

**PONTIFICAL CATHOLIC UNIVERSITY OF RIO GRANDE DO SUL  
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**USING GAMIFICATION AS A  
COLLABORATION MOTIVATOR  
FOR SOFTWARE TEAMS**

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

# USING GAMIFICATION AS A COLLABORATION MOTIVATOR FOR SOFTWARE TEAMS

## 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 its work being based upon human-centric and brain-intensive activity in which the experience, motivation and discipline of developers represent crucial ingredients to achieve success. This research proposal presents the topics of motivation, collaboration and gamification in the context of software engineering, and discusses the opportunity to create a framework that could help fostering and augmenting collaboration in software development teams through the application of game elements.

**Keywords:** gamification, collaboration, software development, software team, motivation.

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## 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 [NBG<sup>+</sup>10]. In other words, software development demands a lot of cognitive effort of who is involved with it.

There are 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 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. In other words, they need to collaborate with one another.

But since software engineering have a high dependence with human factors (e.g., communication, trust building, negotiation, etc), a large number of issues faced during software development are associated to people [KSSS11]. Collaboration, in special, plays an important role in determining the success of a software project [KSSS11], so it is important to find ways to foster this aspect and motivate software teams to collaborate more and more efficiently.

Gamification is the use of game elements in non-game contexts [DDKN11], and its use became very popular in the Marketing area [Ste14], with several cases of behaviour changes and effectiveness reported, specially in websites and applications. It has also been successfully used in Education [BT13] [IDSDK14] [dSBDRI14] and in Health Care [LWC<sup>+</sup>14] [JMW14] [KSRV13]. Companies have starting using it given its promise of helping them to achieve their goals and to keep people engaged in their work [WC13].

This work proposes a research to identify, to map and to define a framework with the best practices to promote collaboration in software teams using game elements (gamification). The remainder of this proposal is organized as follows: Chapter 2 describes the motivation for this research; Chapter 3 presents the research goal and questions as well as the research objectives; Chapter 4 presents related work associated to gamification applied to software development resulting from an initial literature review on the topic; Chapter 5 describes the related concepts about this work; Chapter 6 presents the proposed research methodology that will guide this research; and Chapter 7 presents a detailed plan for the realization of the proposed research, including the work schedule, and a brief overview of the progress up to now.

## 2. MOTIVATION

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].

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 [Fun09], sponsored by company Volkswagen, 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 2.1.

Video games are also changing the traditional concepts about playing. An article from the 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]. In other words, video games can help children to develop and overcome cognitive and social challenges.

It is understood that one plays games because it is fun, enjoyable and also challenges one to go "deeper" in the related activity. Good games also makes one experience a state of fully focused and engaged in the activity itself [Csi91]. Therefore, it is expected that



Figure 2.1 – The Fun Theory Project

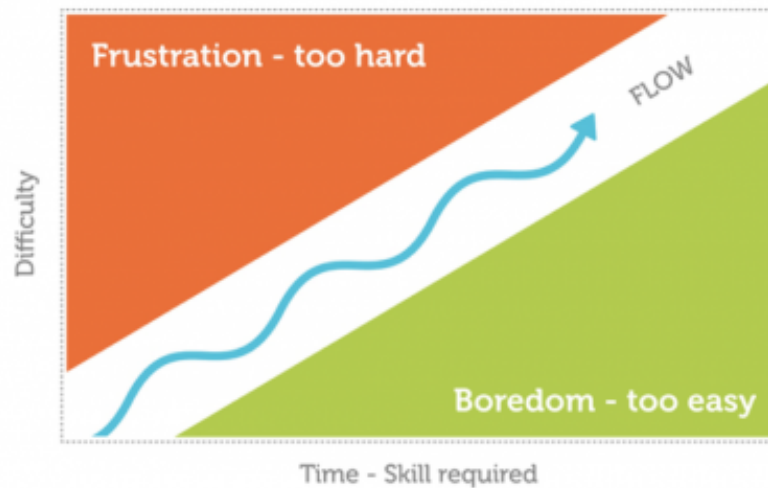


Figure 2.2 – The Flow Theory in Games (Source: [Csi91])

games should challenge one in a borderline between too hard and too easy, to create the engagement and fun that is desirable. This balance is represented in Figure 2.2.

