeting a countdown, where people need to be focused on exchange the objective information. This could avoid having the feeling that the communication was an waste of time.
Progression	Team could have a place where they can track their progression and see who did what. That will increase their awareness when they need to communicate.	A dashboard could be very useful to track the progress of the project, and must be maintained by themselves. A dashboard will increase their awareness for seeking information.
Quests	Quests could be created to map the correct tasks and people that should be involved, avoiding overload to other members.	Improve the quality of information in each quest, where people know exactly who should do what. This will make easy to track the correct members involved. Quests must involve some tasks that could motivate them.

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Excessive Communication		
Game Element	Discussion	Example
Activity Feed	Having an activity feed about the work done by each member could help them to be aware of who they need to talk or discuss about something.	Use a dashboard as an activity feed where team members could be able to see the people involved in the project and also in each task. The dashboard must be maintained by the team.
User Profile	The user profile could help the team members to check and to be aware about each other responsibilities.	Delivery an user profile for each team member (physical or virtual) where they could check more about each person, and see if they could help in their need for information. If you need a tester, you will check the profile of the testers, not the developers.

Ineffective Communication

This issue was mentioned in 18 of the 51 papers of the literature review for collaboration. It was classified as a **communication** issue of collaboration. In this case, 4 game elements were proposed, as presented in Table 5.4.

Table 5.4: Ineffective Communication

Ineffective Communication		
Dimension:	Communication	
Description:	There's no common ground between team members or the tools to communication are poor, and this affects the quality of communication.	
Desired Behavior:	Team members must have a similar language for working together.	
Game Element	Discussion	Example
Cascading Information Theory	Information about the project could be released in minimum snippets for the team, helping them to achieve similar level of understanding.	Very useful in the beginning of a project, you can create a presentation about the project in small chapters, where team members will go further only after completing each chapter.

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Ineffective Communication		
Game Element	Discussion	Example
Quests	Challenges can be created to encourage team members to execute specific tasks that could help them to create a common sense in the team.	A nice way to create a common ground for the team is having quests where teams must work in different areas of the project. For example, a quest where a developer have tasks to work with a designer or a tester.
Appointments	Appointments could force team to meet in a specific time and place, where they could discuss about the project.	Set a meeting for all team in a war room, every week, where everyone involved with the project could sit and discuss about their problems, challenges, suggestions, etc, focusing on foster their communication.
User Profile	Each member could have a profile where their progress and personal information could help the team to better understand each other.	Define a profile for each team member, available to everyone involved in the project, where they could check skills and specialities of each one. This will help them to ask for help and increase their common ground.

Lack of Focus in Meetings

This issue was mentioned in 5 of the 51 papers of the literature review for collaboration. It was classified as a **communication** issue of collaboration. In this case, 6 game elements were proposed, as presented in Table 5.5.

Table 5.5: Lack of Focus in Meetings

Lack of Focus in Meetings		
Dimension:	Communication	
Description:	Too much distraction in meetings causes loss of information and impacts decisions.	
Desired Behavior:	improve the focus of team members in meetings to support better decisions.	
Game Element	Discussion	Example
Achievements	Create a set of achievements and badges for each meeting, having people know what they must do to accomplish and earn them.	A fun stuff to do is create a set of objectives and challenges which team members could achieve. Like badges for who lead the meeting, give most suggestions, best organize the meeting, etc.
Bonuses	Bonuses could be provided to members who achieve specific tasks in the meetings, helping them to participate in an active way.	Set some bonuses for each member who achieve specific additional objectives that improve the quality of the meeting. Like someone who write down the agenda, or that earn the badges, etc.
Quests	Each team member could choose specific quests for the meeting, like: asking questions, writing down the minute, etc.	Have specific tasks or a whole quest that are focused on meetings. Make everyone have a role and responsibility on the meeting, so they will have to focus on that.
Countdown	Countdown could be used to create a time boxed experience for the meeting. Each member will be aware of the time left for the meeting.	Set a specific timeframe for the meeting, so team members will try to do their best to be focused and maintain the quality of the meeting.
Reward Schedules	A reward schedule could be created to reward the team if they accomplish specific behaviours or tasks in a specific time.	If you set a bonuses, mention before, you should create a specific schedule of how the team members will earn those rewards.
Progression	Progression could be used to show the progression of the discussions in the meeting, so members could feel like moving on it.	Having a visual agenda where people could see what is in discussion (and its progression during the time) could improve the quality of the meeting.

No Meetings

This issue was mentioned in 10 of the 51 papers of the literature review for collaboration. It was classified as a **communication** issue of collaboration. In this case, 8 game elements were proposed, as presented in Table 5.6.

Table 5.6: No Meetings

No Meetings		
Dimension:	Communication	
Description:	There are no meetings for the team to communicate and discuss.	
Desired Behavior:	Create a routine of meetings for the team.	
Game Element	Discussion	Example
Achievements	Achievements could be created to allow members to earn badges for accomplish a specific set of meetings.	Set a group of badges for the team if they could achieve 1, 5, 10, 20, 40 meetings (and so on). Reward them for that.
Quests	Quests could help the members by creating tasks involving meetings during a journey to complete the project.	When you set a quest for the team, always make at least one of the tasks as a meeting where everyone should attend in order to continue.
Appointments	Having meetings set up in specific days and times, as appointments, could help team members to create a routine for it.	Set a visual reminder where people can see the date and time of the meetings, and reward if the team attend on time.
Notifier	Notifiers could give feedback to members about the results of the meeting, and also could be used to warn members about the coming meetings.	When the meeting is about to start, make somone responsible to hit a gong to notify the team.
Bonuses	Bonuses could be provided to teams who attend to important meetings or a set of meetings predefined.	Give some good perks for all the team if they attend on meeting on time or if they decide important things.
Reward Schedules	Reward Schedules should give team members information about what they need to do in order to earn their rewards.	If you set a bonuses, mention before, you should create a specific schedule of how the team members will earn thoses rewards.

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No Meetings		
Game Element	Discussion	Example
Combos	Combos of tasks, that maximize the effects desired for this behavior, could foster team members to achieve better results for a better reward.	Set some specific combos for team members, where they could earn some bonuses. If someone schedule the meeting, set the place and also make everyone arrive on time, the one who was responsible for that will earn a bonus.
Progression	Progression could be useful to give feedback about a specific meeting, or a set of meetings.	Having a visual agenda where people could see how many meetings they already made, what was the decisions that where produced by it, etc. will give a sense of progression for the team.

No Technical Discussions

This issue was mentioned in 6 of the 51 papers of the literature review for collaboration. It was classified as a **communication** issue of collaboration. In this case, 4 game elements were proposed, as presented in Table 5.7.

Table 5.7: No Technical Discussions

No Technical Discussions		
Dimension:	Communication	
Description:	Team members do not discuss technical information.	
Desired Behavior:	Create a routine for fostering technical discussions.	
Game Element	Discussion	Example
Quests	Quests could be created to have tasks where members need to discuss technical issues of their work.	After create a quest for achieve some objective, make sure that at least one quest if set where team member should sit together and discuss about tech aspects.
Appointments	Appointments could help the team members to discuss technical information, by setting up a specific time for each iterations.	Create a war room, and define a specific day and time where team members must sit together and discuss technical stuff. Create na informal environment for this meeting.

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No Technical Discussions		
Game Element	Discussion	Example
Bonuses	Bonuses could reward those members who foster the technical discussion in the team, or achieved specific tasks.	Set a special reward for those team members who make sure that technical discussion are occurring weekly.
Reward Schedules	Reward Schedules should give team members information about what they need to do in order to earn their rewards.	If you set a bonuses, mention before, you should create a specific schedule of how the team members will earn thoses rewards.

Lack of Informal Communication

This issue was mentioned in 12 of the 51 papers of the literature review for collaboration. It was classified as a **communication** issue of collaboration. In this case, 3 game elements were proposed, as presented in Table 5.8.

Table 5.8: Lack of Informal Communication

Lack of Informal Communication		
Dimension:	Communication	
Description:	There's no Informal communication (not involving work) or ad-hoc communication.	
Desired Behavior:	Foster the informal communication in the team, letting them chat about anything and anywhere, or have social events.	
Game Element	Discussion	Example
Quests	Quests could be created to have tasks where members need to gather information by informal ways.	Set a specific quest, specially in the beginning of the project, where the team members should hang out together outside the workstation, to know each other.
Appointments	Appointments could help the team members to meet outside the work, or in informal places in workspace.	Create a specific day and time where team members should hang out together outside the workspace (like in the cafeteria).
User Profile	User Profile could be useful to make team members be aware of informal information about their colleagues.	Set in the user profile of the team members some things like hobbies, books, movies, etc. that could foster them to know each other a little more.

Lack of face to face communication

This issue was mentioned in 5 of the 51 papers of the literature review for collaboration. It was classified as a **communication** issue of collaboration. In this case, 3 game elements were proposed, as presented in Table 5.9.

Table 5.9: Lack of face to face communication

Lack of face to face communication		
Dimension:	Communication	
Description:	Team members do not have rich face-to-face communication.	
Desired Behavior:	Encourage the team to have more face-to-face communication.	
Game Element	Discussion	Example
Quests	Quests could be created to have tasks where members need to gather and discuss face to face.	When creating a quest for your team, make sure that at least one of the tasks involve specific face-to-face interaction between team members.
Lottery	Lottery could foster face-to-face communication by creating some "chaos" in their routines, creating a different experience everyday.	Create a lottery system where two team members will be random selected and must only communicate to each other (or to the team) face-to-face.
Appointments	Appointments could help the team members to meet in specific time and have face to face communication.	Create a specific time for teams to make a daily meeting where they should stay together and discuss, face to face, their work.

Lack of Feedback

This issue was mentioned in 10 of the 51 papers of the literature review for collaboration. It was classified as a **communication** issue of collaboration. In this case, 8 game elements were proposed, as presented in Table 5.10.

Table 5.10: Lack of Feedback

Lack of Feedback		
Dimension:	Communication	
Description:	Team members do not give feedback to each other.	
Desired Behavior:	Foster the feedback process in the team by allowing them to discuss about their work relations.	
Game Element	Discussion	Example
Achievements	Achievements could be created to allow members to earn badges when giving specific number of feedback to each other.	Create a set of badges that team members could earn when achieve specific number of feedback sessions (5, 10, 15, etc) and give special reward for that.
Quests	Quests could be created to have tasks where members need to evaluate and give feedback about the work of other members.	Create a specific quest that involves all the team members to give feedback to each other, like in a retrospective session. Each task could involve any subject to discuss.
Appointments	Appointments could help the team members to have a specific time where they could give feedback to each other.	Set a war room, and define a specific day and time where team members must attend. The meeting should be informal, making them more comfortable to discuss.
Bonuses	Rewards could be given for the team if they give quality feedback, that others could evaluate to see if it was useful.	Give a nice bonus reward if all the team complete the feedback sessions with themselves.
Combos	Combos of tasks, that maximize the effects desired for this behavior, could foster team members to achieve better results for a better reward.	Combos could be very useful to give bonuses if team members give feedback in a combined themes, like leadership, communication, compromise, etc.
Reward Schedules	Reward Schedules should give team members information about what they need to do in order to earn their rewards.	Set a schedule where team members know how they are able to receive their rewards.
Progression	Progression could be very useful to track the evolution of each member, during the time, based on the feedback received.	Have an spreadsheet or a dashboard where team members could see their evolution in the feedback sessions, with some visual aids (red, green, yellow, for example). This could help them to track their progression.

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Lack of Feedback		
Game Element	Discussion	Example
Lottery	Lottery could insert a different dynamic for the feedback system, where members are randomly selected and need to give/receive feedback to each other.	Use lottery to make the feedback session more interesting. Every team member must give feedback to other, based on chance.

5.2 Coordination

No Clear Goals

This issue was mentioned in 13 of the 51 papers of the literature review for collaboration. It was classified as a **coordination** issue of collaboration. In this case, 6 game elements were proposed, as presented in Table 5.11.

Table 5.11: No Clear Goals

No Clear Goals		
Dimension:	Coordination	
Description:	No clear goals and objectives about the work to be done.	
Desired Behavior:	Goals are defined, clear and available for every team member.	
Game Element	Discussion	Example
Cascading Information Theory	Cascading Information Theory could create a structured path where team members could progressively understand the objectives of the projects, having a better understanding of it.	Create a mini tutorial where the members will learn the goals step by step. In order to move further, they need to fully accomplish the tutorial steps.
Epic Meaning	Epic Meaning could help creating a narrative for the project, making the team members understand and visualize the objectives in a different approach.	A goal should be a great objective that need to be achieved by the team. So, create a powerful meaning to motivate people on completing that. A simple example: "We need to finish the sign up functionality of the website because we can let the users start registering and love this application".

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No Clear Goals		
Game Element	Discussion	Example
Instances	Instances could set different approaches for solving the same objective, by fostering team members to set mitigation plans if things go wrong.	To achieve a goal, the teams could choose three paths: an easy one, a hard one and a challenged one. Each path have different tasks and quests to be achieved.
Reward Schedules	You can set rewards for each goals to motivate your team.	Set some interesting rewards like a paid happy hour when the goal is achieved.
Progression	Having the team knowing their progression is important to let them know where they are to achieve the goals.	A dashboard is always a great choice to let them see what they are doing and what are the importance of that to achieve the goal.
Quests	Quests could be very useful to help team members to create challenges and a set of tasks that need to be done in order to achieve specific objectives.	Set quests with a couple of tasks each. Quests should be like intermediary objectives to achieve the goal.

No Clear Tasks

This issue was mentioned in 10 of the 51 papers of the literature review for collaboration. It was classified as a **coordination** issue of collaboration. In this case, 5 game elements were proposed, as presented in Table 5.12.

Table 5.12: No Clear Tasks

No Clear Tasks		
Dimension:	Coordination	
Description:	No clear tasks for the work to be done.	
Desired Behavior:	Tasks are properly defined and team members know what they have to do.	
Game Element	Discussion	Example
Quests	Quests could be very useful to help team members to visualize the paths and tasks that they need to achieve in order to finish tasks.	Each quest should have a group of tasks that have enough information or what should be done, who is involved and what is the goal.

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No Clear Tasks		
Game Element	Discussion	Example
Reward Schedules	Reward Schedules should give team members information about what they need to do in order to earn their rewards.	You can define a specific reward for some tasks that are more important for the process, so team members will pay more attention for that.
Activity Feed	Activity Feed could be very useful to make members be aware of team evolution in tasks, and to see who could help clarify a task if a similar one was already made.	A Dashboard is very useful to work as a Activity Feed, where team members must manage their tasks in a flow process, like to do, doing and done.
Notifier	Notifiers could give feedback to team members to help them understand if their tasks are clearly achieved or not.	Everytime someone create a task, a notifier could be send to every team member, in order to make them aware of that. Notifiers must send positive feedback in order to encourage them.
Progression	Progression could be useful to help team members track their progress when achieving tasks. They could understand their path through the tasks.	Tracking your tasks is a good way to make sure that you are not stuck in something. If someone is stuck on a task, maybe it is not well defined.

Unrealistic Plan

This issue was mentioned in 7 of the 51 papers of the literature review for collaboration. It was classified as a **coordination** issue of collaboration. In this case, 9 game elements were proposed, as presented in Table 5.13.

Table 5.13: Unrealistic Plan

Unrealistic Plan		
Dimension:	Coordination	
Description:	Unrealistic schedules, milestones, goals, estimates, etc.	
Desired Behavior:	Plans should be created with the participation of every team member, to gather every opinion and then guarantee better estimates.	
Game Element	Discussion	Example
Community Collaboration	Community Collaboration could be use to use the crowd to help team members check if their estimates or requirements are realistic.	When creating a plan with the team members, you could use other sources like Stack Overflow as a helper to support some decisions. You can even try to ask something during the process.
Virality	Virality should be used in order to make clear that everyone is important in the process of creating the plan.	Make the process of creating the plan as mandatory to every team member, in order to produce better results.
Activity Feed	Activity Feed could help team members to be aware of what is being discussed.	A white board could be a great support during the process of creating the plan, making everyone in the meeting aware of the progression.
Cascading Information Theory	Cascading Information Theory could be useful to set a specific step-by-step process that plans need to follow in order to be more realistic, with information being discussed in a specific order.	Structure the process of the plan step by step, trying to focus on each part to maintain the focus. The team only will progress if they achieve the last goal of the plan.
Discovery	Discovery could let team members to explore their plan, using different approaches and techniques, in order to find different perspectives.	Let the team members brainstorm and seek for different solutions. This exploration could produce interesting results.
Epic Meaning	Epic Meaning could create a narrative with the objectives that need to be achieved, and foster team members to realize what is need to be done in order to achieve it in a realistic way.	A plan should be created in order to achieve a goal. So, set an epic goal, with meaningful objectives, that motivate the team.
Progression	Progression could be important to make team members aware of what is being discussed.	A white board could be a great support during the process of creating the plan, making everyone in the meeting aware of the progression.

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Unrealistic Plan		
Game Element	Discussion	Example
Instances	Instances could set different approaches for solving the same objective, by fostering team members to set mitigation plans if things go wrong.	You can define that the team member should create two or three versions of the plan, in order to make them mitigate problems or seek for different solutions.
Quests	Quests could be made in order to create specific tasks that can help team members to create a better plan.	Create a specific quest for the creation of the plan, like a "Quest zero". All the tasks must be the steps for the creation of the plan.