In the last years, researchers started to study ways to bring this gaming spirit into other contexts and activities, using game elements and components as key factors to create a behaviour change. This is how the gamification idea has started.

*Gamification* is the use of game elements in non-game contexts [DDKN11]. An example is StackOverflow, a web-based question and answer website that has become one of the most successful social media resources for software developers. At StackOverflow users earn points for providing questions and answers that are voted on by their peers, and these points are aggregated to create the users' reputation on the site. Based on their points and the action they take, users can earn special privileges that empower them to, for example, promote good and demote unsuitable content on the site.

The use of gamification also attracted the attention of software organizations. These environments depends on knowledge, creativity and cognitive efforts to create software products, with quality and innovation. That is why motivation of software development teams - that is recognized to have the single largest impact on productivity and quality [BBH<sup>+</sup>08] - started to gain 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 improve the adoption of software engineering practices for developers [SS12] or to improve internal documentation in software projects [Pra11]. Other related work are presented in Chapter 4.

But another important factor for the success of software projects is the collaboration between teams members [GF11]. Collaboration, when two or more people work together



on a task [RS10], in software projects is essential for ensuring the team meets its goals. While software programming might seem an individual task, software development is a collaborative team effort with team members needing to spend considerable time interacting with each other [HM03]. Such collaboration involves, for instance, coordinating tasks, communicating tasks-related information, being aware of others and their related work, among others.

In the initial systematic review conducted in this work, I did not find any research on how to foster collaboration in software development teams using gamification as motivational strategy. Therefore, to fill in this gap, the goal of my work is *to understand, to identify, to map, and to propose a framework of best practices to apply gamification techniques to improve collaboration between software team members*. By achieving this goal, my work contributes to the body of knowledge of gamification at work environments.

### 3. RESEARCH GOAL AND QUESTIONS

This section presents the main research goal and associated research questions of my proposal as well as the related objectives to achieve the posed goal.

#### 3.1 Main Research Goal and Questions

The main goal of my work is to explore, to identify, to map, and to propose a theoretical framework of best practices for the use of gamification to foster collaboration in software development. To achieve it, I pose two research questions as stated below:

**Research Question 1 (RQ1):**

What are the most common collaboration issues in software development?

**Research Question 2 (RQ2):**

How can gamification reduce the impact of these collaboration issues and improve team members' collaboration experience in software development?

#### 3.2 Objectives

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

- a. To understand the concepts of gamification, game design and game elements;
- b. To understand the concepts of collaboration and motivation in software development;
- c. To understand 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 define a theoretical framework of best practices with the use of game elements to promote collaboration in software development teams.

**g.** To validate and to collect feedback about this proposed framework with practitioners who are experts in software development.

## 4. RELATED WORK

Gamification as a motivator 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, Health Care, and Design. This chapter analyzes studies on gamification applied to work environment and software development.

One of the first studies about gamification was conducted by Deterding et al. [Deterding2011] [DDKN11]. They defined gamification as the use of game design elements in non-game contexts. They stated that the term was not widespread adopted until late 2010. Later, some studies used the terms "productivity games", "funware", "playful design", among others to refer to the same idea of using games in non-game contexts.

Deterding et al study contextualizes the term gamification and creates a referential definition for it. For example, they clarify that gamification relates to games, not to playing. In this same study, they also characterized the term "game elements" or "mechanisms", explaining how to identify and then list these. The authors also offer an explanation about the differences between gamification and serious games. In sum, they state that gamification merely incorporates elements of games while serious games describe the design of full-fledged games for non-entertainment purposes.

Sheth, Bell and Kaiser [SBK11] did not use the gamification term, but 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). Basically, their purpose is that HALO represents everyday tasks as quests with social rewards to instigate players to achieve them.

Another study that use game elements but did not mention it as gamification is the one defined by Prause [Pra11]. His goal is to improve internal documentation in software projects since it is known that developers do not like to manage documentation. He purpose a prototype called CollabReview, which is a web-based reputation systems that analyzes artifacts and give social rewards to those who collaborate with the reviews.

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. He discusses in his work some thoughts about global shifts that would result in the adoption of gamification by the companies.

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. 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.

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 is composed of 4 steps, namely: identification of the main objective; identification of the transversal objective, selection of game mechanics, and analysis of the effectiveness. They did not evaluate the proposed metrics and the application of the method in real cases.