No Clear Roles

This issue was mentioned in 8 of the 51 papers of the literature review for collaboration. It was classified as a **coordination** issue of collaboration. In this case, 6 game elements were proposed, as presented in Table 5.14.

Table 5.14: No Clear Roles

No Clear Roles		
Dimension:	Coordination	
Description:	Team members do not know or are not satisfied about their roles in the project.	
Desired Behavior:	Team members must know their responsibilities, and also the ones of their colleagues.	
Game Element	Discussion	Example
Quests	Quests could be created including which players (roles) are needed in order to achieve its objectives.	Quests could be set to specific roles in team members. For example, quest XYZ should be completed only with a programmer, a tester and an architect.
Activity Feed	Activity feed could help team members by showing who is doing what, and making them be aware of who is responsible for each tasks.	A dashboard with tasks and team members assigned, could help team to be aware of each one role in the project.
Epic Meaning	Epic Meaning could give a narrative for each role showing their importance and giving them context about their roles in the project.	Each role could be created with specific roles and skills. For example, a developer could have the skill to spend $50/week for helping the team.

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No Clear Roles		
Game Element	Discussion	Example
Avatars	Avatars could be useful to clearly help in the visualization of each role of team members in the project.	Create some avatars for each team members, based on their role, and put that in a dashboard or anywhere visible to everyone.
Instances	Instances are very useful to create a different experience (quests, narrative) for each role. For example, developers have specific tasks that are different to testers.	Have tasks that are specific for each role on the team. This will give them responsibilities and create different instances in the project.
User Profile	User profile could be very useful to help team members to know who their colleagues are and which are their abilities.	Create a place where people could see the user profile of each one.

Lack of Support for New Members

This issue was mentioned in 3 of the 51 papers of the literature review for collaboration. It was classified as a **coordination** issue of collaboration. In this case, 14 game elements were proposed, as presented in Table 5.15.

Table 5.15: Lack of Support for New Members

Lack of Support for New Members		
Dimension:	Coordination	
Description:	Newcomers do not have specific support from team members.	
Desired Behavior:	Newcomers must know what to do, and the team must know how to support them.	
Game Element	Discussion	Example
Achievements	Achievements could be useful to set some specific objectives that needed to be achieved in order to earn some bonuses or badges.	Create some specific achievements that foster team members to help the new ones. For example: a badge could be offered for those who help in the procedures of commits. Badges also could help new members to seek who is more helpful.

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Lack of Support for New Members		
Game Element	Discussion	Example
Appointments	Appointments could set some specific time where team members and newcomers should sit together and discuss about the project.	Create a specific date and time where new members and team members must sit together and discuss about the project. And make this encounter a responsibility for the new members, trying to motivate them to present themselves to the team.
Quests	Quests can be created to set specific tasks where newcomers must have interaction with team members in order to understand the project.	When creating new quests, make sure that some of them have specific tasks where new members receive support.
Bonuses	Bonuses could be given to newcomers and team members who share information about the project.	Offer some bonuses for team members who help or support new ones. You can measure that with specific achievements, for example.
Cascading Information Theory	Cascading Information Theory could be useful to set a specific step-by-step process where newcomers could train and understand the context where they are entering.	Specify an information structure where new members will learn technical and cultural aspects of the company and project, step by step, like a tutorial for example.
Discovery	Discovery could let newcomers to find more about their project, having freedom to explore workspace and team members information.	Set some tasks where new members must achieve some objectives, but give them more freedom to discover how to complete the challenges.
Levels	Levels could be useful to set different grades between members, like "newcomers", "regulars" and "seniors". This could help people to be aware about who they need to talk with.	As mention, set some grades to your team members (newcomers, regulars, seniors, etc.) that could help to be aware of each one experience in the company. You can set some movie/game grades, to make this more fun.
Progression	Progression could be useful to help newcomers to track their progress during the process of achieving new information about the team and the project.	If you could set a specific roadmap for new members, you could help them track their progress during the process. This will help them to understand where they are and where they need to go.

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Lack of Support for New Members		
Game Element	Discussion	Example
Reward Schedules	Reward schedules could give members awareness about what they need to do in order to earn specific rewards.	If you are planning to set bonuses, points or levels, you need to make sure that new members and team members know exactly what they need to do to earn them.
Status	Status could be useful to foster motivation in team members in order to achieve senior level and be more respected.	If you choose to use levels, you may let some members seek for the status that a higher level can bring. So, it is important to be clear about the rewards of being a "senior" level.
Points	Points could be useful to foster the support to newcomers, by setting specific points to each quest achieved by the team members.	Make a rewards schedule for your team, where every task every team members help the new ones, they will receive more points for that.
Leaderboard	Reward team members based on a leaderboard of those who best support newcomers could foster cooperation in the team and also incentive them by rewarding the best ones.	If you going to bring the points, you need to use leaderboards to incentive the team members to achieve higher ranking, just like status do.
Activity Feed	Activity Feed could help newcomers to track the project tasks and see who can help them when doing similar tasks.	Having a dashboard where new members could see the situation of the project is important, because that will be easy to let them ask for help for the right people.
User Profile	User profile could be useful to newcomers by knowing better their colleagues.	An user profile is very useful as a tool to make new members know better their colleagues. Have one with picture, skills, short bio, etc. that give them enough information to help.

Lack of Involvement from Managers

This issue was mentioned in 7 of the 51 papers of the literature review for collaboration. It was classified as a **coordination** issue of collaboration. In this case, 5 game elements were proposed, as presented in Table 5.16.

Table 5.16: Lack of Involvement from Managers

Lack of Involvement from Managers		
Dimension:	Coordination	
Description:	Managers do not support the team.	
Desired Behavior:	Managers must be available to support the team, when needed.	
Game Element	Discussion	Example
Appointments	Appointments could be useful to set a specific time where team and managers could sit together and discuss about their project.	Set a specific date, time and place where team members could meet their managers in order to help. Make this meeting be organized by the manager, in order to have him personally involved.
Quests	Quests could create specific tasks where the participation of the manager is needed in order to finish it.	Create quests where managers are active players, and their participation are very essential to complete some tasks.
Progression	Progression could make clear to the team if the manager is available or not during the project.	A simple to-do dashboard could help team members to check if any task is being stopped due the lack of support from managers. This will give them enough evidence to convince them about the importance of participation.
Instances	Instances could be useful to set different approaches to the problem. One regarding the participation of the manager, other not.	When creating a quest, think about that with two possibilities: one with the presence of the manager and one without him. Those should produce similar results, if possible.
Countdown	Countdown could be used to set a specific time frame where managers must be available to team members.	When making an appointment with your manager, make clear that the meeting is time-boxed. This will help everyone to be more focused on the results.

Excessive Workload

This issue was mentioned in 5 of the 51 papers of the literature review for collaboration. It was classified as a **coordination** issue of collaboration. In this case, 8 game elements were proposed, as presented in Table 5.17.

Table 5.17: Excessive Workload

Excessive Workload		
Dimension:	Coordination	
Description:	Team members work many extra hours on tasks.	
Desired Behavior:	Team members must work properly, without burnouts.	
Game Element	Discussion	Example
Achievements	Achievements could help team members to earn badges by not working too much.	You can use badges to incentive your team members to set some objectives to achieve. For example: 5 days without burnout; one day with all tasks completed, etc.
Loss Aversion	Loss Aversion could help team members to avoid working too much by setting some "punishments" (like losing points or levels).	If you set some badges, points or levels for this issue, you can use Loss Aversion to make your team members try to avoid to burnout, or they could lose their rewards.
Notifier	A notifier could be used to feedback a member if he is working too much.	You can use a simple clock alarm to make all team members know when they need to stop working. It is a very cheap way to use notifier and start to address this issue.
Countdown	Countdown could be very useful to set a specific timeframe for each quest of task that need to be done. This could help avoid excessive workload.	Using a technique like Pomodoro could be useful to your team, because they will be aware of how much timeframe they will need to achieve their objectives.
Levels	Members who earn enough points could increase their levels on a scale of healthy work, for example.	You can use levels in order to encourage your team members to be more focused. Higher levels could be for those who achieve more badges, and are more productive.
Status	Status could be useful to create motivation in team members where the higher levels (members who do not have too much workload) are respected.	The status of being a higher level could make team members feel more important in the company. Also, other team members could ask for advice for those who have higher levels.
Quests	Quests could be created where team members should achieve their tasks in a specific time frame (useful if used with countdown).	Create quests and tasks where team members could complete in a realistic timeframe, without the need of burnout.

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Excessive Workload		
Game Element	Discussion	Example
Progression	Progression could be applied in order to make team members be aware of their progression in each task, so they can be aware of how much effort were made.	You can create a chart with worked time every week. With that, team members could track their progress in order to achieve their objective of eliminate burnout.

Excessive Changes in Plan or Process

This issue was mentioned in 9 of the 51 papers of the literature review for collaboration. It was classified as a **coordination** issue of collaboration. In this case, 5 game elements were proposed, as presented in Table 5.18.

Table 5.18: Excessive Changes in Plan or Process

Excessive Changes in Plan or Process		
Dimension:	Coordination	
Description:	Planning and processes (like methodology) change frequently.	
Desired Behavior:	Plans must maintain a minimum of previsibility to give the team some security in work.	
Game Element	Discussion	Example
Quests	When you create a plan, you should create quests in order to achieve the objectives. These quests could give a sensation of a journey in the project.	Create some quests and tasks that will help you to achieve the objectives of the plan. These quests and tasks must not change when in production.
Instances	Instances could help team members to visualize the plan in different approaches and paths, helping them to better respond to changes.	When creating quests, you can think on alternatives paths in order to achieve these objectives. Like a "plan B", that could be more challenge.
Progression	Progression could be very useful to track the evolution of the plan and see if things are going as expected.	A dashboard is a great tool to track your progress in order to see what you done, what are you doing and what you need to do.
Ownership	Team members could use the plan as a thing that they must care about, since they need to dedicate their efforts for it.	When creating a plan, make sure that the team is fully compromised with it. If they feel that this plan was like their vision of work, they will defend it with more passion.

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Excessive Changes in Plan or Process		
Game Element	Discussion	Example
Activity Feed	Activity feed also could help team members to track the progress of the plan by seeing all team members activities.	A dashboard is a great tool to work as an activity feed for your team members. They could see in real time what everyone is doing.

Lack of Challenges or Purpose

This issue was mentioned in 4 of the 51 papers of the literature review for collaboration. It was classified as a **coordination** issue of collaboration. In this case, 10 game elements were proposed, as presented in Table 5.19.

Table 5.19: Lack of Challenges or Purpose

Lack of Challenges or Purpose		
Dimension:	Coordination	
Description:	The project does not represent a meaningful motivation for team members.	
Desired Behavior:	The project must represent a challenge for the people who will work on it.	
Game Element	Discussion	Example
Achievements	Achievements could be useful to set some specific challenges to each team members (developers, testers, designers, etc) that only each one could complete.	When a project need to be more meaningful, you can create some alternative objectives and challenges for your team members. For example, you can set specific time challenges for specific tasks. Or create a quality challenge for tasks (no bugs), etc.
Bonuses	Rewards could be given by team members who achieve specific tasks, quests or earn badges.	If you choose to use achievements, you can set some bonuses to encourage team members to achieve them.
Combos	Combos could be created in order to set specific combination or variation of tasks that should to be done in order to increase the challenges.	Combos are also interesting to create specific challenges. For example, you can set a specific combination of actions or tasks that a team member must execute in order to earn a big bonuses.

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Lack of Challenges or Purpose		
Game Element	Discussion	Example
Discovery	Discovery could help team members to explore their objectives, finding other creative ways to resolve them.	When creating quests, you can leave some tasks more opened in order to make team members explore for the better results. This could motivate them to seek for new experiences.
Epic Meaning	Epic Meaning could create a powerful narrative for the project making the team members feel that they are making part of something big.	When you create a project, you should try to create a narrative for it. Why the team are doing that? What will be the impacts when they finish? Try to give meaning for the project.
Quests	Quests could be created to make team members seek for specific tasks to achieve the project objectives.	Create quests that have some good challenges for your team members, not only routine tasks. Make them feel like they need to go further in order to complete it.
Reward Schedules	Reward schedules could give members awareness about what they need to do in order to earn specific rewards.	If you create some rewards (like bonuses), you need to make clear to team members how they could earn them.
Instances	Instances could create different approaches for the project by different roles (developers, testers, etc) making each member "journey" different and more challenged.	The project could have different instances, based on different approaches. So, when you create quests, try to think about what could change and what you should do.
Progression	Progression could be used to show the situation of work and what they will need to do.	Track the project with a to-do dashboard where your team could see what is happeing and what they will need to do. This progression will help them to see their evolution in the challenges.
Lottery	Lottery could be used to create different and random aspects for the project, like rewards, resources for the project or even specific activities.	Sometimes you can create some tasks where you will make a lottery to make team members work on it. This will create a different approach in order to challenge them.

Lack of Incentives

This issue was mentioned in 6 of the 51 papers of the literature review for collaboration. It was classified as a **coordination** issue of collaboration. In this case, 10 game elements were proposed, as presented in Table 5.20.

Table 5.20: Lack of Incentives

Lack of Incentives		
Dimension:	Coordination	
Description:	There's no extrinsic motivation for team members.	
Desired Behavior:	There should be incentives from the company to generate motivation in the teams.	
Game Element	Discussion	Example
Achievements	Achievements could be useful to set some specific incentives to each team members that can be only earned by achieving some tasks or situations.	Foster the intrinsic motivation in your team by creating some alternative objectives to achieve. If you could create them more specific to each one role or make it more personal, it will be better.
Bonuses	Rewards could be given by team members who achieve specific tasks, quests or earn badges.	You can use bonuses as a reward for these achievements. Or you can set some bonuses for some specific results in each quest created.
Combos	Combos could be created in order to set specific combination or variation of tasks that should to be done in order to increase the challenges. Like a tester completing his work in a specific time frame.	Combos are also interesting to create specific challenges. For example, you can set a specific combination of actions or tasks that a team member must execute in order to earn a big bonuses.
Levels	Creating levels could be useful to create specific quests, badges or rewards that could increase depending on the member levels.	Levels could be created for your team members to encourage them to progress in the company. Set at least three levels, like "novice", "regular" and "senior" and make the roadmap for each one available to team members.

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Lack of Incentives		
Game Element	Discussion	Example
Points	Points could be given for team members who achieve their objectives and tasks. Using in combination with combos, for examples, team members could earn more points if they complete tasks in better ways.	Create a points structure in your project, where team members could earn points by completing some quests, tasks or achievements.
Progression	Progression could give team members a view of what is being done and helping them to visualize what how much they need to achieve to complete their objectives.	Having a visual graph or dashboard where people could track their performance in the company. Team members could check instantly what they need to do to improve more.
Quests	Quests could be created to make team members seek for specific tasks to achieve the project objectives.	Set quests with tasks that challenge the team members, and also offers some incentives, that could be something intrinsic or extrinsic.
Reward Schedules	Reward schedules could give members awareness about what they need to do in order to earn specific rewards.	Set a schedule where team members know how they are able to receive their rewards. For example, finishing a task they will earn 10 points. Finishing the same task in half a day, will make them earn 20 points.
Leaderboard	Leaderboard could foster team members to try to compete for those who are best achieving the project objectives.	If you set points, you will need a leaderboard to track their progress. The leaderboard could foster their cooperation and also their competition, that will be great.
Status	Members who have more points in leaderboard or achieve specific levels could earn some privileges in the project (or company), making them be proud of their status.	If you choose to set levels, you can foster the team members to try to achieve higher levels, so they could earn more status in the company.

Lack of Autonomy

This issue was mentioned in 9 of the 51 papers of the literature review for collaboration. It was classified as a **coordination** issue of collaboration. In this case, 5 game elements were proposed, as presented in Table 5.21.

Table 5.21: Lack of Autonomy

Lack of Autonomy		
Dimension:	Coordination	
Description:	Team members do not have autonomy to work.	
Desired Behavior:	Team members must have autonomy to decide the best way to work on the problems.	
Game Element	Discussion	Example
Discovery	Discovery could give team members the feeling that they need to explore their objectives in order to better achieve them.	When you create the plans or quests, set some open tasks where team members will decide the best way to explore the best actions to achieve results.
Ownership	Ownership could help team members to see the project as something they own and care about, having the feeling that their participation are important for achieving success.	When creating a quest, you can encourage a specific team member to be responsible for the the creation of it. This "ownership" feeling will make them more happy to decide the best ways to achieve that.
Quests	Quests could be created by the team members, so they will have more empowerment in the decisions.	Leave the creation of the quests for your team members. They will have autonomy to decide the best ways to achieve the objectives.
Levels	Levels could be useful to set expectations in team members, where higher levels have power of decision about the project guidance. Lower levels could give their opinions, but not having power for decide.	You can set some levels, like "novice", "regular" and "senior", based on experience or skills, and when deciding the quests, each level will have more or less force in the decisions.
Status	Status for the higher levels should give team members motivation for seeking this condition and have more autonomy in the project.	Have a roadmap for each level where team members feel encouraged to achieve higher levels, in order to have more autonomy for decisions.

Lack of Social Events

This issue was mentioned in 3 of the 51 papers of the literature review for collaboration. It was classified as a **coordination** issue of collaboration. In this case, 6 game elements were proposed, as presented in Table 5.22.