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. They conducted an experiment with 37 students and concluded that the experiment revealed some good points but that the adopted process could be improved to achieve even better results.

Lotufo, Passos and Czarnecki [LPC12] proposed a work to improve bug tracking systems using game mechanisms, to encourage team members to increase the frequency and the quality of their contributions. They used open source systems and found that most of the mechanisms are applicable to the context. They also investigated the Stack Overflow system to identify the game elements and tried to apply them in their study. As a result, they concluded that applying a formal reputation and reward system the improvements are readily accessible.

One interesting study was conducted by Mocozet 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. They described how they gamified the platform and, as a result, stated how it encouraged students to contribute and collaborate more.

Teh et al [TSJG13] proposed a theoretical model for task motivation and help-seeking through game mechanics. Their study shows that it is hard to create a potential gamified system using a "one size fits all" solution, so the model tests the efficacy of several alternative implementations of gamification artifacts based upon the profiles of the people involved in the activity.

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 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]. They presented the outcome of an online survey where they analyzed the users opinion about gamification in the workplace. Next, they analyzed the logs of a re-designed gamified enterprise system to compare the

employees' subjective perception of the concept. As a result, 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.

Knaving and Björk [KB13] argued that gamification should consider playfulness and also consider the focus of the main objectives of the activities. They presented some design suggestions and concluded that their guidelines could be the basis for creating gamification at work.

Kumar [Kum13] explained what is gamification, how can it be used in the workplace, and presented a collection of best practices that can increase the chance of success of enterprise gamification efforts, called Played-Centered Design.

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 approach to understand how the principles of game mechanisms may be successfully applied to the software development process. The authors did not answer how to design and to use gamification in this context, but presented a set of related challenges and a research agenda to help future work to explore more the topic.

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, but in the experiment only two of the six developers in fact adjusted their practices when presented with game elements.

Fernandéz-Luna et al [FLHRARC14] proposed an enhanced engagement to collaborative search systems using gamification. Collaborative search systems require to make sense of the information to achieve shared goals and reduce additional costs. The study presents a set of elements to gamify collaborative search systems.

Lounis, Pramataris and Theotokis [LPT14] studied the role of two game elements namely incentive type and community collaboration. They investigated the impact of these elements on user's experiencing fun during participation in a gamified service. Their results indicated that the selection of community collaboration as a form of interaction presents significant difference in experienced fun during participation, whereas receiving an incentive does not.

The gamification applied to software process improvement (SPI) initiatives was the subject of the study of Herranz et al [HPSY14]. They stated that most of SPI initiatives had failed due lack of engagement and commitment of the people involved. So they proposed a framework that is oriented to organization needs and team members involved with the SPI initiative. Since they did not conducted an empirical validation, their results are not consolidated yet.

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.

Oprea, 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. The principles have not been evaluated yet.

Amir and Ralph [AR14] created a theory that gamification success depends on the game elements that are employed and their effects on user motivation and immersion. They presented their theoretical model and concluded that they need some empirical testing to determinate its veracity.

Based on the results of before mentioned literature review, to the best of my knowledge there are only a few research work that discuss collaboration and gamification, but none of them make a in-depth analysis of how game elements can improve the collaboration in software development teams. This gives me the opportunity to better explore more the topic in the context of software development given the importance of collaboration to this kind of knowledge-based work.

## 5. RELATED CONCEPTS

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

### 5.1 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 5.1 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 difficult to deal with changes to the software 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 known idea of following an incremental and iterative process: the agile philosophy [Agi01]. That was the rising of frameworks like Extreme Programming (XP) and Scrum (illustrated in Figure 5.2), based upon delivering software in small amount of time and reconsidering the scope at each new development cycle.