Table 5.22: Lack of Social Events

Lack of Social Events		
Dimension:	Coordination	
Description:	Team members do not have social events or spaces to build relationship.	
Desired Behavior:	Foster the social events for helping the team to create an identity.	
Game Element	Discussion	Example
Quests	Quests could be created where social events are important for the project for team building. Specific tasks could be part of quests.	Make sure that at least one of the quests created in the project have a task where team members must hang out together in order to complete it.
Appointments	Appointments could create social events in specific time during the project.	You could choose a specific date, time and place where team members must hang out together.
Virality	Virality could set up a social event where all team members must attend in order to make it happen.	Make sure that these task only could be completed with the participation of everyone of the team.
Activity Feed	Activity feed could help team members to be aware about the social events of the team.	In a dashboard, make it very visible the day and time of the social events incoming, setting some fun responsibilities for each of team member.
Community Collaboration	Community Collaboration could encourage your team members to create a specific event where they could meet some communities of practices outside work.	When deciding which place the team should hang out, create a poll where the other teams (from inside or outside the company) should vote to decide where to go.
Free Lunch	Free Lunch could be useful to foster the behavior of gather the team outside the work, by stablishing that if all members go to a bar, for example, one of them will not pay for it (the company pays).	Make a special reward where if everyone from the team hang out together in a place outside of work, the company will pay for a round of beer.

Lack of Monitoring

This issue was mentioned in 5 of the 51 papers of the literature review for collaboration. It was classified as a **coordination** issue of collaboration. In this case, 4 game elements were proposed, as presented in Table 5.23.

Table 5.23: Lack of Monitoring

Lack of Monitoring		
Dimension:	Coordination	
Description:	There's no monitoring from managers or team members in the work.	
Desired Behavior:	Make managers be more present and give them this responsability.	
Game Element	Discussion	Example
Appointments	Appointments could set specific time where managers could monitor the work of team members.	Set one or two specific date, time and place where the manager need to make sure that he will be available to the team for the review process. Create an informal environment for the meeting.
Quests	Quests could specify tasks where monitoring are needed in order to complete the objectives.	Make sure when creating a quest that some tasks have the participation of the manager to be completed. The manager should get the responsibility to make the team progress only with their OK.
Progression	Progression could be useful to track the work to be reviewed by the manager.	Have a dashboard with a specific lane called "Waiting Review", where it is visible to everyone which tasks need to be reviewed by the manager.
Notifier	Notifier could help team members and also the manager to be informed about the review of the work.	When time is coming for the review, make someone of the team send a funny email reminding people about it. The email should use things like "memes" or "gifs".

Lack of Training

This issue was mentioned in 3 of the 51 papers of the literature review for collaboration. It was classified as a **coordination** issue of collaboration. In this case, 13 game elements were proposed, as presented in Table 5.24.

Table 5.24: Lack of Training

Lack of Training		
Dimension:	Coordination	
Description:	Team members do not have training for the work to be done.	
Desired Behavior:	Create a process to have training sessions for the team.	
Game Element	Discussion	Example
Cascading Information Theory	Cascading Information Theory are useful for training programs, by structuring the process of learning giving specific information in specific time and progress of the members	When you create your training program, make sure that your tutorials will bring snippets of information for your trainees. Make them mastery these snippets before go further
Achievements	Achievements could help members who are being training by setting milestones that must be completed in order to finish the training program	Your training program have a goal, but you can set some intermediate objectives. When trainees complete these, they will earn badges for the success
Quests	Quests could be set up in order to create tasks that needed to be achieved for finishing the training program	The training program could be created like quests, where each quest have a specific set of training for new technologies or skills
Appointments	Appointments could help team members to set up specific time where they need to start the training program	Set a specific date, time and place where team members should start their training lessons. If the team members do not attend, they will lose points or levels
Bonuses	Rewards and bonuses could be offered for those who finished the training lessons	When using achievements or quests, you can offer some bonuses to those who achieve success in less time, or in a specific grade of quality
Reward Schedules	Reward schedules could give members awareness about what they need to do in order to earn specific rewards	If you will use points, levels or bonuses, you will need to set a specific schedule about how it will work
Points	Points could be used to encourage team members to complete a training, by earning points for each tasks or module of training	Set experience points for each task involving training. These points will give trainees the feeling of evolution, specially if you use levels with it

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Lack of Training		
Game Element	Discussion	Example
Levels	Levels could be used to create specific profiles of members who invest in training programs for capacitation. For example, "senior" are top members who participate at least 5 training programs in the company	Levels could be earned with points. So each team member (or trainee) could earn points and levels by completing training lessions that will improve their skills
Progression	Progression are useful for team members know where they are in the training process, and where they need to go to complete it	Have a dashboard and some graph of the evolution of each skill of the trainees. So he could see which skills he need to improve and which are the goals
Leaderboard	Leaderboard could be useful to set a competition between team members where they will focus on complete training programs to earn points and be better positioned in the leaderboards	Having points, you can create a leaderboard to foster trainees to compete for the best results in the training session. Also, they could use the leaderboard to help each other to improve
Status	Status could be useful to foster motivation in team members in order to achieve senior level and be more respected	Having levels and leaderboard, your team members will start being proud of their status if they acheve higher levels. So make a clear roadmap for them
User Profile	User profiles can be set up for members knowing more about each other training programs	In each user profile of the team members, make it visible their skills so they can see what they need to improve
Loss Aversion	Loss Aversion are useful to keep members interested on keep doing training program, or they will be "punished" (lose points or levels, for example)	Keep your team members always seeking for training by creating a process where if they do not do some training lessions in a period of time, they will start losing their levels and points

5.3 Cooperation

No relationship between team members

This issue was mentioned in 13 of the 51 papers of the literature review for collaboration. It was classified as a **cooperation** issue of collaboration. In this case, 6 game elements were proposed, as presented in Table 5.25.

Table 5.25: No relationship between team members

No relationship between team members		
Dimension:	Coordination	
Description:	Team members working alone, not talking to each other, not collaborating.	
Desired Behavior:	Team members must talk to each other, sharing information and work.	
Game Element	Discussion	Example
Appointments	Appointments are useful to create tasks or situations in specific time where team members must work together	Create a specific time and place, weekly, where team members must sit together and discuss about other stuff, in order to create a relationship
Quests	Quests could be created with specific tasks where team members should work together to complete them	Specially in the beginning, is important to create tasks where team members must sit together and discuss their upcoming work. But tasks should "push" them to do talk to each other, in order to complete the quests
Progression	Progression could help team members to track their knowledge sharing, by seeing what was shared	A burndown chart is a very good visual aid to help team member see their progress in the project. Seeing their evolution will help foster their relations
Virality	Some badges, challenges or even tasks could be created using virality, by setting that they only could be completed if all members work together	Make sure that tasks where they need to discuss work will only be completed if everyone of the team is on the meeting
User Profile	User profile could help team members to be aware of each other, helping them to start relationships in work	Make a user profile of each team member available with information about them, in order to make them be aware of each other background

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No relationship between team members		
Game Element	Discussion	Example
Activity Feed	Activity Feed could increase awareness of the team and making members know what each other are doing. This could help foster communication between them	A dashboard is very useful to be used as an activity feed, where tasks are set in lanes like to do, doing and done. Create a lane like "review", where other team members must reviews other's work

No relationship with stakeholders

This issue was mentioned in 11 of the 51 papers of the literature review for collaboration. It was classified as a **cooperation** issue of collaboration. In this case, 6 game elements were proposed, as presented in Table 5.26.

Table 5.26: No relationship with stakeholders

No relationship with stakeholders		
Dimension:	Coordination	
Description:	Team members do not have access to users, clients and stakeholders.	
Desired Behavior:	Stakeholders must be available to team members.	
Game Element	Discussion	Example
Appointments	Appointments could create events in specific time where stakeholders must attend	Create a specific time and place, weekly, where team members must sit together and discuss about work with stakeholders. This meeting should take place in an informal environment, in order to help cut down barriers between stakeholders and teams
Quests	Quests could be set up with specific tasks where stakeholders are needed in order to complete the work	Create specific quests and tasks where stakeholders are needed in order to complete it. Make some very specific tasks, where they need to review something, in order to the project progress
Countdown	Countdown could help stakeholders to be aware of the timeframe needed for these meetings	For every task where stakeholders are needed, create a countdown time where the timeframe will help the meeting to be more focused

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No relationship with stakeholders		
Game Element	Discussion	Example
Activity Feed	Activity Feed will help team members to be aware of when stakeholders are needed	Specify a visual aid in your tasks where stakeholders are needed to be consulted. These will help team members to better plan the process
Virality	Virality could set that they only could be completed if all members and stakeholders work together	Tasks where stakeholders are needed only will be completed with the participation of all involved
Instances	Instances could help team members to visualize the plan in different approaches and paths, helping them to see the project with or without the presence of stakeholders	It will be nice to create some alternative plans when stakeholders are not allowed for meetings by any reason. Create some plan B tasks in your quests

Lack of Tools and Resources

This issue was mentioned in 21 of the 51 papers of the literature review for collaboration. It was classified as a **cooperation** issue of collaboration. In this case, 5 game elements were proposed, as presented in Table 5.27.

Table 5.27: Lack of Tools and Resources

Lack of Tools and Resources		
Dimension:	Coordination	
Description:	Tools to facilitate the collaboration are not available or are not appropriated.	
Desired Behavior:	Teams must have available the right tools for the work.	
Game Element	Discussion	Example
Discovery	Team members could be encouraged to explore different tools and systems in order to see the best resources for the project	When creating tasks and quests where team members must seek for tools and resources, make them more free, so team members could explore and discover the better choices
Quests	Quests could be created where team members must seek for different technologies and tools that could help the work	Create quests where team members need to seek for tools and resources that are needed to achieve the project

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Lack of Tools and Resources		
Game Element	Discussion	Example
Bonuses	Bonuses could be given to team members who discover the best tools and resources for the project	Set a bonus for the team if they find some tools and resources that could be used in the project, and could improve their work
Reward Schedules	Reward schedules could give members awareness about what they need to do in order to earn specific rewards	Create a schedule where team members knows exactly how they will be rewarded by seeking the tools and resources
Instances	Instances could help team members to discuss different approaches for achieving the success of the project with different tools and resources	Have team members set quests where they will need to achieve their objectives with and without the resources needed. This will make them be more resilient to the objectives

No Shared Work Space

This issue was mentioned in 13 of the 51 papers of the literature review for collaboration. It was classified as a **cooperation** issue of collaboration. In this case, 3 game elements were proposed, as presented in Table 5.28.

Table 5.28: No Shared Work Space

No Shared Work Space		
Dimension:	Coordination	
Description:	Team members do not have a physical space to share.	
Desired Behavior:	Team members must sit together and share the same information in most of the time.	
Game Element	Discussion	Example
Appointments	Appointments could set specific tasks like pair programming in specific time, for team members	To create a culture of sit together, make a specific time and place (frequently) where they will need to sit together in order to discuss about work
Quests	Quests could be created having tasks where team members must share their work space in order to complete them	Have quests and tasks that clearly set that they need to share their works space in order to achieve their objectives

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No Shared Work Space		
Game Element	Discussion	Example
Activity Feed	Activity feed could help team members to be aware of each other work, helping them to identify the best moments to share their work	Having a dashboard to track the project will help team members to have like a "war room" where they will need to be together in order to update the activity feed

Excessive Conflicts Between Team Members

This issue was mentioned in 9 of the 51 papers of the literature review for collaboration. It was classified as a **cooperation** issue of collaboration. In this case, 6 game elements were proposed, as presented in Table 5.29.

Table 5.29: Excessive Conflicts Between Team Members

Excessive Conflicts Between Team Members		
Dimension:	Coordination	
Description:	Conflict between team members happens frequently.	
Desired Behavior:	Team members must communicate better to avoid having conflicts that will affect the work.	
Game Element	Discussion	Example
Appointments	Appointments could be created where team members must sit together and discuss their relations in order to avoid future conflicts	Set a specific time and place where team members must sit together and discuss their work and relationship. Feedback sessions are also important
Countdown	Countdown could be used to set up a specific timeframe which members will have to discuss their relation	When have the meetings with the team members, set a countdown timer where they will have a specific timeframe to talk, in order to maintain the focus and objectives
Activity Feed	Activity Feed will help members to be aware of other's work and also find facts that could help them find an agreement	A dashboard, visible to all team members, will make them aware of everyone's work, and this will help to foster the communication between them
User Profile	User Profile will help team members to know better each other, helping in the discussion to find a solution	Have the user profile of each team member available to others. This will help them to know each other a little better

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Excessive Conflicts Between Team Members		
Game Element	Discussion	Example
Lottery	Lottery could be useful to encourage team members to random select a team members who they need to discuss about their relationship	If you create a feedback session where the team members must discuss their relation and work, you can use a lottery where chance will decide who should give feedback to who
Quests	Quests could be created where team members must discuss about themselves in order to go further in the project	Set quests and specific tasks where team members must sit together and discuss their relations, in order to advance in the project. Feedback sessions, for example

Lack of Knowledge Sharing

This issue was mentioned in 10 of the 51 papers of the literature review for collaboration. It was classified as a **cooperation** issue of collaboration. In this case, 8 game elements were proposed, as presented in Table 5.30.

Table 5.30: Lack of Knowledge Sharing

Lack of Knowledge Sharing		
Dimension:	Coordination	
Description:	Knowledge does not flow in the team due to lack of moments and artifacts for knowledge sharing.	
Desired Behavior:	Foster the knowledge sharing by improving awareness and communication.	
Game Element	Discussion	Example
Achievements	Achievements could be created to foster team members to sit together, discuss the project, etc. and earn badges for it	Create specific achivements and badges where team members could earn some bonuses if they share useful things with others
Quests	Quests could be created having tasks where team members must share their knowledge with other members	Create daily or weekly quests with tasks where team members must share some specific topics in order to complete
Bonuses	Bonuses could encourage team members to share their knowledges	Create some bonuses for those who share useful contents and knowledges with other team members

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Lack of Knowledge Sharing		
Game Element	Discussion	Example
Appointments	Appointments could be created where team members must sit together and discuss their knowledge about the project	Set a specific date, time and place where team members must sit together and share something they learn. Like an informal and internal workshop
Activity Feed	Progression could help team members to track their knowledge sharing, by seeing what was shared	Create a specific whiteboard where team members could see their knowledge adquired during the project. New contents could be pin or write down in the board
Reward Schedules	Reward schedules could give members awareness about what they need to do in order to earn specific rewards	If you reward those who brings knowledge, set a specific schedule of how they will be rewarded
Progression	Progression could be useful to track how the knowledge were adquired during the project	The whiteboard mentioned in Activity Feed could help team members to track their progress in these kind of content
Community Collaboration	Community Collaboration could be useful to encourage team members to ask community for help in their projects. The community could earn rewards for giving good answers	Make team members participate of community forums or events where they could share and learn new knowledges

5.4 Group Formation

Individual over teams

This issue was mentioned in 6 of the 51 papers of the literature review for collaboration. It was classified as a **group formation** issue of collaboration. In this case, 6 game elements were proposed, as presented in Table 5.31.

Table 5.31: Individual over teams

Individual over teams		
Dimension:	Coordination	
Description:	When individual goals are more important than the team goals.	
Desired Behavior:	Team members must understand the importance of the team, seeking their personal goals by achieving the team goals.	
Game Element	Discussion	Example
Achievements	Achievements could be very useful to set personal and team goals that could be achieved	Create specific achievements for each team member, in order to align their expectations to the project goals. For example, if he want to learn a new technology, make that available somehow in the project
Epic Meaning	Epic Meaning could create a powerful narrative for the project making the team members feel that they are making part of something big and that they must work together to achieve it	When creating a plan or a quest, make sure that you set an epic meaning for it. In other words, specify why they are doing and what will be the impacts of the results
Quests	Quests could be created where tasks should be achieved by individual work and also team work	Create quests where team members could give their opinion about the best way to achieve the results. And making this, they will feel more aligned to the work to be done
User Profile	User profile could help team members to be aware of each other goals, so they could try to achieve these goals together	Have the user profiles of each team members available to everyone in the project, so everyone could see their personal goals and could help each other to achieve it
Appointments	Appointments could set meetings for team members to discuss the project. This could foster the team work in the project	Set a specific date, time and place where the team could sit and have a strategic meeting, trying to discuss their personal goals
Progression	Progression could be very useful for showing the team members the actual status of the project and where they need to go in order to complete it. This progression could show that only team work could achieve success	Have a dashboard for track the project, and also try to create a graph of evolution for each team member. This could help them track their personal goals to the project goals

Lack of Trust

This issue was mentioned in 8 of the 51 papers of the literature review for collaboration. It was classified as a **group formation** issue of collaboration. In this case, 5 game elements were proposed, as presented in Table 5.32.

Table 5.32: Lack of Trust

Lack of Trust		
Dimension:	Coordination	
Description:	Team members do not trust each other.	
Desired Behavior:	Team members must know each other to start building a relationship.	
Game Element	Discussion	Example
Appointments	Appointments are useful to create tasks or situations in specific time where team members must interate, fostering the building of trust	Create a specific date, time and place for an activity where team members must play coop games in order to build their relation
Quests	Quests could be created with specific tasks where team members should work together to complete them	Create quests where team members could work together in order to build a better relationship. Also, create some tasks where they could discuss their work
Virality	Some challenges or even tasks could be created using virality, by setting that they only could be completed if all members work together	Make some tasks or quests only to be achieved by the participation of all the team members. They will need to work together in order to complete it
User Profile	User profile could help team members to be aware of each other, helping them to start relationships in work	Have the user profiles of each team members available to everyone in the project, so everyone could see their personal information and know each other a little more
Activity Feed	Activity Feed could increase awareness of the team and making members know what each other are doing. This could help foster communication between them	A dashboard of the project could foster the communication by let everyone knowing what each other are doing. More communication could help in building trust

5.5 Awareness

Lack of Perception of Work in Progress

This issue was mentioned in 23 of the 51 papers of the literature review for collaboration. It was classified as a **awareness** issue of collaboration. In this case, 5 game elements were proposed, as presented in Table 5.33.

Table 5.33: Lack of Perception of Work in Progress

Lack of Perception of Work in Progress		
Dimension:	Coordination	
Description:	Team members do not have the perception of status, who is working on specific tasks, who to report, etc..	
Desired Behavior:	Create an environment that fosters the perception of work by team members.	
Game Element	Discussion	Example
Appointments	Appointments are useful to set specific tasks, like meetings, in specific time, making team members schedule discussion moments	A daily meeting is a great solution for create awareness of work of every team member. Make it different from usual meetings
Quests	Quests could be created with a set of specific tasks where team members must discuss their work, creating awareness	When creating quests ans tasks, also try to point the roles of each team member in every work to be done
Progression	Progression could show team members where they are and what they need to do in order to achieve success in the tasks or objective	A dashboard could help team members to know who is doing what, and also what has been already done
Activity Feed	Activity feed could show the current situation of work of each team member, as a dashboard	A dashboard is very useful if its updated almost live, so everyone could know what is being happening in the project
Notifier	Notifiers could give feedback to team members to help them understand if their tasks are clearly achieved or not	A notifier could be created to let everyone in team knows when a task or a quest is completed. Use a gong for that

Lack of Perception of Team Availability

This issue was mentioned in 5 of the 51 papers of the literature review for collaboration. It was classified as a **awareness** issue of collaboration. In this case, 5 game elements were proposed, as presented in Table 5.34.

Table 5.34: Lack of Perception of Team Availability

Lack of Perception of Team Availability		
Dimension:	Coordination	
Description:	Team members do not have the perception about team members' availability or status.	
Desired Behavior:	Create an environment that fosters the awareness of team members availability.	
Game Element	Discussion	Example
Appointments	Appointments are useful to create specific tasks in specific time. This could help team members to be aware of availability of other members	Create a specific date and time to make sure that everyone is available for a meeting. In that particularly day, everyone must be free to everyone
Avatars	Avatars could be useful to represent when team members are available or not, by using green/red status, for example	If you use avatars, you can set some flags (like red = busy, green = available) to show to other team members the disponibility
User Profile	User profiles can be set up for members knowing more about availability of team members	Just like the avatars, you can set the same flags in a user profile to make the availability of each one visible to the team
Activity Feed	Activity feed could help team members to be aware of each other work, and also their availability (for example, showing that someone is entering in a meeting)	A dashboard could also use flags to show who is available or not in the work day
Notifier	Notifiers could give an instant feedback when some members are available or not	When someone will not be available to something, create a visual notifier (a funny advice, for example) to put in the desk

Lack of Sources to Help Awareness

This issue was mentioned in 7 of the 51 papers of the literature review for collaboration. It was classified as a **awareness** issue of collaboration. In this case, 8 game elements were proposed, as presented in Table 5.35.

Table 5.35: Lack of Sources to Help Awareness

Lack of Sources to Help Awareness		
Dimension:	Coordination	
Description:	There are no artifacts, documents or tools to help teams to maintain awareness.	
Desired Behavior:	Create an environment that fosters the cooperation of artifacts by team members.	
Game Element	Discussion	Example
Achievements	Achievements could create specific conditions where team members should produce specific artifacts in order to earn badges and rewards for it	Create some alternative objectives that team members could achieve, to earn some rewards, to increase the quality of the artifacts produced
Bonuses	Bonuses and rewards could be offered for those who invest their time creating good artifacts for the project	Set some bonuses for those team members who complete the achievements of the project, to motivate them to produce better artifacts
Quests	Quests could be created with tasks that encourage team members to complete artifacts for the project	Create specific quests and tasks where the focus will be the creation of the artifacts, with the expected results
Progression	Progression could help to track the evolution of the artifacts that are being produced	A version control could help to track the progress of creation of the artifact. Team members could see who did what and also continue the work
Reward Schedules	Reward schedules could give members awareness about what they need to do in order to earn specific rewards	If you plan to set bonuses for the production of artifacts, you should create a schedule to help team members to see what they need to do in order to earn those
Community Collaboration	Community Collaboration could help team members to produce the artifacts, but having the care to not use strategic information	Make the artifacts public in communities like GitHub, where others practitioners could also help creating and updating the content

Continued on next page

Lack of Sources to Help Awareness		
Game Element	Discussion	Example
Ownership	Ownership could make the creator of the artifact earn better rewards if the artifact is continuous incremented	Make a team member responsible for the quality of a artifact. This will increase the sensation of ownership of him, making the team taking more care about the content
Activity Feed	Team members could be aware of who is working on the artifacts and be encourage to collaborate, by information presented in activity feed	A version control usually have an activity feed to make every action visible to the team. This will help to be aware of what is being done

6. PRELIMINARY EVALUATION

This chapter describes the preliminary evaluation process of this framework (as mentioned in Chapter 4), detailing the findings and threats to validity.

6.1 Findings

Each specialist started by selecting three issues that they experienced or considered as most common at work, which resulted in 18 issues analyzed. Coordination had 10 issues mentioned, while communication and cooperation had 4 issues each. Besides that, two communication issues were pointed the most by the specialists: lack of feedback (6) and ineffective communication (3), as shown in Figure 6.1.

The specialists perceptions about these issues selected and the framework proposal were reviewed and discussed next.

Lack of Feedback

Lack of Feedback is a communication issue that was most cited by the specialists, with 6 mentions. The feedback could be seen as one of key motivators for employees. S1 stated that "*without feedback, team members tend to have less motivation during time*", which S5 agreed pointing that "*feedback is motivational, and should be used a lot*". S8 gave an example of his own experience when he was a Scrum Master and team members, even with daily meetings, did not gave correctly feedback to each other: "*the impact of this could be seen weeks later, with the team becoming less motivated*". Lack of transparency in feedback was mentioned by S3 when she stated that "*in general, people have problems on giving and receiving feedback*", and she concludes that this bad behavior tends to make feedback sessions very uncomfortable. Finally, the impact of people not being aware if their work is OK is mentioned by S1 and S9, who pointed that "*when you do something and you do not have a feedback if it's OK or not, you become insecure*".

The specialists were asked to give their perceptions about the framework proposal. In general, there were positive reviews. Lottery was one of the most mentioned game element, with S1 stating that he would consider to apply the suggestions in his own work environment. S8 pointed that the approach suggested by lottery could be interesting, if you already have a feedback session. S3 believes that lottery could create a different approach for the feedback sessions stating that "*the process of feedback could be more informal*".

Achievements and combos was also cited as interesting by some specialists. They see achievements and combos as ways to create a informal structure for the feedback ses-

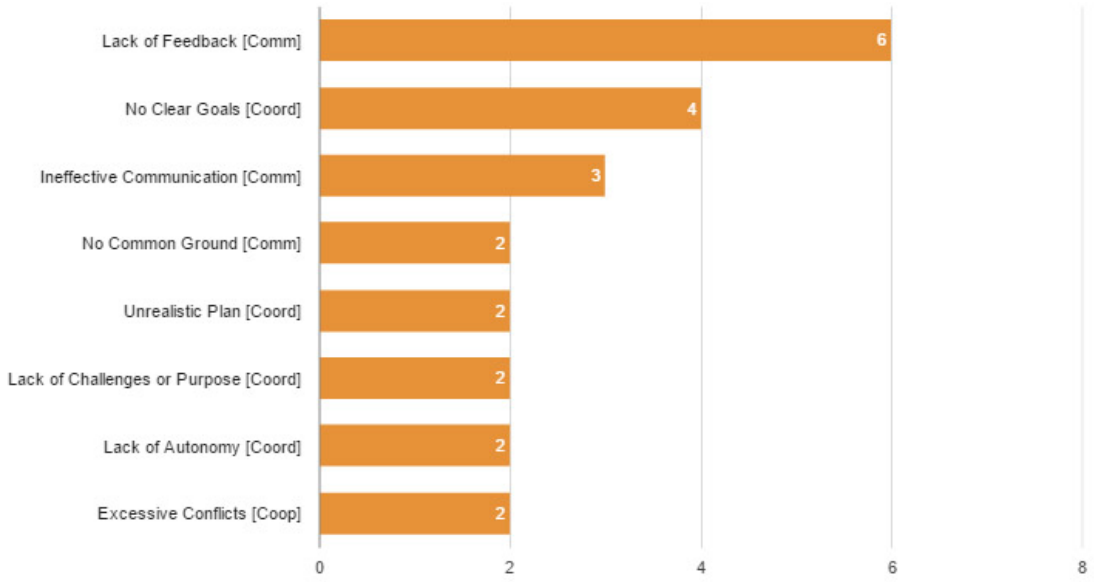

Figure 6.1: Most Mentioned Issues

sions. S11 stated that achievements "*could help in creating the plan for the feedback session, in a checklist style*" and that combos "*could foster different feedback for each group, forcing developers to give feedback beyond technical*".

Progression also presents a sense of professional growth, which were commented by two specialists. S3 stated that she liked this approach because, as she stated, "*it could help people to be more oriented on what they should do to progress*". Consistency was used by S11 to justify why he liked this game element. He mentioned that "*I can give better feedback if I see the progression of the employee*".

Bonuses, in the other hand, had mixed perceptions. Some specialists, like S11, could see bonuses being applied to a feedback session to "*reward those who give and receive quality feedback*". In opposite, S1 stated that "*bonuses could foster the quantitative feedback, which is not the focus here*". S8 also questioned if rewarding feedback could cause collateral damage, and suggest that this risk should be considered.

Appointments also had opposite reactions. S1 pointed a game element that, in his opinion, could not be applied to this situation. He stated that he did not like the Appointments suggestion, because the example feels negative. But, in other hand, S11 stated that he liked the approach proposed by Appointments, and stated that he is using a similar suggestion in his company, so as S8 that stated that "*a feedback session should have a time and place to take place*".

When asked for suggestion, most specialists discussed about the differences between quantitative and qualitative feedback. S1 was discussing about how bonus could be applied to this issue, and stated "*a bonus could foster the quantitative feedback, which is not the point here*". Later, he also suggest that the focus should be on qualitative, in order to

generate value for the employee. This was also stated by S5 and S8, when they suggested that the framework should consider the qualitative feedback.

Other suggestions were punctual, like to change the expression "war room" presented in framework (S1), to propose a process for a feedback session (S3) and to define a minimum and maximum quantity of game elements in the framework (S9).

When asked if they believe that this framework proposal could mitigate the issue and jump start the behavior change, they all pointed yes. S3 highlighted this framework excerpt as the most interesting of those which she analyzed, stating that "*feedback sessions are usually boring, and with this ideas I could make things more informal and fun*". S5 liked the proposal and stated that most of the ideas could foster feedback between managers and team members. S1, S8, S9 and S11 made similar statements suggesting that most of the presented game elements made sense in their gamification knowledge.

It is interesting to highlight that two specialists gave a real work perception to apply this framework. S1 mentioned that he liked so much the suggestion of lottery, that he will try it with his team. And S11 stated that he already used the Appointments approach at work, claiming that "*I am being forced to do this in order to create a more formal feedback session, which was requested by my employees*". He justified this by saying that his employees prefer a time and place to receive feedback, which, in his opinion, results in a more formal process.

In general, this framework was well reviewed by the specialists, in special by two of them who claimed that they used or will apply some ideas in their work. These perceptions give evidences that "Lack of Feedback" could be mitigated using this framework suggested.

No Clear Goals

No Clear Goals is a coordination issue that was cited by 4 specialists. Team motivation usually are affected when goals are not visible for the team. S3 claimed that "*a company strategy is not clear, people do not have the feeling of progression and meaning for what they are doing*". S9 and S10 claimed the same, with the first one stating that "*this also affects the sense of autonomy*", and S10 claiming that "*team will be lost, if they do not know where to go*". S6 remembered an own experience when "*the Product Owner did not explain the objectives of the project for the team, so they worked in tasks that they did not know the objectives*".

The specialists were asked to give their perceptions about the framework proposal. In general, they mentioned that they liked the ideas presented and provided positive reviews. Epic Meaning was mentioned by two specialists as the one which they most like. S3 claimed that "*Epic Meaning could be used to inspire people, by giving them an epic purpose*", which was corroborated by S6, when she stated that "*Epic Meaning is interesting because creates a purpose for the project*". In other hand, S9 stated that Epic Meaning could be useful, but

he pointed that "*some people may not be touched by the epic goal, so you need to consider the profile of motivation of each employee*".

Similar discussion was stated with Instances approach. S3 mentioned that she liked the idea of creating different paths to achieve same goals, and had never thought about using this approach before. But, besides his approval for this game element, S9 warned that in this case, the framework also should consider the profile of motivation of team members in order to achieve better results.

Cascading Information Theory had different reviews. It proposed a structured path where team members could progressively understand the objectives, and as example it presented a mini-tutorial. S3 mentioned that liked the approach, stating that "*creating a step-by-step process for the team, they could stay aware of the goals*". But S6 did not like the approach, as she stated that "*it will depends that people read these documents*". It is possible to state that both reviews were based upon their own understanding of the discussion and example proposed.

Other two game elements were mentioned. S3 stated that Progression would be interesting in order to create a sense of progression towards the goal. S10 mentioned that Rewards Schedules is interesting and, specially, looks the easier to apply first.

The specialists did not presented many suggestions for this framework. S3 suggested that some metrics could be useful in order to track the progression approach, and also claimed that this framework should consider also managers and directors, since they are the ones responsible for the goals.

When asked if they believe that this framework proposal could mitigate the issue and jump start behavior change, all specialists pointed yes. S6 stated that "*I like the ideas here. In general, it is very aligned with the purpose*". S10 stated that he liked the approaches because they were measurable and, as he stated, "*I is more easy to apply because do not depends on reorganizing your project for gamification*". S3 stated that all ideas made sense and are very tangible to her. Finally, S9 mentioned that did not seen anything implausible in this framework, and that the ideas seems to be well justified. One specialist in particular, S10, spontaneous mentioned that he could see this framework proposal being applied at his work.

In general, this framework was well reviewed by the specialists, in special by one of them who claimed that could apply some ideas in his work. These perceptions give evidences that "No Clear Goals" could be mitigated using this framework suggested.

Ineffective Communication

Ineffective Communication is a communication issue that was cited by 3 specialists. Team is impacted by this issue when they do not have a common ground and this usually affects the quality of communication. S2 also stated that "*ineffective communication is deadly to a project*", and he claimed that "*when there is no communication, people start to assume things and this normally causes conflicts*". S5 stated that in her perception "*communication in Brazilian companies are very weak*", arguing that most teams had shared goals, but do not communicate. S9 uses his own experience stating that "*I worked in projects where I had a lot of meetings, but nothing were decided, demotivating the team members*".

The specialists were asked to give their perceptions about the framework proposal. In general, they provided positive reviews. Appointments was the most mentioned game element. S5 claimed that she liked the proposal of Appointments because, as she stated, "*Appointments would force the communication between team members by defining a time and place to communicate*". S2 also liked this proposal stating that it could made sense in his experienced situation.

Cascading Information Theory was highlighted by S5. In her opinion, "*proposing a presentation in the beginning of a project, with all subjects covered, could create a common ground of knowledge in the team*", which was the suggested idea of the framework.

In other hand, Quests had mixed perceptions. S2 liked the idea of making team members creating a common ground of knowledge by having tasks where they should work in different areas. He also suggested two activities for this: pair programming and code review. In other hand, S5 was not sure if this could help. In her opinion, "*I should consider that this will make people feel uncomfortable*".

One game elements suggestion was pointed by S5 as not interesting for this framework: User Profile. After reading the rationale and the example presented, which encourages the creation of a profile for each team member, available to everyone involved in the project, she stated that can not see how this could mitigate the ineffective communication issue.

No directly suggestions were given for this framework in order to improve it. When asked if they believe that this framework proposal could mitigate the issue and jump start behavior change, all specialists pointed yes. S9, in special, claimed that this framework was a very interesting approach and, as he stated "*is very well gamified, in my opinion*". S2 and S5 pointed that all proposed game elements here are feasible with the proposal.

In general, this framework was well reviewed by the specialists, in special by one of them who claimed that it was very well gamified. These perceptions give evidences that "Ineffective Communication" could be mitigated using this framework suggested.

No Common Ground Between Team Members

No Common Ground Between Team Members is a communication issue that was cited by 2 specialists. Team is impacted by this issue when them do not have common ground, alignment, compromise and motivation. S6 argue that team members must have compromise, if they want to work together. S10 stated that "*a different background or compromise between team members could cause a distance between them, and usually causes in some members being more overloaded than others*". He remembered a personal experience where a senior development and an intern were in the same team. That different backgrounds created a barrier between them, affecting all the team.

The specialists were asked to give their perceptions about the framework proposal. In general, they provided positive reviews, but S6 claimed that did not find suggestions that could foster motivation. As she stated "*I believe that this proposal is not focus on soft skills. You could make more references to motivation here*". Besides that, she stated that alignment and compromise could be fostered by the framework.