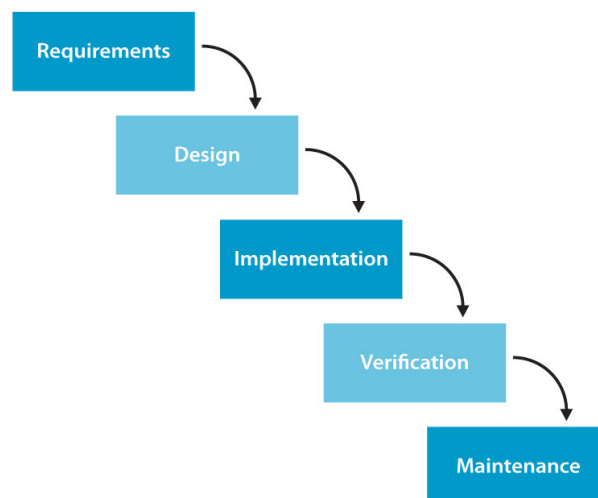


Figure 5.1 – Illustration of the Waterfall Process



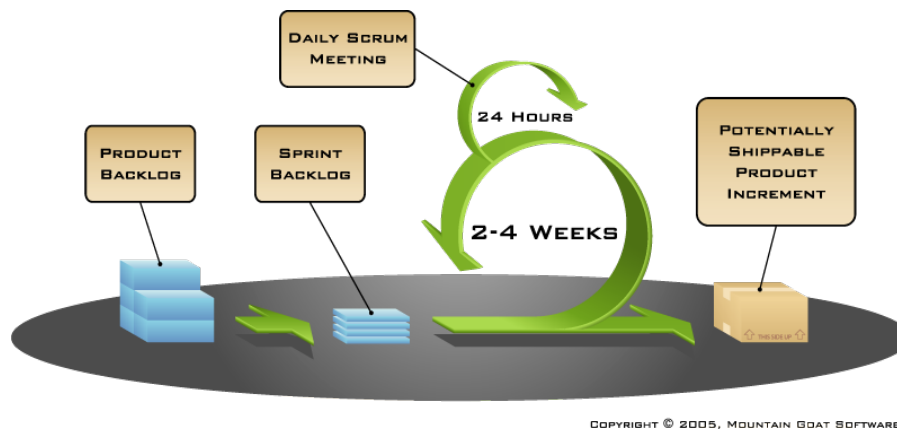


Figure 5.2 – Agile Software Development: Scrum Process

Besides these two different approaches, that represents two of the most used software development processes, all of them 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<sup>+</sup>10]. In other words, software development demands cognitive effort of who is involved with it.

Having people working in software projects as teams is one of the best ways to produce good 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. Team are embedded in an organizational context that sets boundaries, constrains the team actions, and influences exchanges with other units in the broader entity [KI06].

But given that software development is a knowledge-based activity that requires human interaction, researchers have been studying how human factors impact the progress of software development processes. For example, motivation - what prompts a person to act in a certain way [Wik14] - is reported to have the single largest impact on practitioner productivity and software quality management [BBH<sup>+</sup>08]. So, 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]. Zappos, an online shoe retailer, also invested in the creation of a culture that encourages the employees to "live the brand" [Rid11].

Motivation can be drive by internal or external forces. Intrinsic motivation refers to doing something because it is inherently interesting or enjoyable (for example, playing a game) and extrinsic motivation refers to doing something because it leads to a separable outcome (for example, money) [RD00].

Intrinsic motivation is being discussed in recent years as the focus to engage and motivate employees. Some authors explain that intrinsic motivation results in high-quality

learning and creativity [RD00]. Others discuss the advantages of intrinsic motivation compared to the traditional old-school external motivation of fear, money, and rewards [Pin09].

But besides motivation, another human factor that is quite important to achieve success in software development process is collaboration. Most modern businesses require their workers to establish collaborative relationships to achieve organizational goals [SAS<sup>+</sup>09]. Whitehead [Whi07] explains that one must work together to complete large projects in reasonable time, and have other people try to catch one mistakes. Kotlarsky and Oshri [KO05] explain collaboration as a complex, multi-dimensional process characterized by constructs such as coordination, communication, meaning, relationships, trust, and structure.

Kusumasari et al [KSSS11] explain that collaboration and coordination in software development project play an important role in defining the success of a software project. Treude, Storey and Weber [TSW09] stated that research on issues related to communication, collaboration 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.

As a conclusion, it noted that collaboration and motivation have a important aspect on software development teams, influencing directly the quality, productivity and success of software projects.

## 5.2 Gamification

The term gamification was first used by Nick Pelling [Fit13] in 2003 to describe his work as a consultant for making hardware 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 such as the Stack Overflow and Foursquare websites and conferences on the topic [DKND11].