In other hand, S10 liked all the ideas proposed, because, in his opinion, he can see most of them solving that problem that he stated as his own experience. He mentioned that while he was reading the game elements discussion and examples, he was already thinking on how that could be applied to that reality. The only side effect that he identified was that to apply those suggestions, the team would need to reorganize all the plan previous created. He stated that "*this could be critical if the team do not have time*".

The game elements highlighted were Cascading Information Theory and Activity Feed, in which, as S10 stated, "*those examples made a lot of sense to me*". S6 did not mentioned any game element since, in her opinion, none of them foster motivation.

The only suggestion mentioned specific to this framework was stated by S6, and was the idea on focusing those game elements in soft skills, in order to foster more strongly the motivation.

Besides this position, when asked if they believe that this framework proposal could mitigate the issue and jump start behavior change, all specialists pointed yes. S10 claimed that all examples made sense to him, and added that "*this framework idea was not easy, but I believe that worth to try*". He also reinforce that could see these ideas being applied in reality, specially in his own. B6 also pointed yes, justifying that the framework at least attend to the compromise and alignment of the team.

In general, this framework was accepted by the specialists. Their perceptions gave evidences that "No Common Ground Between Team Members" could be mitigated using this framework suggested.

Unrealistic Plan

Unrealistic Plan is a coordination issue that was cited by 2 specialists. Team members are impacted by schedules, milestones, goals and estimates that are too unrealistic, causing stress and demotivating people. S7 stated that team members get frustrated when estimation was repeatedly poor, causing frustration and, sometimes, breaking the unity of the team. S2 gave an personal experience about this stating that "*This is very common where I work. Managers creates strategies and goals hard to achieve, and this cause demotivation in the team*".

The specialists were asked to give their perceptions about the framework proposal. Some game elements were highlighted by both of them: Activity Feed, Discovery and Progression. In S2 opinion, these are the key elements to foster the collaboration here. In his opinion, "*team members must have a artifacts and a tracking process where they could understand the whole and improve their estimates*". He only stated that discovery have a better example, in order to be more clear to readers.

And S7 also stated that these three game elements are interesting. She pointed that Activity Feed and Progression are "*very important to maintain the alignment in team*", and that Discovery is something that they used a lot at work, helping to keep the plan realistic with the participation of all.

She also stated that Community Collaboration is a great suggestion for this, because she had an real experience with that. As she stated: "*I were not sure if an user story should receive a big or small estimate. So I posted that in a forum, where other developers helped us to understand the context and to break down that story, which later improved my estimates*". And that Quests are interesting because she can see it as a Sprint Goal, in Agile Methodologies.

In the opposite side, S7 mentioned that Cascading Information Theory is suggesting that team members will not have the complete perspective of the project and, as she questioned, "*how can I promote collaboration if I hide information from the team?*".

As suggestion of improvements, S2 mentioned that the Discovery example should be improved, since he did not find it related to the discussion of the game element. He also considered that the framework should provide more information about the impact of the rewards in different team members, and their own motivation.

When asked if they believe that this framework proposal could mitigate the issue and jump start behavior change, all specialists pointed yes. S2 argued that this proposal could generate engagement in team members. S7 stated that most suggestions attended to the purpose of the work. She also stated that some of those examples she already applied at her work.

In general, this framework was well reviewed by the specialists, in special by one of them who claimed that used a lot of those suggestion at work. These perceptions give evidences that "Unrealistic Plan" could be mitigated using this framework suggested.

Lack of Challenges and Purpose

Lack of Challenges and Purpose is a coordination issue that was cited by 2 specialists. It represents an issue when the project does not represent a meaningful motivation for team members. This issue caused two opposite reviews by the specialists.

One of them, S11, mentioned that he is facing this issue in his actual work, where the board of executives are discussing different ways to foster the change of challenges in the team. He also stated that "*he could see how this lack of challenges affects the productivity of team members*". Analyzing the framework, he stated that he liked the ideas proposed. He highlighted some game elements, like Lottery (because he used this approach at work), Discovery (to create a sense of exploration in team members), Instances (because it is interesting to foster people to think on risks) and Epic Meaning, which he stated that "*is a great idea, if you have the right person to create a narrative to generate engagement*". For this last one, he mentioned that he already used a narrative to create a challenge in his team, and that he could see some employees that were not believing in this approach, changed their minds weeks later. His only restriction was to Bonuses and Combos, because he had bad experiences in rewarding people. In his opinion, "*if you want to reward someone, you should reward all the company too, or people will start to create conflicts*".

But S6 had a different opinion. She said that all the ideas proposed could not foster a different behavior. To justify that, she mentioned a bad experience, where she had a team that was working on a very challenge project, and everyone were excited. But a decision from management moved them to a maintenance project. She was their leader, and could not change their demotivation in the following weeks. So, she was very skeptical on using any of the proposed game elements. This was the only situation where two different specialists stated a different conclusion for the framework.

Besides the fact that S11 has a gamification background and gave interesting evidences, based on real life experience, that this framework could mitigate this issue, the fact that S6 stated the opposite, using also an real experience, let the conclusion that "Lack of Challenges and Purpose" framework needs to be investigated to seek for a better review.

Lack of Autonomy

Lack of Autonomy is a coordination issue that was cited by 2 specialists. It represents an issue when team members do not have autonomy to work and, in most cases,

feeling demotivated. This issue caused two different reviews by the specialists. S4 argue that "*how should I innovate at work, if I do not have power to decide?*". S5 stated that "*usually team members think that have autonomy, but managers - or even team members - go against this*". She also stated that this aspect should be considered as critical today in companies.

The specialists were asked to give their perceptions about the framework proposal. Both of them mentioned that Quests are an interesting approach for this situation. S4 stated that Quests could foster collectiveness in the team, and S5 mentioned that quests gives purpose for the tasks which they are involved. Both also pointed that Discovery could create a sense of autonomy for team members. S4 suggested that "*Discovery could foster autonomy since team members would be able to define their own work to be done*". S5 also pointed the same direction, but stated that she could not see how to apply this at her work. Ownership was other game element highlighted by both of specialists, with S4 stating that he can see this as a consequence of Quests and Discovery.

Both specialists have doubts about the suggestions for Levels and Status. In their opinion, these two game elements foster competition. S4 stated that "*Levels and Status should not be suggested, since what is important is a collaborative environment, not competition*". S5 was not sure if this competition could motivate the employees.

As a suggestion, S5 mentioned that the framework should consider the maturity of the team. She stated that "*in order to foster autonomy, I need to make sure that the team have the maturity for it*".

When asked if they believe that this framework proposal could mitigate the issue and jump start behavior change, all specialists pointed yes. S4 also stated that he could see these ideas being applied in his reality, while S5 mentioned that, besides Status, she believe that the others game elements could foster autonomy.

In general, this framework was well reviewed by the specialists, in special by one of them who claimed that can see these ideas happening in his own reality. These perceptions give evidences that "Lack of Autonomy" could be mitigated using this framework suggested.

Excessive Conflicts Between Team Members

Excessive Conflicts Between Team Members is a cooperation issue that was cited by 2 specialists. It represents an issue when team members have frequently conflicts that impacts their motivation and productivity. S4 stated that "*If teams do not resolve their conflicts, things could escalate to a worst situation*". S7 claimed that "*this issue is terrible. It breaks the team and cut off the collaboration, causing lack of trust and other bad situations*". She argued that this issue is breaking point for a team.

The specialists were asked to give their perceptions about the framework proposal. Both specialists highlighted Appointments as a good approach for this situation. S4 stated that having a time and place defined could be useful to sit the team together and foster the resolution of the conflicts. Similar rationale was given by S7, who stated that "*sometimes I need to force the team to sit and discuss about their conflicts*".

User Profile was a good idea, for S7. She mentioned that creating a user profile for each team member could create empathy for them. She exemplified stating that "*if I have a conflict with someone, and using an User Profile I discover that he likes the same things than me, that could be a start to resolve this issue*".

Activity Feed was mentioned by S7 as another good way to create empathy in the team. She also mentioned that she had a Dashboard where all her team members could be aware of each one, and that reduced the conflicts, because started to foster the collaboration. She stated "*team members started to help themselves to keep the project in progress*".

Some game elements were not well reviewed by the specialists. Countdown had the proposal of creating a specific timeframe in which members will have to discuss their relation. S4 stated that the idea could be good, because it will maintain the focus of the meeting, but he stated that this timer countdown could cause stress as a collateral damage. This was the same reason why S7 disliked this game element. She stated that a timer could cause stress and create more conflicts in the team.

Also, S4 stated that lottery could not be a good idea, based on a similar experience that he had. He pointed that during a project, his manager created a lottery process where team members should give negative feedback to each other. This created an uncomfortable environment which resulted in him asking to leave the company.

As suggestions, S4 stated that most of the conflicts he experienced had communication as main reason. So he suggested to foster communication as one asset to reduce conflicts. And S7 suggested to change the issue name, from "Excessive" to "Eventual", because she believe that when a team have excessive conflicts, it is a dead end.

When asked if they believe that this framework proposal could mitigate the issue and jump start behavior change, all specialists pointed yes. Both claimed that those ideas were aligned with the proposal of the framework.

In general, this framework was well reviewed by the specialists. These perceptions gave evidences that "Excessive Conflicts Between Team Members" could be mitigated using this framework suggested.

Other Issues Analyzed

Ten issues were mentioned one time during the interviews. Their perceptions about each framework proposed is described next.

Lack of Focus in Meetings is a communication issue that was mentioned by S3. She stated that liked the ideas presented, specially the game elements Countdown and Progression, which make the progress of the meeting visible. Bonuses, as she states, "*could change behavior in short term*". She stated that already used these three concepts at work, and seen good results. She stated that only Achievements did not made sense to her, because she could not see how to apply it. She did not suggested improvements, and claimed that believe that these framework could jump start the behavior change to mitigate the issue.

No Clear Tasks is a coordination issue that was mentioned by S10. He claimed that liked the approach because its daily approach. He stated that "*teams could see changes daily which is a great benefit for them*". He highlighted the Notifier because of the idea of having daily feedback for the team, which could foster their motivation. He did not gave any suggestion for this framework. When about his perceptions of this framework to mitigate the issue, he pointed that he can see all those ideas being applied in his reality, making the work more clear to every team member.

Lack of Support for New Members is a coordination issue that was mentioned by S1. He highlighted Progression and Discovery, stating that "*Discovery brings the idea of empowerment to new members, encouraging them at work, while Progression I see as a roadmap, where the new members could track their progress in the company*". He did not liked the Levels approach, because, in his opinion, different levels normally tends to create barriers for the new member. As suggestion, he pointed that some game elements could give the idea of competition, which is not good. So he suggest to avoid any competition idea. Finally, S1 claimed that this framework have potential to be applied at work. He also stated that he can see some ideas being used in his own reality.

Excessive Changes in Plan is a coordination issue that was mentioned by S2. He highlighted Progression and Activity Feed, because, as he pointed "*these game elements provides a track for team members, in order to make the progression visible*", and disliked the idea of Ownership, because, in his vision, "*it is hard to for team members feel this ownership, when the managers are the responsible for real changes*". He suggested to consider the stakeholder in this scenario. S2 argue that this framework could mitigate the issue, because ideas and examples made sense in order to achieve what is proposed.

Lack of Incentives is a coordination issue that was mentioned by S11. He stated that he liked the ideas, because, in his opinion, it is a very practical approach. He highlighted Levels, Points and Leaderboard. Points and Leaderboards, in special, were mentioned because he applied this concept at work. As he stated, "*I used points and leaderboard in order*

to make the team work in code review. I did not expected so many good results, and team members stated that they felt more engaged with those elements". He pointed that he did not liked the Bonuses and Rewards Schedules because he believe that you can not reward a team without considering all the company, in order to avoid conflicts. He suggested to mentioned that in Quests I should create some rules to maximize the results. For example, he stated that "*my team knows that Quests should be estimated in no more than 500 hours*". Finally, S11 claimed that he believe that this issue could be mitigated by this framework, and that I can jump start behavior change with those ideas.

Lack of Social Events is a coordination issue that was mentioned by S8. He argued that this issue could be interesting associated with gamification. He highlighted Free Lunch, while stated that "*most of companies already offer free beer to team members, but in this case, I could Gamify this*". He pointed that his company created something similar and that the results were very nice, creating a more confident team. He pointed that could not see any gamification in the Activity Feed example, and suggested a review in this idea. He also suggested the use of Achievements, since he could see a team being motivated by using the badges as a reward system to foster the participation of all team members. Finally, he mentioned that see evidences that this issue could be mitigated by the ideas proposed.

Lack of Training is a coordination issue that was also mentioned by S8. He stated that he used a gamification training application to teach new members the technology of their company. This approach produced some good results, so he believes that gamification could be useful here. Using this example, he stated that he liked most of the ideas proposed. For example, he pointed that "*Loss Aversion is a good idea, because it keeps you on track. If you stop your training for too long, the system makes you study again all the same content*". He disliked the use of Points, arguing that "*alone, points do not make sense to me*". As a suggestion, he claimed that I should relate some game elements in order to create a more complex ideas. Finally, S8 stated that this framework had evidences that could mitigate this issue, and foster the changes to achieve the desired behavior.

No Relation Between Team Members is a cooperation issue mentioned by S4. After asked about his perceptions on this framework, he stated that already used most of the ideas presented. He pointed that Virality and Activity Feed are the most interesting ideas, because he already used and could seen it working, while disliked the User Profile approach. In his opinion, User Profile could kill the curiosity between team members, as they will not need to chat in order to know better each other. He suggested that Appointments should be marked as the first game element to be applied, and finally stated that he could see evidences that this framework could mitigate the issue and jump start the desired behavior.

No Shared Workspace is a cooperation issue mentioned by S7. When asked about her perceptions about the framework, she stated that she really liked all those three ideas mentioned. In her opinion, making the team sit together is crucial for fostering collaboration in teams and create a sense of unity in the team. So, in her opinion, all those suggestions are

attached to this rationale. As a suggestion, she stated that other game elements could be suggested here. Besides that, she argued that this framework was aligned with the proposal, so she can saw those ideas mitigating this issue.

Lack of Knowledge Sharing is a cooperation issue mentioned by S1. He highlighted the ideas associated with rewards (Points, Rewards Schedule, Bonuses, etc.) because he believe that this are the best solution to foster a behavior change, in short term. He disliked the User Profile approach because, as he stated, "*I could not see how the use of User Profile could foster team members to share knowledge*". He suggested to consider the difference between sharing and absorbing this knowledge. Finally, he stated that he could some ideas happening in real world. And pointed that the framework had evidences that could mitigate this issue.

General Findings

In general, all specialists pointed that the framework presents good ideas and that could foster collaboration by jump starting behavior change. When asked about their perceptions about the framework presented, most of specialists pointed the importance of the examples for each game element presented. S2 stated that "*with the examples, the process of understanding became less subjective for me*". Similar statement was made by S8 and S11, who pointed that the examples were important to create an association with the proposal and his reality. S2 reinforce that the examples should be more detailed to maximize the understanding, and S3 suggested the use of cases, in order to improve the quality of it.

Another mentioned perception was about the format and organization of the framework. S2 stated that "*this approach made me see the framework as a guide to give a north to apply gamification in my reality*". S3 also stated the same, pointed that the format is easy to understand and assimilate. S4 also see the format as a good proposal for this work, making it more accessible to readers. S5 stated that the format and generalization was useful to think in her reality, which actually do not involve software development. S6 suggested that the framework should keep less bureaucratic as possible. S9 and S11, who had experience in gamification also liked a lot the format proposed. S9 stated that "*this simple format could help readers to understand the framework*".

Despite the format being clammed to be easy to understand, it was noted that some specialists had different interpretation of same material. For example, S1 argued that he saw the framework as a set of heuristics, because he have the idea of a framework being process oriented. In the other hand, S3 and S11, for example, see the framework as a guide for getting ideas and a north to start. Also, it was stated that some game elements discussions and examples were understood differently by some specialists. For example, S6 claimed that she did not find any evidence that Lack of Challenges and Purpose issue had a motivation approach. But S11 gave some examples where motivation was described. For

example, when he stated that "*Discovery could motivate the team by making them explore and have the bias to fail*".

An interesting finding that could be observed was that most of specialists have already experienced some of those ideas suggested. These could be observed in statements by most specialists. For example, S11 constantly mentioned the use of some ideas in the framework analyzed, as he stated when mentioned that points and leaderboards helped his team to change behavior. S3 claimed that used some of the suggestion proposed in the Lack of Focus in Meeting issue.

Also, some specialists who did not experienced gamification, claimed that could see some ideas being applied in his reality. For example, S10 stated in his three analysis that he could see those ideas being applied at his work to mitigate those issues selected. S1 pointed that he was interested on using the Lottery approach in the Lack of Feedback issue. S7 claimed that used most of ideas at work, but also argue that get some other ideas that she is willing to apply in her teams.

Finally, it was interesting to see how the personal experiences could influence the analysis of the framework. All specialists stated, at least in one analysis, that thought about a personal experience in work. The resulted in different considerations for the same issue. For example, Excessive Conflicts Between Team Members was analyzed by S4 and S7. S4 mentioned that he disliked the idea of lottery, based on a bad experience that he had at work. Lottery was not highlighted by S7, but also was not disliked, which infers that she liked the idea. But the most significant case was the Lack of Challenges and Purpose issue, where S6 claimed that none of the game elements suggested could mitigate that issue, based on her own experience. In the other side, S11 based his analysis also in his own experience and claimed that most of the ideas proposed could be useful to mitigate this issue. In fact, he also stated that he used some at work with good results.

Giving these findings, it is possible to see some evidences that the framework have potential to mitigate the collaboration issues presented and jump start behavior change.

Suggestions

Many suggestion for improvement were collected during the interview with specialists. These 6 were the most mentioned:

a. Improve the examples: most specialists stated the importance of the examples to make the reading less subjective. S3 suggest the use of cases in order to improve these examples;

b. Empirical Results: all specialists pointed that are interested in see this framework evaluated in a real scenario. S9 stated that "*the idea is very good, and I am very curious to see it empirical results*";

c. Considering the profiles of motivation: mentioned by specialists when the game element proposed could produce different results in people with different motivation. For example, S11 stated that "*Epic Meaning should consider the different motivation in people*";

d. Create a How-to Process: some specialists argued that the the framework could have a process to help readers to understand and to apply the ideas at work. S6 mentioned that "*since I do not know gamification, a how to process could give me a better approach to apply it*";

e. Open it to the Community: some specialists claimed that the framework should be opened to community and published on the Web. Not only to foster the discussion about it, but, as S11 stated, "*to create a space where people could post their lessons learned when applied the ideas*";

f. Combining Elements: a few specialists stated that the framework could be improved if game elements could be combined. As S8 mentioned when analyzed one issue, "*alone, points do not make sense to me. You should combine it to others*".

Other suggestions were specific, like generalize the framework to other contexts (S5), create a recommendation system (S8), consider the profile of the company (S8), or link the idea to the concept of Design Thinking (S11).

6.2 Threats to Validity

Threats to the conclusion validity are concerned with issues that affect the ability to draw the correct conclusion about relations between the treatment and the outcome of an experiment [WRH+12].

Since my final evaluation was based upon interviewing specialists, I selected 11 subjects who had the background needed. But I can state that I had a low statistical power threat, since these subjects did not analyze all the framework, and only pieces of it. This hardly could reveal a true pattern in the data.

Having the framework being proposed and evaluated by the same author, could result in fishing the error rate, since I could be searching for a specific result or confirmation. In order to avoid this threat, I tried to present the most detailed data possible.

The interview was conducted by video conference and by face to face meetings. This could cause the reliability of treatment implementation, which the risk is that the implementation is not similar between different persons applying the treatment or between different occasions. To mitigate this threat, I used the same material in both situations, but in different states (physical and digital).

Most of interviews where conducted by video conference, so the threat random irrelevancies in experimental setting could caused some interferences. At least with one subject, he participated the session while his daughter is in the same room, asking for attention. This threat could not be mitigated via video conference.

To avoid the random heterogeneity of subjects, where there is a risk that variation due to individual differences is larger than due to the treatment, I defined that my subject background should have large experience in software development, and also should background in leadership, research or gamification. Also, one subject is not directly working with software development, besides her formation in the area.

Threats to internal validity are influences that can affect the independent variable with respect to causality, without the researcher's knowledge [WRH+12]. Thus they threat the conclusion about a possible causal relationship between treatment and outcome.

The final interview was planned to take no longer than 1 hour, but in some occasions they lasted 30 minutes longer. In these cases, the maturation could be observed in some subjects as they became tired with the process, which may caused some effects in data provided. This threat was hard to avoid, since it depends mostly on the subject communication skills.

Besides that no subject argued about the artifacts used in the activity, a threat in instrumentation could be happen since most of the interviews were conducted via video conference. Beyond depending on Internet connection, not having a face to face meeting in a controlled environment could caused some influences in subjects, since they were at their own environments, sometimes with family or coworkers in the same room.

The subjects were selected based on their background and proximity with the author. This could caused the threat of selection, since most of them were asked to participate and not voluntarily selected. Even if the background could be defined as consistent for the activity, I could state that 11 subjects may not represent the whole population. To avoid the impact of this threat, the subjects were selected based upon their maturity.

Construct validity concerns generalizing the result of the experiment to the concept or theory behind the experiment [WRH+12].

I am assuming that game elements could be used to mitigate collaboration issues and to jump start behavior change. But this could cause a Inadequate preoperational explication of constructs, because it is not clear which means to "mitigate" those issues. The interview was structured in order to state those conditions, but the theory of gamification applied at collaboration can not be sufficient clear to every subject.

To avoid the mono-operation bias threat, in which if the experiment includes a single independent variable, case, subject or treatment, the experiment may under-represent the construct and thus not give the full picture of the theory, the interview was designed by

making the subjects selected three collaboration issues in order to collect a best analysis from the whole framework, rather than only one piece.

Since the subjects selected had at least 5 years of experience in software development and know at least the basis of gamification, the confounding constructs and levels of constructs threat could be controlled.

Hypothesis guessing was a threat which people take part in an experiment and might try to figure out what the purpose and intended result of the experiment is. Since I based my interview in capturing their perceptions about the work, this threat could not be fulled mitigated and may affect the data collected.

Evaluation apprehension, when people are afraid to be evaluated, was not identified on this research, based on the maturity of the subjects, which provided interesting and useful data.

As mentioned, the research and the interviews were executed by the same author, which could generate the threat experimenter expectancies, in which experimenters can bias the results of a study both consciously and unconsciously based on what they expect from the experiment. In this case, it was not possible to have a different person to collect the data, so this threat could have an effect on the collected data.

Finally, threats to external validity are conditions that limit my ability to generalize the results of my experiment to industrial practice [WRH+12].

Interaction of selection and treatment threat, which effect is having a subject population not representative of the population I want to generalize to, was mitigated by selecting some different profiles of subjects, like tech leaders, project managers and directors. This could bring a more wide perspective of those perceptions.

As for interaction of setting and treatment, this research do not execute an experiment in order to validate its proposal. All findings were based upon the perceptions of the subjects, which can generate some bias in the data collected.

6.3 Discussion

The interview with specialists were set up in order to evaluate the ideas proposed by the framework. I decided to choose specialists from industry who had previous knowledge (or experience) in gamification, to collect more consistent perceptions about the framework.

As seen in the data analysis, most of specialists had positive reviews about the framework, stating that most of ideas could be applied in their environments. I can see this positive feedback as a result of the comprehensive organization of the framework. This perception is powered by some specialists who clearly mentioned that they already used or are considering to use some of the ideas of the framework.

Being a trend in last years, gamification is suffering from a misconception that causes the wrong use of techniques and concepts in companies. The framework proposes a simple way to jump start behaviors in teams, using ideas that could be easy understand by teams and managers. Game elements were gathered from a specialist company, which helped to create this body of knowledge about the subject.

Gamification is a great motivator for behavior change, but the environment should be set up for this to happen. As seen in one case, where two different specialists gave two different visions of the same issue: one stated that gamification will not help on that situation, while other stated the opposite. In cases like this, the profile of people involved should be considered. Not only the team, but also the managers who will support it.

The bad experience that one specialist had causes a bad perception of how gamification could help on that situation. She could not see any good perspective for it. In the other case, the specialists had good experiences with gamification, with gave him confidence to state that it will work on his environment. That is why, as future work, it is important to investigate the profiles of people, to create more meaningful experiences to individuals, not only for teams.

Profiling also could give light to another discussion about gamification: its effectiveness in long term. This framework was proposed as a short term initiative, to jump start behavior change in collaboration for teams. The subject is still been study for researchers and proposing something more wider may not present some clear evidences, as this research presented. I personally believe that a long term motivator should consider only intrinsic motivators. And to create such experiences, we need to create personal experiences, as mentioned before. This kind of discussion should transcend the most common ideas of badges, points and leaderboard concepts.

The framework not only presented some good evidences about how it could be useful in industry, but also gave light to some future ideas that increase the body of knowledge about gamification applied at work. Gamification is not a silver bullet, but could be very powerful to jump start behaviors. I hope that practitioners, specialists and researchers could be benefit for this work.

7. FINAL CONSIDERATIONS

This research proposed a framework to use gamification as a motivator for software development teams to mitigate their collaboration issues, which often affect group formation, communication, coordination, cooperation, and awareness, and to jump start behavior change in short term.

The design of this research was based on 4 Phases: a literature review, an exploratory stage, the framework development and the framework evaluation. Its evaluation was composed by two stages: a member checking and interview with specialists.

A preliminary version of the framework was created based upon the findings of a literature review and interviews with experts. Later, a mapping process of each issue to game elements that might help foster collaboration in teams. These results were later preliminarily evaluated by a group of experts that suggested improvements for the beta version of the framework. The interview with the specialists evaluated the framework by generating the final version, presented on this research.

Even that some threats of validity could not be mitigated, findings on the framework evaluation presented evidence that the framework has the potential to be a useful tool to be applied in work environments and help to mitigate collaboration issues in software teams, by jump starting behavior change.

Both research questions were answered in this work. I consolidated a comprehensive list of collaboration issues that were presented in literature, which was the basis of the framework. The second research question resulted in the proposed framework, which presented ideas of how the game elements could be use to mitigate those issues, fostering collaboration.

The framework can be used by management and team leaders to promote behavioral change in their industrial teams and by researchers to advance the state of the art in collaboration in the field. Tool designers can also benefit from it by having access to the comprehensive and compiled body of knowledge to inspire them to design new tools or improve current ones to support collaboration in software teams.

7.1 Future Work

There is 6 suggestion for future work identified after the evaluation phase. The first one, and most relevant, was the need of empirical evaluation, in order to collect a more consistent data. Indeed, increasing software quality is an emergent property of gamification that is difficult to derive without a proper experimental evidence in non-educational context.

This future work is in research process by a fellow researcher, and should be executed in the following two years, with some interesting findings.

Other interesting suggestion was the improvement of the examples. This was noted as very relevant, because the impact of these examples in the framework analysis. Most specialists based their reviews on the suggestions presented for each game element. So, it might be important to create more value to each suggestion.

Considering the differences of profiles and motivation was also mentioned by some specialists. Realizing that some people are motivated by intrinsic and extrinsic rewards, some specialists suggested that the framework should consider the differences between employees.

Create a how-to process, open the framework to community and combining the game elements, were also mentioned as suggestion and could be considered as future work. These three improvements could bring a different perspective in this framework, making it more complex and comprehensive to the community.

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ATTACHMENT A – Script Interview for Activities

Script for the Interview with Specialists (Phase 2)

Name of Practitioner: _____

Job description: _____

Company: _____

Years of Experience in Soft. Develop.: _____

[Present the research and goals]
[Contextualizate collaboration]
[Present the list with 42 collaboration issues]

Ask the practitioner to read those issues.
In your opinion, which are the three collaboration issues that you considered most relevant, in a software development project? Why?

_____
_____
_____
_____

Do you agree that these collaboration issues mentioned were the most common? Why?

_____
_____
_____

Can you remember any other collaboration issues that were not mentioned in the list?

_____
_____
_____
_____

[Present the 5 cards with the dimensions]]
[Explain the dimensions]

Please, classify each one of those issues in these five dimensions presented. If possible, say your decisions in loud.

Comm	Coord	Coop	Group Form.	Awareness

[Ask about some decisions, in order to clarify]
[Let the practitioner have time to re-think about his classification, and change if he wants to]

Did you leave any collaboration issue outside the classification? If yes, why?

Which were your perceptions about this activity?

Script for the Member Checking (Phase 4 - A)

Name of Practitioner: _____

Job description: _____

Company: _____

Years of Experience in Soft. Develop.: _____

Experience with Gamification: _____

[Present the research and goals]
[Contextualizate the progress so far]
[Present the alpha version of the framework]

Which were your first perceptions about the framework (structure, organization, content, etc.)?

_____
_____
_____
_____
_____
_____

Choose at least 3 issues presented by the framework. Read the texts. Do you agree with it?

_____
_____
_____
_____
_____
_____

What do you liked the most, in this alpha version of the framework?

What do you believe could be improved in the framework?

Do you believe that those ideas could jump start behavior change, to minimize these collaboration issues presented?

Script for the Interview with Specialists (Phase 4 - B)

Name of Practitioner: _____

City \ Country:_____

Job(s) description(s): _____

Company \ Size: _____

Years of Experience in Soft. Develop.: _____

Years of Experience in Leadership.: _____

Experience with Gamification: _____

[Present the research and goals]
[Contextualizate the progress so far]
[Present the beta version of the framework]
[Present the list with 34 collaboration issues and explain it]

By this list, can you choose 3 of the most significant collaboration issues that you experienced with your team?

Issue #1	Issue #2	Issue #3
Dimension	Dimension	Dimension

Why did you choose those issues?

_____
_____
_____
_____
_____

Issue #1 - [ ]

What are your impressions about the framework proposition for this issue #1 (format, content, organization, positive and negative thoughts)?

Do you believe that these proposed ideas could minimize this collaboration issue #1, jump starting behavior change? Why?

Issue #2 - [ ]

What are your impressions about the framework proposition for this issue #2 (format, content, organization, positive and negative thoughts)?

Do you believe that these proposed ideas could minimize this collaboration issue #2, jump starting behavior change? Why?

Issue #3 - [ ]

What are your impressions about the framework proposition for this issue #3 (format, content, organization, positive and negative thoughts)?

Do you believe that these proposed ideas could minimize this collaboration issue #3, jump starting behavior change? Why?

IN GENERAL

What are your impressions about the framework proposition that you selected?

Which improvements do you believe that could be inserted in the framework?

In general, do you believe that this proposed ideas could minimize these most common collaboration issues, jump starting behavior change? Why?

ATTACHMENT B – Paper Accepted at the LA@CSCW 2015 Workshop

Studying Gamification as a Collaboration Motivator for Virtual Software Teams: Social Issues, Cultural Issues, and Research Methods

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Abstract
Gamification is the application of game elements and game design techniques in non-game contexts to engage and motivate people to achieve their goals. Motivation is an essential requirement for effective and efficient collaboration, which is particularly challenging when people work distributedly. In this paper, we discuss the topics of collaboration, motivation, and gamification in the context of software engineering. We then introduce our long-term research goal—building a theoretical framework that defines how gamification can be used as a collaboration motivator for virtual software teams. We also highlight the roles that social and cultural issues might play in understanding the phenomenon. Finally, we give an overview of our proposed research method to foster discussion during the workshop on how to best investigate the topic.

Author Keywords
Gamification; virtual team collaboration; motivation; social and cultural issues; empirical work.

ACM Classification Keywords
H5.3 Group and Organization Interface: Computer-supported cooperative work; K.4.3 Computers and Society: Organizational Impacts: Computer-supported collaborative work.

Introduction

Virtual teams–those in which team members are in different locations or time zones [1]–have become common due to several factors: the need to reduce travel costs, a globalized and competitive market, the distribution of qualified human resources across different locations, and the availability of software applications and infrastructure for collaborative activities. While there is a reasonable body of knowledge on how to support collaboration among members of virtual teams, how to motivate such collaboration remains an open question.

Virtual teams need to overcome the challenges of collaborating across different boundaries that emerge as a result of time zones and physical, cultural, functional, and organizational distribution. Motivation–the force that triggers an organism to take action towards a goal–becomes essential to promote collaboration in such dispersed environments [2]. We seek to explore whether *gamification* can motivate virtual team members to collaborate.

Gamification is the use of game elements in non-game contexts [3]. More specifically, it is the application of game elements (e.g., points, badges, or leaderboards) and game design techniques to engage and motivate people to achieve their goals [4]. A popular example of gamification is Stack Overflow[1], a Q&A site in which users earn points for providing programming-related questions and answers that are voted on by their peers, and these points are aggregated to create the users' reputation on the site.

The gamification of activities has recently received attention because of its broader adoption in several work-related situations (e.g., [5]). *How exactly gamification can motivate collaboration in virtual software teams*, however, is still an open question. In this paper, we present our proposed research method for investigating this topic and for uncovering the roles that social and cultural issues might play in understanding this phenomenon. Our aim is to foster discussion on how to best investigate the topic from diverse local perspectives.

Collaboration, Motivation, and Gamification in Software Engineering

Essential collaboration activities include having members share information with each other, coordinating dependent activities, communicating in a timely fashion, participating in active knowledge sharing, and building trust. Previous work investigating collaboration in virtual teams has focused on the role of communication [6], distance [7], and performance [8].

The collaboration that is necessary to complete a task can be fostered through individual or group motivation. Beecham and colleagues (2008) [9] conducted a literature review on motivation in software engineering and found that motivation has a large impact on developer productivity and quality. While there are

1 http://stackoverflow.com/

several studies discussing the topic, most of them focus on identifying the motivators and de-motivators for developers (e.g., [10]). To the best of our knowledge, none have directly investigated how to motivate collaboration in virtual software teams.

Gamification has recently been reported as a means for motivating people to achieve their goals [4]. In software engineering, the gamification of collaborative work has become a topic of interest. For instance, researchers have reported the interplay of human aspects, social media, and gamification in open-source software [11], on monetarily rewarding open-source developers [12], on motivating developers to adopt new practices, tools [13], and methods [14], as well as on motivating developers to perform certain software development activities, such as version controlling [15]. However, there are no studies yet on how to foster collaboration in virtual software teams using gamification as a motivational strategy.

Proposed Research Method

Our goal is to develop an understanding of how exactly gamification can motivate collaboration in virtual software teams. We understand that motivation and collaboration are affected, to a certain extent, by social and cultural aspects. For instance, in a collectivist culture (e.g., Latin America), an individual is typically committed to the well-being of the community or the collective, whereas in an individualistic culture (e.g., the US), the individual is more concerned about personal gains and achievements [16]. Game mechanisms can also be perceived differently by developers from different cultures.