Also, in 2010, Jane McGonigal's speech at TED [McG10] about how gaming can make a better world became very popular and was later used on her popular book "Reality is Broken" [McG11]. The book became popular for explaining why games could change the world, arguing that games contribute powerfully to human happiness and motivation, a sense of meaning, and the development of community.

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 (see Figure 5.3).

Gamification is different from its similar concepts like games - the characterization of rules, competition (or strife) towards specified, discrete outcomes or goals by human

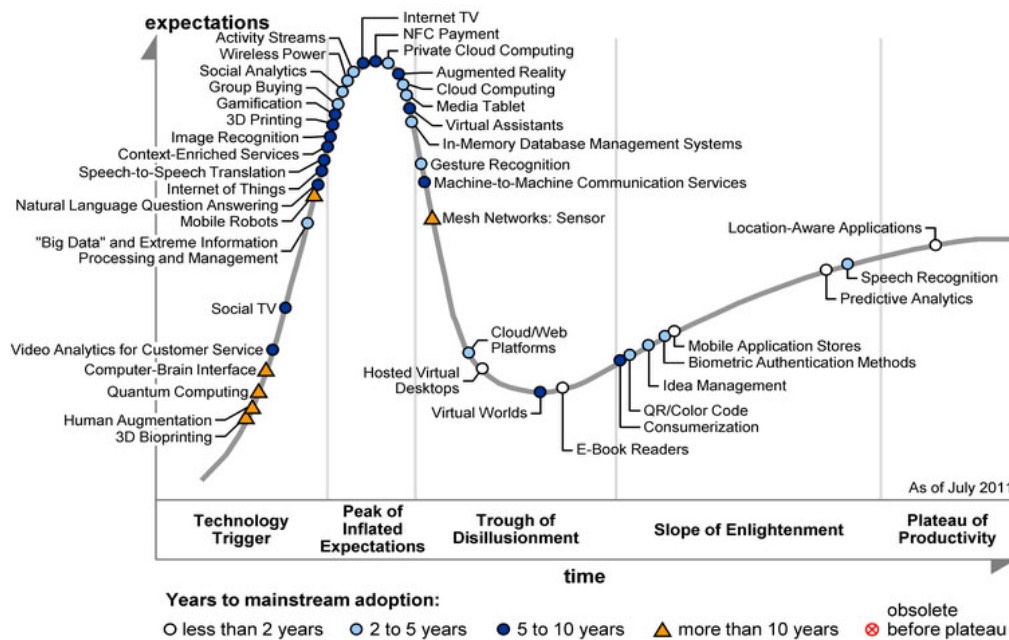


Figure 5.3 – Gartner HypeCycle, 2011

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].

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 most elementary gamification element consists of a rewarding mechanism that awards people in response of the accomplishment of certain activities (also known as challenges) that need to be encouraged [DT13].

In conclusion, gamification have a different context from its similar concepts. These differences are represented in Figure 5.4 below, proposed by Marczewski [Mar13b].

Gamification is based upon the use of game elements but in literature there is not a specific list of these game elements. Reeves and Read [RR09], for example, identified ten game elements, that are described as "ingredients of great games":

1. Self representation with avatars;
2. Three-dimensional environments;
3. Narrative context;
4. Feedback;
5. Reputations, ranks and levels;

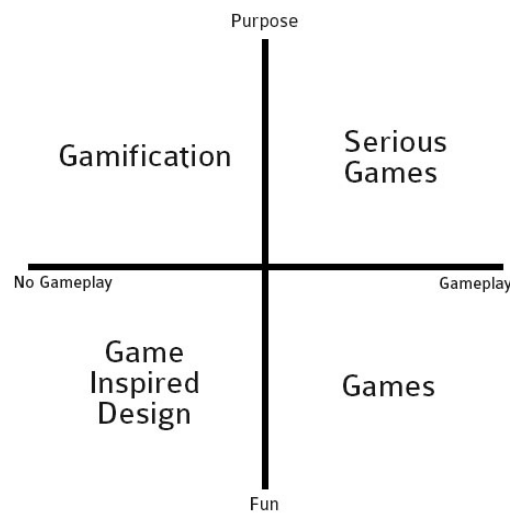


Figure 5.4 – Difference between gamification and similar concepts (Source: [Mar13b])

6. Marketplaces and economies;
7. Competition under rules that are explicit and enforced;
8. Teams;
9. Parallel communication systems that can be easily configured; and
10. Time pressure.

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].

Deterding et al [DDKN11] suggest restricting “gamification” to the description of elements that are characteristic 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.

Based on that, the company Badgeville [Bad14] created a collaborative wiki to list the game mechanics that are most common used in gamification resources. These following elements can be classified in three categories (behavioral, progression and feedback):

1. Achievements;
2. Appointments;
3. Behavioral Momentum;
4. Blissful Productivity;

5. Bonuses;
6. Cascading Information Theory;
7. Combos;
8. Community Collaboration;
9. Countdown;
10. Discovery;
11. Epic Meaning;
12. Free Lunch;
13. Infinite Gameplay;
14. Levels;
15. Loss Aversion;
16. Lottery;
17. Ownership;
18. Points;
19. Progression;
20. Quests;
21. Reward Schedules;
22. Status;
23. Urgent Optimism; and
24. Virality.

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]. 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].

## 6. PROPOSED RESEARCH METHODOLOGY

To achieve the posed research goal, I proposed a qualitative-based research organized in four main phases as presented in Figure 6.1. Each phase is described next.

### 6.1 Phase 1: Literature Review

The main goal of Phase 1, named Literature Review, is to further knowledge on the related topics to this work. Hence, systematic literature reviews will be conducted in the following topics: motivation, collaboration and gamification, focusing in Software Engineering. The original goal for employing systematic literature review was to support evidence-based Medicine, and many guidelines reflect this viewpoint [KC07]. The review helps to collect evidence that the research questions were not answered yet by other studies.

Having all these subjects grounded, the next step will be to make a field research with practitioners that work with software development to explore the topics as they are perceived in practice as presented next.

### 6.2 Phase 2: Exploratory

Phase 2, named Exploratory, will be based on interviews with practitioners about collaboration and gamification. Interviews are often used to collect historical data from the memories of the interviewees, collecting opinions or impressions about something [Sea08].

With the use of this data collection technique, the goal of this phase will be to understand the practitioners perceptions about collaboration and gamification, their related issues and potential solutions and best practices. Data collected will be transcribed, analyzed, and

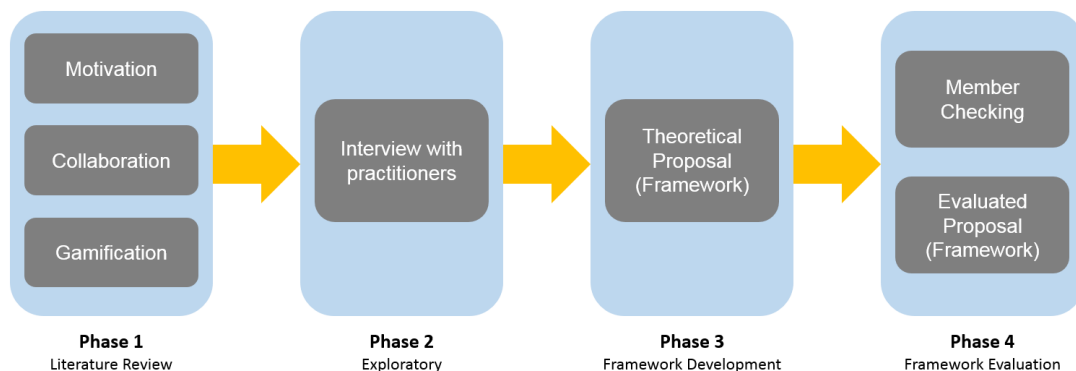


Figure 6.1 – Proposed Research Design

consolidated in a document as a result of this exploratory stage. Then, I will contrast the results of this empirical field study with those found in literature to use as foundation for the framework development, described in Phase 3.

Participants for the interviews will be selected from developers and managers from software development companies based in Brazil, mainly those located in Porto Alegre where my Graduate Program is hosted. The interviews will be conducted face-to-face when possible or by the use of Internet resources if the participants is located in another city. The interviews will be based on a semi-structured script and will have open questions that will allow the participant to express her perception about the related topics.

### **6.3 Phase 3: Framework Development**

Based on the data gathered from the two precedent phases, I can then propose the before mentioned theoretical framework in Phase 3, named Framework Development. The goal of this phase is to map the motivation and collaboration issues identified to the game elements and gamification suggestions proposed, drafting a first version of the framework.