Therefore, to answer our research question and to account for the social and cultural issues mentioned above, we need to better comprehend how developers get motivated to collaborate (objective 1), which collaboration mechanisms they use and which collaboration issues they face when working in a distributed setting (objective 2), which software development activities are suitable to be gamified (objective 3), and how these activities can be gamified in a virtual setting (objective 4). Our contribution will be represented in a framework format, indicating which game elements and mechanisms promote aspects of collaboration in virtual software teams.

We propose a qualitative study organized in four major phases: (1) Literature review, (2) Exploratory field study, (3) Framework development, and (4) Framework evaluation. In *Phase 1 - Literature review*, we will systematically review literature in software engineering on the following topics: motivation, collaboration, and gamification (objectives 1-3). In parallel to Phase 1, in *Phase 2 – Exploratory field study*, given the anticipated limited material available, we will conduct a field study based on semi-structured interviews with experts on global software development aiming to collect their perceptions on these topics (objectives 1-3). We will select practitioners with different roles and seniority levels located in several countries aiming to account for social and cultural issues. Next, in *Phase 3 – Framework development*, we will propose how to gamify such activities (objectives 3-4). The framework proposal will include social and cultural aspects as well as individual, inter-personal and work context factors that shape collaboration processes in virtual teams. Singer [17] has previously identified persuasive mechanisms in a pattern catalog aimed at increasing

the adoption of best practices among software developers—this and similar work will provide a foundation for the framework to be developed. In *Phase 4 – Framework evaluation*, we aim to evaluate the framework through experiments that will measure how much it attends its purpose (objectives 3-4).

Final Considerations

A framework on gamification of software development activities to motivate virtual team collaboration can enable us to provide guidance and recommendations to practitioners for approaching collaboration issues in virtual teams. Researchers will benefit from having a theoretical perspective over existing methods and techniques for investigating the topic. Our main goal for this workshop is to foster discussion on how to improve the investigation of the topic and how to best account for social and cultural issues.

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ATTACHMENT C – Paper Accepted at the SBSC 2015 Conference

Using Gamification as a Collaboration Motivator for Software Development Teams: A Preliminary Framework

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ABSTRACT

Gamification is the use of game elements in non-game context to engage and to motivate people to achieve goals. Its use is becoming very popular in software development organizations due to work being based upon human-centric and brain-intensive activity. This paper presents the topics of collaboration and gamification in the context of software engineering, and proposes a framework that identifies the most common collaboration issues that affect software development teams and how to apply game elements to motivate a change on their behaviors.

Categories and Subject Descriptors

CCS [**Human Centered Computing**]: Collaborative and Social Computing; D.2.8 [**Software Engineering**]: Metrics—*complexity measures, performance measures*

General Terms

Framework, Gamification, Collaboration

Keywords

Gamification, Game Element, Software Development, Team, Motivation, Collaboration, Issue, Empirical Evaluation

1. INTRODUCTION

A software development process requires creative discourse among team members to design and to implement a novel and competitive product that meets usability, performance, and functional requirements set by the customer [20]. In other words, software development demands a large amount of cognitive effort of those who are involved in it.

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There is software that can be created only by one person, but in general, software development is a collaborative activity with the participation of professionals that work together to produce quality code [5]. Team members must coordinate activities, define plans, execute tasks, and also communicate to create a software.

But since software engineering has a high dependence on human factors (e.g., communication, trust building, negotiation, etc), a large number of issues faced during software development is associated with people. Collaboration, in particular, plays an important role in determining the success of a software project [16].

Gamification is the use of game elements in non-game contexts [6], and its use became very popular in several areas but mainly in Marketing with several cases of behaviour changes and effectiveness reported over the last years [13]. Companies from many areas have started using it given its promise of helping them achieve their goals and to keep people engaged in their work [31].

Since collaboration plays an important role in software team activities and its nature of human factors can generate issues that can cause problems in the development process, it is important to find ways to foster this aspect and to motivate software teams to collaborate more efficiently.

This paper proposes a framework that identifies the most common collaboration issues that affect software teams, and how to apply game elements to minimize the impact of each issue. To do so, we first identified collaboration issues in software engineering literature in light of the 3C Collaboration Model [10] and then proposed which game elements can be used as a motivator catalyst to jump start behaviours in software teams and minimize such issues. Next, we conducted a preliminary evaluation of the proposed framework with experts in software development and in gamification.

The remainder of this paper is organized as follows: Section 2 describes the background on software development, collaboration and gamification. Section 3 presents the research methodology we followed in our study, including our research goal. Section 4 presents the preliminary version of the proposed framework defined based on literature. Section 5 describes the preliminary evaluation with experts on the topic. Section 6 concludes the paper with our final considerations and points out our next steps towards stabilizing the framework and using it in practice.

2. BACKGROUND

This section presents background information about the main topics related to this work. First, we present a background information about software development and collaboration, and next we present the topic of gamification.

2.1 Software Development and Collaboration

Having people working in software development projects as teams is one of the best ways to produce good quality products and services. Teams can be defined as collectives who exist to perform tasks, share one or more common goals, interact socially, and maintain and manage boundaries [14]. Teams are embedded in an organizational context that sets boundaries, constrains the team actions, and influences exchanges with other units in the broader entity.

But given that software development is a knowledge-based activity that requires human interaction, researchers have been studying how human factors (e.g., trust and motivation) impact the progress of software development processes.

Motivation is reported to have the single largest impact on practitioner productivity and software quality management [3], so many companies are rethinking their strategies to motivate their employees.

Intrinsic motivation - the act of doing something because it is inherently interesting or enjoyable - is being discussed in recent years as a means to engage and motivate employees. Ryan and Deci [23] explain that intrinsic motivation results in high-quality learning and creativity. Pink [22] discusses the advantages of intrinsic motivation compared to the traditional external motivation of fear, money, and rewards.

Besides motivation, another human factor that is important to achieve success in a software development process is collaboration. Most modern businesses require their workers to establish collaborative relationships to achieve organizational goals [25]. Kusumasari et al [16] explain that collaboration and coordination in a software development project play an important role in defining the success of a software project. Treude, Storey and Weber [29] stated that research on issues related to communication, collaboration and coordination has increased significantly over the last decade because both industry and academia acknowledge the importance of team work in software development.

Collaboration can be seen as the combination of communication, coordination and cooperation [10]. Communication is related to the exchange of messages and information among people; coordination is related to the management of people, their activities and resources; and cooperation is the production taking place in a shared space. All of these concepts are connected to and interrelated with awareness, that is an understanding of the activities of others, which provides a context for one's own activities [28].

A model called the '3C Collaboration Model', originally proposed by Ellis et al [8] and later extended by Fuks et al [10] (see Fig. 1), is used to organize Computer Supported Cooperative Work (CSCW) tools and components [9] [11] according to their collaboration, communication, and coordination dimensions. This model was then used by Steinmacher, Chaves and Gerosa [28] to help categorizing papers on awareness. After studying the topic for a while they realized that it is easier to analyze issues and problems decomposed into each of the 3C dimensions separately than altogether; thus their study.

The three dimensions used in the 3C Model were described as ontologies to guide team collaboration by Vivacqua and Garcia [30]. These ontologies describe a set of activities of a specific domain and its concepts. Also, Vivacqua and Garcia included another important dimension to their ontologies: group formation, which is necessary to take place before collaboration can happen, to understand why and how groups and teams are formed.

Given the above, we note how motivation and collaboration are important aspects for software development teams, influencing directly the quality, productivity and success of projects. Motivation drives the real desire of team members to accomplish their tasks with quality and productivity. The 3C Collaboration Model (communication, coordination, cooperation), plus awareness and group formation, are useful dimensions to identify and to evaluate collaboration issues.

2.2 Gamification

The widely spread definition of gamification is "the use of game elements in non-gaming contexts" [6]. Aspects of play and fun may have been incorporated in non-game activities before, but gamification represents a more ordered and aware approach.

Although gamification is based upon the use of game elements and mechanics, there is still no consolidated list or classification of these game elements in literature. For example, Dubois [7] reports that the most elementary gamification element–named challenge–consists of a reward mechanism that awards people in response to the accomplishment of certain activities that need to be encouraged [7]. Kumar et al [15] cite that points, badges and leaderboard are among the most used elements.

Zichermann [32] presents a comprehensive list while the Badgeville company [2] created a collaborative wiki in 2011 to list and to describe the most commonly used game elements. The list is currently composed by 31 game elements, which can be found online[1]. Their description, as exemplified below, can help us to understand how to apply them.

1. **Achievements**: A virtual or physical representation of accomplishment. Badges can be earned from completing tasks/missions in gamification platforms.

2. **Levels**: A system, or "ramp", by which players are rewarded an increasing value for an accumulation of points. Leveling is one of the highest components of motivation for gamers.

[1]BadgeVille Wiki have two resources for game elements available at http://bit.ly/BVGameMechanics and http://bit.ly/BVGameFeatures

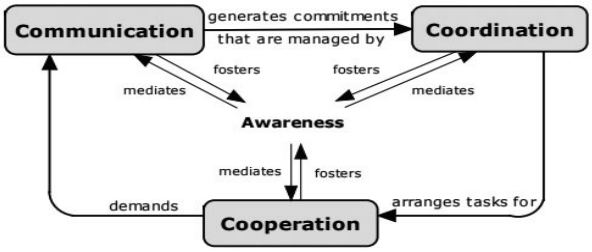

Figure 1: The 3C collaboration model [10]

Business companies are seeking gamification as a tool to motivate and to engage employees in activities and tasks [1], to achieve goals [19], to change behaviors [26], and to keep people engaged in their work [31].

Researchers also found evidence for the impact of the use of gamification in software development environments. Singer and Schneider [26] proposed the gamification of a version control system to encourage Computer Science students to make more frequent commits. The results of the experiment revealed good practices and pointed to improvements that may help to achieve even better results. Lotufo, Passos and Czarnecki [17] proposed a work to improve bug tracking systems using game mechanisms, to encourage teams to increase the frequency and the quality of their contributions. As a result, they concluded that by applying a reputation and reward system, the improvements are readily accessible.

Moccozet et al. [18] did not focus on software development, but their work was one of the first studies that tried to understand how gamification and collaboration could work together. They created a gamified online community for students to improve the group work among them. They described how they gamified the platform and, as a result, stated how it encouraged students to contribute and collaborate more. Snipes, Nair and Murphy-Hill [27] conducted their study based on the idea that software development practices and tools are constantly evolving. They proposed an idea by adding game-like feedback to the development environment to help improve adoption of tools and practices for code navigation. They identified that most of the developers are interested in gamification.

Game elements can be used as a motivator to consolidate practices and change behaviors of people at work. Gartner predicts that by 2016, gamification will be an essential element for marketing, user loyalty and employee engagement [4], an important evidence that this is a promising theory that can also be used in software development industry.

3. RESEARCH METHODOLOGY

Despite the fact that gamification became a trend in software engineering research in the last years, we did not find any study that addresses how game elements could foster collaboration in software teams. Besides the fact that software is a huge area with different activities, we can state that some collaboration issues are common for all of them. Therefore, we posed as our goal *to understand which are the most common collaboration issues in software development and how game elements could help to minimize these issues.*

Our research can be characterized as an *exploratory study*, and its design is based on four main phases as follows: literature review, exploratory, framework development and framework evaluation, as shown in Figure 2. The phases and their main activities are described next.

3.1 Phase 1: Literature Review

We first conducted an informal literature review on the topic of gamification, aiming to identify how mature the subject is, which papers, authors and keywords are relevant and also which areas are researching the subject the most.

Based upon the results, we conducted a literature review to investigate and to understand how gamification is applied in work and in software environments, and which are the game elements used in both scenarios. Gamification had already two systematic literature reviews [12] [21] which helped us to understand the topic. Most of our review findings have been cited by both studies. Next, we conducted a literature review in collaboration to identify the common issues that impacts collaboration in software teams. Finally, we studied the topic of motivation in software engineering to understand what drives people to accomplish their work.

We identified an initial list of 343 collaboration issues and then later refined this list for duplicates and similarities, resulting in a list with 34 collaboration issues. These issues were categorized and grouped as per the 3C Collaboration Model [10][28] by the first author and the classification discussed with the second author and later validated with experts as presented next.

For gamification, we found that authors like Zichermann [32], Hamari [12], and Pedreira [21] provide lists of game elements which are not available for quick references or do not have enough detailed information. Therefore, we consider the BadgeVille' list of 31 game elements [2] as reference to our work. The list provides additional information, examples, and other useful information. We cross-referred the elements in this list with the lists of the above mentioned authors for consistency of definitions.

3.2 Phase 2: Exploratory

In this phase we interviewed 3 experts on software development, selected based on our contacts and their level of expertise on the topic (e.g., at least 5 years of experience), and invited them to evaluate the preliminary list of issues encountered in literature and to classify the issues using the five before mentioned dimensions (communication, coordination, cooperation, awareness and group formation). We also asked them if they would add any other issues to the list. The first and second authors double-checked and discussed in details the received feedback.

The experts were given 34 printed cards containing each one of the identified issues, a number ID, and a short description of the referred issue. They were introduced to the dynamics and asked to classify each issue per the five dimensions. They were also instructed to feel free to point out if they did not feel that a particular issue was relevant for the list. At the end of the dynamics, each expert was interviewed to see if she would like to add any other collaboration-related issue that she might have experienced in her work environment and to provide overall comments about her contribution.

3.3 Phase 3: Framework Development

Next, based on the literature reviews and on our own knowledge of the subject, we identified which game elements can be applied for each issue. The mapping was a subjective process where we defined which are the desirable behaviors expected for the collaboration issues identified, and how the

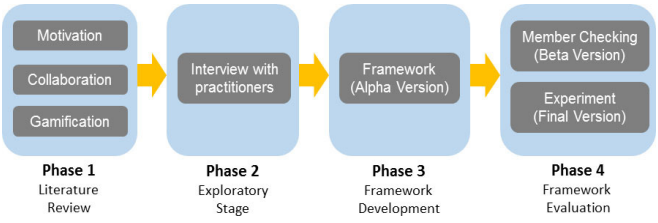

Figure 2: Proposed research design

game elements could help to foster such behaviour. For example, the issue "No Meetings" is defined by "there is no meeting for the team", and as a desired behavior we want to "create a routine of meetings for the team". So, based on examples from literature and on our own understanding of each game element, we choose those who could help to jump start that desired behavior. For example, "quests" could help by creating tasks for team members where they obligatorily need to meet in order to complete the challenge.

The proposed preliminary framework is organized into the five collaboration dimensions, each one composed by one or more identified collaboration issues. Issues are identified by a singular name and description, and brings together the associated desired behaviour (what is expected), game elements and discussion (how the game elements proposed can be applied). The framework is presented in table 1.

This first version was initially proposed by the first author and extensively discussed with the second author for refinement. Later it was discussed among all authors until an alpha version was considered ready for evaluation activities.

3.4 Phase 4: Framework Evaluation

We planned the framework evaluation into two stages: the preliminary evaluation using member checking technique [24], to collect feedback from experts about the alpha version (presented in this paper), and a second evaluation using a controlled experiment aiming to identify how a sample of the framework is observed in practice (still to take place).

For the preliminary evaluation, we used the member checking technique, which collects feedback on the findings from the subjects who provided the data in the first place [24]. Thus, we contacted two of the experts that participated in the exploratory study (Phase 2) and invited them to provided us feedback about the alpha version of the framework. Given that we could have no concluding feedback, we decided to invite three additional experts, who have at least the same background of the others. Two of them had previous practical experience with gamification, providing us a different perspective from the previous experts.

The controlled experiment is currently being designed. We will select a sample of collaboration issues of our interest and will conduct a two months-long activity with graduate students of a CSCW course within a Computer Science program in which they will demonstrate how they handle behaviour change promoted based on the introduction of the game elements into the software development processes they will be adopting to complete the task-at-hand. Most students of the candidate program often have work experience in industry, thus we assume they will have a practical comprehension of the situations presented on the framework.

4. PROPOSED FRAMEWORK

The preliminary framework was developed based upon the findings on Phases 1 and 2 as previously described. The main goal is to consolidate knowledge in a single artifact to facilitate practitioners and researchers' work either by being a guideline to be used in practice with software teams or having it as a baseline to further research on the topic. The framework proposes how to use game elements to minimize each of the 34 identified collaboration issues faced by software teams in their activities. Table 1 presents our defined alpha version.

5. PRELIMINARY EVALUATION

We present in this section the findings of the preliminary evaluation as introduced in Section 3.4. We initially selected the same five experts that have participated in Phase 2. The main goal of this evaluation was to collect participants' feedback about the alpha version of the framework, and identify whether they would suggest changes or improvements to it. An individual interview of about one hour long was conducted with each of them, having the list of game elements explained and version of the framework, as shown in Table 1. The interview was structured by questions about their opinion about collaboration, gamification and how the issues encountered can be addressed by each set of game elements proposed in the framework.

The feedback was collected, analyzed and grouped into similar suggestions. an action plan was defined to address the suggestions. The main contributions of this preliminary evaluation are summarized below:

1. **The need for examples from literature**: All experts suggested us to add examples from literature to facilitate the understanding of the framework. Examples will be added to the beta version.

2. **The need for profiles**: Four experts asked if those game elements could be applied to any kind of role (e.g., developer, manager). Since it is known that some game elements are most suitable to different profiles, the idea to consider the profiles will also be considered for the beta version.