The proposed framework will be written as a best practices guide that will point out the game elements and mechanisms that can impact positively in each one of the most common collaboration problems identified in the previous stages. Each one of the proposed best practices will have a set of actions that will guide the users to implement and adopt them. The idea is that the framework works as a guide to practitioners.

It is a common understanding in the software development market that it is hard to achieve a "one size fits all" solution since each organization has its personal contexts, cultures and individuals. So, one important concern of this proposal is how generalizable the framework will be so that it can be used by any software organization.

### **6.4 Stage 4: Framework Evaluation**

The final phase, Phase 4, named Framework Evaluation, aims to validate the proposed framework. This evaluation will take place using the member checking technique [Sea99]. This technique is particularly well suited to most studies of software engineering, getting feedback on the findings from the subjects who provided the data in the first place [Sea99]. This is specially important when the results of the study may change the way the subjects will be expected to do their jobs.

The same practitioners that previously participated in the interviews (in Phase 2) will be invited to evaluate the draft version of the framework. I will present the framework

and will invite them to analyze, review, provide feedback about the proposed best practices and associated actions.

The feedback provided by the participants in this phase will be used to refine the draft version of the framework. A second and final version of the framework within the limits of this work will then be the outcome of this phase.



## 7. DETAILED RESEARCH PLAN AND CURRENT PROGRESS

The following sections present the planned activities, schedule and the research progress so far.

### 7.1 Planned Activities and Schedule

Below, I present the detailed plan (activities) for each of the proposed research phases that address the posed research goal and questions.

#### 7.1.1 Phase 1: Literature Review

**1.1 To create the protocols for the systematic literature reviews.** These protocols will contain keywords, criteria and directions for the systematic literature reviews about motivation and collaboration in software engineering.

**1.2 To map and to identify issues related to collaboration and motivation.** I will map and identify the most cited issues related to collaboration and motivation in software development based on the results of the literature reviews mentioned in the Activity 1.1.

**1.3 To map and to identify game elements.** I will map and identify the literature results about the aspects and characteristics of gamification applied to software engineering.

**1.4 To consolidate the results of this phase activities in a single document.** A document summarizing the findings of each activity be created to register the information gathered about the related topics.

#### 7.1.2 Phase 2: Exploratory

**2.1 To identify practitioners.** For the interviews, the first activity should be identify the practitioners that have any level of experience with software engineering, collaboration and gamification. I will define expected profiles and the sample to be used in this research.

**2.2 To create the first draft of the interview script.** It is important to create a first draft of the semi-structured interview script about motivation, collaboration and gamification. Also, I have to draft the consent document, prepare recording equipment, and an introductory document to introduce myself and the research to the prospective participants.

**2.3 To pilot and validate the interview script.** The first two interviews should be scheduled and focus on piloting the script and validating it. I will also use this activity to learn how to take notes during the interviews and improve the data collection process as a whole.

**2.4 To create the final interview script version.** Once I have piloted and validated the interview script draft, I can then review the provided feedback and generate a final version of the interview script.

**2.5 To schedule and to interview the participants.** Next, I will schedule the interviews and interview the practitioners using the final version of the interview script. I will record each interview and collect the participants' authorization for the use of the data collected.

**2.6 To transcript and to analyze the interview transcripts.** With the interviews recorded, I can then transcribe the audio and increment with the notes taken. Later, I will then analyze the data collected and start to organize the data collected.

**2.7 To consolidate data and write a paper.** With all the data collected, transcribed and analyzed, I can consolidate and transform these data into information. These information will result in a paper about the results discovered by these exploratory stage of the research (Phase 2).

### 7.1.3 Phase 3: Framework Development

**3.1 To consolidate literature and practitioners data.** Having the results collected from interviews and from the systematic literature review, an informal document will be written having the consolidation of the findings about collaboration, motivation and gamification, in software engineering.

**3.2 To map the game elements and collaboration issues.** The consolidated document will help in the mapping of the game elements that best fits to each collaboration issues identified. And this will be the basis of the proposed framework.

**3.3 To structure the framework.** The framework with best practices about gamification to foster collaboration in software development teams should be created. The idea is to find the best representation of the framework to be easily used and understood by any software company.