3. **Scope boundaries**: Each practitioner suggested some different approaches to the framework. For example, one asked if the framework will be suitable for outsourcing teams; another asked if the framework will propose who should apply the guidelines to the team. So it became important to clearly limit the boundaries of the framework scope. We will add such a refined description when we have the final version.

4. **How to measure**: Three experts asked how each behaviour change will be measured. It may be interesting to consider some metrics to measure the effectiveness of the framework in action. This is an open issue.

5. **Publication on the Web**: One practitioner suggested the publication of the framework on the Web, to be easily consulted by other researchers and people interested in gamification studies. Coming soon either.

6. CONCLUSION AND FUTURE WORK

Collaboration plays an important role in software team activities, so it is important to find ways to minimize the impact of its issues, and also foster the collaboration in teams. Gamification is the use of game elements in non-game contexts, and its use is becoming more popular in industry.

This study proposed a preliminary version of a framework to use gamification as a motivator for software development teams to minimize their collaboration issues, which often affect group formation, communication, coordination, cooperation, and awareness.

This version of the framework was created based upon the findings of literature reviews and interviews with experts. Later, we mapped each issue to game elements that

Table 1: The Alpha Version of the Proposed Framework

Communication					
#	Issue	Description	Desired Behavior	Game Elements	Discussion
1	No common sense between team members	Team members don't have common sense, alignment, compromise, motivation, etc.	Teams must have a common sense about the expectations of the project.	Cascading Information Theory, Achievements, Quests, Notifier, User Profile, Status	Cascading information theory can help the team to achieve the common sense of the work to be done. Quests and achievements can create a step-by-step path where team members can learn all important thing about the project. Notifiers, user profile and status also may help in the situation.
2	Excessive Communication	Overload of information and communication	Team members must know exactly who should be aware of their information	Achievements, Appointments, Quests, Notifier, User Profile, Status	Achievements, appointments and quests can create and describe the team members who must be aware of the results of the accomplishment. Notifier, user profile and status can support the idea for knowing who must be informed about something.
3	Ineffective Communication	There's no common ground between team members and this affects the quality of communication	Team members must have a similar language for working together.	Cascading Information Theory, Achievements, Quests, Notifier, User Profile, Status	Cascading information theory can help the team to achieve the common sense of the work to be done. Quests and achievements can create a step-by-step path where team members can learn all important thing about the project. Notifiers, user profile and status also may help in the situation
4	Lack of Focus in Meetings	Too much distraction in meetings causes loss of information and impacts decisions	Improve the focus in meetings by creating mechanisms to help it	Achievements, Reward Schedules, Countdown, Loss Aversion, Virality, Blissful Productivity	Achievements, reward schedules and loss aversion can create some behaviors that will reward the team members who paid attention in the meeting. Countdown can create the awareness that the team must use that specific amount of time do conclude the meeting. Virality can create the idea that team members must conclude the meeting together. Blissful productivity can be used to create an interest in the meetings.
5	No Meetings	There are no meetings for the team	Create a routine of meetings for the team	Achievements, Quests, Appointments, Notifier, Bonuses, Levels, Points, Leaderboard, Progression	Achievements, quests and appointments are crucial to help create the routine of meetings. Also, notifier can notify the team members about the meetings. The rewards will come in form of bonuses, points, etc.
6	No Technical Discussions	Team members don't discuss technical information	Create a routine for fostering technical discussions	Achievements, Quests, Appointments, Notifier, Bonuses, Levels, Points, Leaderboard, Progression	Achievements, quests and appointments are crucial to help create the routine of meetings. Also, notifier can notify the team members about the meetings. The rewards will come in form of bonuses, points, etc.
7	Lack of Informal Communication	There's no Informal communication (not involving work) or adhoc communication	Foster the informal communication in the team, by allowing them to gather outside the workspace	Achievements, Quests Appointments, Bonuses Levels, Points, Leaderboard, Virality, Community Collaboration	Achievements, quests and appointments are crucial to help create the routine of informal communication. The rewards will come in form of bonuses, points, levels, etc. Community Collaboration and Virality also can help people to cooperate.
8	Lack of face-to-face communication	Team members don't have rich face-to-face communication	Sit the team together to help the face-to-face communication	Achievements, Quests, Appointments, Bonuses Levels, Points, Leaderboard, Virality, Community Collaboration	Achievements, quests and appointments are crucial to help create the routine of face to face communication. The rewards will come in form of bonuses, points, levels, etc. Community Collaboration and Virality also can help people to cooperate.
9	Lack of Feedback	Team members don't give feedback to each other	Foster the feedback process in the team	Achievements, Quests, Appointments, Bonuses, Levels, Points, Leaderboard, Progression, Virality , Community Collaboration, Loss Aversion, Lottery	Achievements, quests and appointments are crucial to help create the routine of feedback. The rewards will come in form of bonuses, points, levels, etc. Community Collaboration and Virality also can help people to cooperate. Loss Aversion can make team members focus on giving feedback in a specific timebox. And lottery may create an environment where team members must give random feedback to team members based on chance.
Coordination					
#	Issue	Description	Desired Behavior	Game Elements	Discussion
10	No clear goals	No clear goals and objectives about the work to be done	Goals are clear and available for every team member	Achievements, Cascading Information Theory, Epic Meaning, Quests	Achievements and quests can create milestones that the team might follow to achieve the goal, giving them the step-by-step to success. Cascading Information Theory may give to the team only the right information for the time they need, making them focused on mastering the first steps. Epic Meaning may give the goal a special narrative, giving the feeling that the team will be really impacted by achieving the goals.
11	No clear tasks	No clear tasks for the work to be done	Tasks are properly defined and team members know what to do	Achievements, Quests, Combos, Progression	Achievements and quests may create the ideal meaning for each task, giving purpose for them. Combos can create the step-by-step desired results to be achieved. Progression will allow the team members to see the stage of the work done and to be made.
12	Unrealistic plan	Unrealistic schedules, milestones, goals, estimates, etc.	Plans should be created with the participation of every team member, to gather every opinion and then guarantee better estimates.	Community Collaboration, Virality, Discovery, Loss aversion, Urgent Optimism	Virality (when considering only the team) and community collaboration (stakeholders) can help team members to cooperate in creating the plan. Discovery allow members to seek for better ways to understand and achieve the goals. Loss aversion can be used to make members update the plan constantly, so they will not lose privileges (for example, if they do not update the plan, they will be responsible for the estimates). Urgent optimism may be useful to help members to have the feeling that the plan is able to have success.
13	No clear roles	Team members don't know or are not satisfied about their roles in the project	Team members must know their responsibilities, and also the ones of their colleagues	Achievements, Appointments, Quests, User Profile	Appointments, achievements and quests can help define the roles and expected tasks of team members. User profile is useful to allow the others to see their information.

14	Lack of support for new members	Newcomers don't have specific support from team members	Newcomers must know what to do, and the team must know how to support them.	Achievements, Appointments, Quests, Bonuses, Cascading Information Theory, Discovery, Levels, Points, Progression, Reward Schedules, Status, Leaderboard, User Profile	Newcomers might have achievements, appointments, quests and reward schedules to begin knowing what to do and the expected results. A cascading information theory can help them to have a tutorial for understanding the new processes. Let them discover the new work. The use of levels, bonuses, points, progression, status and leaderboard is also interesting for the team to be rewarded by supporting the new member.
15	Lack of involvement from managers	Managers don't support the team	Managers must support the team, when needed.	Appointments, Community Collaboration, Epic Meaning, Ownership, Quests, Virality	Appointments and quests can be set up to help the team to synchronize actions with the managers. Community Collaboration enable the managers to take part in the problem solving, helping directly the results of the process. Epic Meaning and Ownership may boost the interest by the manager in participating in the process, because they can see the value of that. Virality creates the background to allow people to cooperate
16	Excessive Workload	Team members work many extra hours on tasks	Team members must not burn out too much.	Countdown, Loss Aversion, Notifier, Achievements, Bonuses, Points, Levels, Progression, Leaderboard	Countdown might incentivize the team members to not overcome the specific time. Notifiers can give some alerts to the team members who are working too much. Bonuses, points, levels, progression and leaderboard may encourage the change of behavior, rewarding those who do not work too much. Also, loss aversion may help team members to not lose achievements by maintaining the routine to not burnout.
17	Excessive Changes in Plan or Process	Planning and processes (like methodology) change frequently	Plans must maintain a minimum of previsibility to give the team some security in work	Quests, Progression, Activity Feed, Notifiers	Quests can be used to create a set of steps that every task in the plan may have. Changes will impact the progression, so team can see this happening. Activity feed and notifiers can be used to maintain a log of the activities, helping the team to see how things are going or when they changed.
18	Lack of Challenges or Purpose	The project doesn't represent a meaningful motivation for team members	The project must represent a challenge for the people who will work on it	Achievements, Appointments, Blissful Productivity, Bonuses, Combos, Discovery, Epic Meaning, Levels, Loss Aversion, Ownership, Points, Progression, Quests, Rewarded Schedules, Status, Instances, Easter Eggs, Leaderboard	Achievements, appointments, quests, loss aversion, rewarded schedules can create an environment where the team can have small objectives to accomplish. Doing that, they will be able to get bonuses, combos and points, that will affect their levels, status and the sense of progression and leaderboard. The Epic Meaning and ownership may create also a good environment for the work to do. Easter eggs and instances can create some "chaotic" things making the team leave the routine.
19	Lack of incentives	There's no extrinsic motivation for team members	There should be incentives from the company to generate motivation in the teams	Achievements, Bonuses, Combos, Levels, Points, Progressions, Quests, Rewarded Schedules, Leaderboard, Status	Team members can achieve some rewards, that could be "in game" or even real extrinsic rewards, for accomplishing some quests or seeking some achievements. That will affect their levels, status, progression and leaderboard.
20	Lack of Autonomy	Team members don't have autonomy to work	Team members must have autonomy to decide the best way to work on the problems	Discovery, Community Collaboration, Virality, Ownership	Discovery may give the team the idea of discover how to achieve better ways to work. Community Collaboration and Virality make the team members work together, and have their own opinions, to change the progression of work. Ownership can give the team members a reason for feeling like owning something special about the work.
21	Lack of Social Events	Team members don't have social events or spaces to build relationship	Foster the social events for helping the team to create an identity	Achievements, Quests, Appointments, Virality, Community Collaboration, Reward Schedules, Virality, Levels, Points, Leaderboard, Progression, Bonuses, Status	Having social events is important, so having achievements, quests, appointments and reward schedules that incentivize this stuff will be great. They will get bonuses and points for it, so it will affect their levels and leaderboard. Also, Community Collaboration and Virality are important to create a cooperation mechanism for them.
22	Lack of Monitoring	There's no monitoring from managers or team members in the work	Make managers be more present and give them this responsability	Community Collaboration, Virality, Achievements, Appointments, Quests, Bonuses, Points, Levels, Leaderboard	Community Collaboration and Virality can create the routine of participation by the managers. Also, achievements, appointments and quests are important to set some objectives where the monitoring is important. Doing that, the team members will be rewarded by bonuses, points, levels and leaderboard.
23	Lack of Training	Team members don't have training for the work to be done	Create a process to have training sessions for the team	Cascading Information Theory, Achievements, Quests, Appointments, Schedule Rewards, Points, Bonuses, Combos, Levels, Progression, Leaderboard, Status, User profile, Urgent Optimism	Cascading information theory can create a tutorial for the training. This also can be accomplished with achievements, quests, appointments and schedule rewards that will create step by step tasks to help team members train. They also will be rewarded by points, levels, combos, leaderboard that will update their status and user profile. Also, notifier can remind them to keep training. Urgent optimism is important to keep the team member with the feeling that they will accomplish the objectives
Cooperation					
24	No relationship between team members	Team members working alone, not talking to each other, not collaborating	Team members must talk to each other, sharing information and work	Achievements, Appointments, Bonuses, Points, Levels, Quests, Leaderboard, User Profile, Virality, Reward Schedule	Achievements, appointments and quests can be used to foster the relationship between members, by creating some specific tasks that will allow them to communicate. Also, reward schedule, bonuses, points, levels and leaderboard can create some rewards for these actions. User profile can be used to show more information about team members, to help them knowing each other. Virality creates the background to allow people to cooperate..
25	No relationship with stakeholders	Team members don't have access to users, clients and stakeholders	Stakeholders must be available to team members	Appointments, Community Collaboration, Epic Meaning, Ownership, Quests, Virality	Appointments and quests can be set up to help the team to synchronize actions with the stakeholders. Community Collaboration enable the stakeholders to take part in the problem solving, helping directly the results of the process. Epic Meaning and Ownership may boost the interest by the stakeholder in participating in the process, because they can see the value of that. Virality creates the background to allow people to cooperate.
26	Lack of Tools and Resources	Tools to facilitate the collaboration are not available or are not appropriated	Teams must have available the right tools for the work.	Discovery, Notifier	The team is able to explore and discover the best tools to achieve their work. Also, when they are stuck in something, they can generate a notification to ask for help
27	No Shared Work Space	Team members don't have a physical space to share	Team members must sit together and share the same information in most of the time.	Achievements, Appointments, Quests, Activity Feed	Achievement, appointments and quests can create situations where team members must share their work spaces to make information flow. Also, activity feed can help in awareness

28	Excessive Conflicts Between Team Members	Conflict between team members happens frequently	Team members must communicate better to avoid having conflicts that will affect the work	Achievements, Appointments, Bonuses, Points, Levels, Quests, Leaderboard, User Profile, Virality, Reward Schedule	Achievements, appointments and quests can be used to foster the relationship between members, by creating some specific tasks that will allow them to communicate. Also, reward schedule, bonuses, points, levels and leaderboard can create some rewards for these actions. User profile can be used to show more information about team members, to help them knowing each other. Virality creates the background to allow people to cooperate.
29	Lack of Knowledge Sharing	Knowledge doesn't flow in the team due to lack of moments and artifacts for knowledge sharing	Foster the knowledge sharing by improving awareness and communication	Achievements, Quests, Appointments, Bonuses, Levels, Points, Progression, Leaderboard, Virality, Community Collaboration, Loss Aversion	Achievements, quests and appointments are crucial to help create the routine of knowledge management. The rewards will come in form of bonuses, points, levels, etc. Community Collaboration and Virality also can help people to cooperate. Loss Aversion can make team members focus on maintaining the artifacts or communication in a specific timebox.
Group Formation					
30	Individual over teams	When individual goals are more important than the team goals	Team members must understand the importance of the team, seeking their personal goals by achieving the team goals.	Achievements, Blissful Productivity, Bonuses, Epic Meaning, Free Lunch, Levels, Points, Progression, Quests, Status, Virality, Activity Feed, Leaderboard, Reward Schedule	Achievements and quests can help create specific tasks that must be achieved in cooperation. This will give to the team members points and bonuses, that will improve their levels and improve their status and leaderboard. The blissful productivity combined with virality can make the team work together and hard, which will impacts directly the personal. Free lunch will give the member an opportunity to have rewards based upon the work of the others. Also, the activity feed can help team members to be aware of what the others are doing.
31	Lack of trust	Team members don't trust each other	Team members must know each other to start building a relationship	Achievements, Appointments, Quests, User Profile, Virality	Achievements, appointments and quests can be used to foster the relationship between members, by creating some specific tasks that will allow them to communicate. User profile can be used to show more information about team members, to help them knowing each other. Virality creates the background to allow people to cooperate.
Awareness					
32	Lack of Perception of Work in Progress	Team members don't have the perception of status, who is working on specific tasks, who to report, etc.Team members don't have the perception of status, who is working on specific tasks, who to report, etc.	Create an environment that fosters the perception of work by team members	Achievements, Appointments, Quests, Progression, Activity Feed, Notifier	Achievements, appointments and quests create the milestones where the work can be visualized, and also, the progression helps to see how far the work is made, and how much is pending. Activity feed and notifiers can also help the teams to be instantly aware of work.
33	Lack of Perception of Team Availability	Team members don't have the perception about team members' availability or status	Create an environment that fosters the awareness of team members	Status, User Profile, Activity Feed, Notifiers	Status and user profiles can have the availability of the team members. Notifiers and activity feed can help the team members to be aware of who is doing what, and if they are available or not
34	Lack of Sources to Help Awareness	There are no artifacts, documents or tools to help teams to maintain awareness	Create an environment that fosters the cooperation of documents by team members	Achievements, Appointments, Quests, Progression, Activity Feed, Notifier	Achievements, appointments and quests create the milestones where the work can be visualized, and also, the progression helps to see how far the work is made, and how much is pending. Activity feed and notifiers can also help the teams to be instantly aware of work.

might help foster collaboration in teams. These results were preliminarily evaluated by a group of experts who suggested improvements for a beta version.

Our preliminary evaluation was discussed with 5 experts only but given their level of expertise we consider this version stable enough to be used in our next steps. Also, given the limited number of empirical studies reporting how game elements are used in practice, we need to further explore how they can be effectively used, thus our experiment. Although this is an ongoing work, we believe that this initial version can be of use to both experts and researchers.

We are currently designing the second stage of our planned evaluation as previously presented: the experiment. We expect that this controlled activity will bring us new insights and a better understanding of how the framework can be used in practice. Also it may be interesting to analyze how each issue is related and how their interactions could be affected by the interventions of the game elements. The framework does not consider any software development areas or roles, and their specific collaboration issues. This might be interesting for future work.

As seen in the feedback collected until now, the framework has the potential to be a very interesting tool to be applied in work environments and help to minimize collaboration issues in software teams.

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