#### 7.1.4 Phase 4: Framework Evaluation

**4.1 To contact previous practitioners.** The evaluation of the framework should be done by the same practitioners that were interviewed in Phase 2, therefore I will contact the participants and invite them to contribute once again.

**4.2 To create the first draft of the interview script.** I will create a first draft of the semi-structured interview script to evaluate the proposed framework. Also, I will review the consent document to address any specific reference to the evaluation process if necessary.

**4.3 To pilot and to validate the interview script.** I will pilot and validate the interview script following the same process as the one described in Activity 2.3.

**4.4 To create the final interview script version.** Similarly to activity 2.4, I will here generate the final version of the interview script to be used in the interviews that aim to evaluate the framework.

**4.5 To schedule and to interview the participants.** Next, I will schedule the interviews and interview the practitioners using the final version of the interview script. I will also record each interview and collect the participants' authorization for the use of the data collected similarly as done in Phase 2.

**4.6 To transcript and to analyze the interview transcripts.** With the interviews recorded, I can then transcribe the audio and supplement with my notes if necessary. Next, I will analyze the data collected.

**4.7 To consolidate data and refine the framework.** With all the data collected, transcribed and analyzed, I will refine the draft version of the framework.

**4.8 To write a paper on the final results.** Once I have finished the evaluation process then I can report on the final version of the framework. I intend to write a paper presenting the framework and its development process.

#### 7.1.5 Additional Activities and Documents

**5.1 To write and to present the Seminar.** The seminar is a document about the ongoing and current stage of the research. It is mandatory in the Master's program at PUCRS. I should report on Phase 1 and Phase 2, which should be completed by the expected presentation time of the Seminar as presented in the Schedule (see Table 7.1).

**5.2 To write the Dissertation.** The Dissertation consolidates the results of the conducted research and should be presented by the end of the Master's program. I should be writing it as presented in the Schedule (see Table 7.1).

**5.3 To defend the Dissertation.** I will defend the Dissertation right after writing it. The date is still to be agreed among the Supervisory Committee members and approved by the Graduate Program Coordination Committee. Table 7.1 indicates an estimated period for the defense.

#### 7.1.6 Planned Schedule

Table 7.1 presents the planned schedule for the activities listed above, including the additional documents.

Activities	Months (2015-2016)													
	Jan'15	Feb'15	Mar'15	Apr'15	May'15	Jun'15	Jul'15	Aug'15	Sep'15	Oct'15	Nov'15	Dec'15	Jan'16	Feb'16
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4.4														
4.5														
4.6														
4.7														
4.8														
5.1														
5.2														
5.3														

Table 7.1 – Planned Schedule for the Proposed Activities

## 7.2 Current Progress

The proposed research in this document is under development since June 2014. The work has started with an overall literature review about gamification. A systematic literature review was then conducted to complete the initial review to guarantee that all papers

and research work related to the topic have been covered. Also, online presentations, training and college courses as well as several videos related to the topic were analyzed to help furthering knowledge on the topic. The results of this initial study and the literature review is summarized in Section 4.

I am currently developing the protocols for the systematic literature reviews on motivation and collaboration in Software Engineering. My initial search for material on motivation has indicated that there are several studies and systematic reviews on motivation in the area, and as such I might be able to use these studies as a baseline for my own review. I will also, next, update my systematic review on the gamification topic since given its novelty it is likely that new studies are being published month after month in peer reviewed scientific journals and magazines.

I should also shortly start planning the interviews listed in Phase 2 and follow the proposed schedule (presented in Table 7.1).

I had a paper recently accepted at the "Doing CSCW Research in Latin American: Differences, Opportunities, Challenges, and Lessons Learned" workshop at the Computer-Supported Cooperative Work and Social Computing Conference (CSCW '15) to take place in Vancouver, BC, Canada in March. The paper is entitled "Studying Gamification as a Collaboration Motivator for Virtual Software Teams: Social Issues, Cultural Issues, and Research Methods" and is co-authored with several researchers studying collaboration issues in software engineering. The camera-ready copy of the paper is available in Attachment A.

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**ATTACHMENT A – Paper Accepted at the LA@CSCW 2015 Workshop**

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# 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.

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ACM xxx.

### 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<sup>1</sup>, 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

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<sup>1</sup> <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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