

# Leveraging motivational theories for designing gamification for RE

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**Abstract**—Requirement engineering (RE) presents several challenges stemming from the required collaboration and knowledge transfer between analysts, developers and customers. Motivation theories have been used occasionally to analyze and encourage motivation and engagement of stakeholders in RE tasks. In recent years, gamification techniques have been used in software engineering tasks, and in some cases, in RE tasks in order to promote stakeholder engagement. This paper presents a preliminary literature review that was conducted in order to model correlations documented in literature between RE tasks, stakeholder motivation and engagement, and gamification. The preliminary findings show promise for conducting a full systematic literature review (SLR) in order to complete modeling existing evidence-based literature. The SLR and the emergent model will set the grounds for a research agenda toward an exhaustive model that will offer guidance for designing gamified environments for different RE tasks, based on motivational and behavioral factors.

**Index Terms** — Requirement Engineering, Gamification, Motivation, Engagement.

## I. INTRODUCTION

Stakeholders involved in requirements engineering (RE), taking part in ongoing communication and collaboration processes, include customers, managers, developers, and more. The RE process requires knowledge sharing and collaboration between different stakeholders, varying in their backgrounds and technical knowledge. The process of eliciting requirements and specifying them in a way that is coherent to all stakeholders is complex and effortful; it introduces challenges stemming from the required high customer engagement and continuous communication between the development team and the customers[8].

Engagement is described as reflecting “a person’s active involvement in a task or activity” and can be expressed in behavioral and in cognitive aspects [1]. Previous research addressed the challenge of engagement in SE tasks [9], and

proposed solutions to facilitate high engagement of the different stakeholders in the RE process and an ongoing communication between them typically focus on user involvement (e.g., [9][17]). Some solutions have recently employed the idea of gamification, which has been receiving increasing attention and considered of high potential in this context (e.g., [6]). Gamification was also found to improve user motivation in performing SE tasks [5][11].

Literature reports on various attempts to gamify different processes of software engineering (SE) in general [5][7], and of RE in particular [6][11]. However, additional research is required in this area to substantiate and fulfil the potential of gamification. Moreover, while these efforts show promise for improvements, the field of SE is yet to provide a systematic approach for leveraging gamification for improving SE.

This ongoing research focuses on the field of RE, with the objective to understand how gamification techniques can be used in RE processes for encouraging and guiding productive behavior contributing to their successful completion. As a first step toward addressing this objective, and while acknowledging that gamification aims to invoke motivation and engagement [4], we set out to answer the following questions: (1) What RE tasks may benefit from increasing the motivation of their executors? (2) What gamification techniques affect motivational aspects? (3) What gamification techniques affect observed behavior?

The answers to the above questions will enable constructing a model linking between RE tasks and the gamification techniques that may be effective for enhancing these tasks, using motivation theories as mediators. This model will thus provide a structured guidance for designing gamification solutions for RE tasks based on existing accumulated knowledge, as well as a research agenda for completing the knowledge that is not yet available.

Thus far, a first round of literature review was conducted, in order to provide a preliminary answer to each of the above-listed questions. For question 1, we looked for research on RE and related motivation analyses, focusing on research works that examined performance of various tasks in the RE process, building on motivation theories. For questions 2&3, we looked for research examining the use of gamification in contexts relevant to ours. As gamification research is relatively new, we broadened the review to include research works of using gamification in SE as well as RE to allow for a rich set of data.

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In this paper, we present the preliminary results of the literature review conducted so far, and discuss the potential contribution of a comprehensive, systematic literature review to be completed in the next of step of the research.

## II. BACKGROUND

### A. RE current challenges

A major concern of the current RE practice is collaboration. Specifically, many recent research works have focused on the potential of user involvement to enhance the quality of requirements [2][8]. Users' role in software development can be informative, consultative or participative, according to their level of participation in the process [3]. In the informative role, users are mostly providers of information and objects of observation; in the consultative role, users can comment on predefined design solutions; and finally, in the participative role, users actively take part in the design process and have decision-making authority regarding the design solution. Importantly, involvement of users in early stages of the RE process enhances the product quality [9].

These practices comply with the agile manifesto, which is widely practiced in the SE industry, and are becoming increasingly common in various types of software companies. Using agile practices has led to solving many challenges of traditional RE. However, performing RE according to the agile principles is still an evolving craft. Inayat et al. [8], conducted a systematic literature review in order to understand what the main characteristics and challenges in agile RE are, and identified communication with the customers as a critical factor contributing to the success of RE. Another key issue they found was requirements change management, because requirements elicitation in agile development is usually based on user stories, which are frequently changing. Therefore, requirements are validated usually through prototyping, and documentation hardly takes place. The customer involvement is key, as the customer provides user stories, which are usually the sole source of product requirements. The customer is also responsible of requirements prioritization, which determines the timetable of the development [8].

With the current common practices of RE, user involvement is highly important and, when not achieved, leads to underperformed RE tasks resulting in lower quality of the software product. Thus, providing platforms facilitating and promoting user engagement in RE is of high importance.

### B. Gamification and its implications for SE

Gamification is defined as "the use of game design elements in non-game contexts" [4], and refers to the use of techniques taken from games in order to encourage individuals to participate in certain tasks and contribute to their success. In recent years, various gamification elements have been embedded in different information systems and applications in general and, more recently, in applications intended for the use of software engineers in particular.

Many of the research works concerning gamification in SE have thus far been mostly examined empirically among students (e.g., [14][15]), with several recent examples among

practitioners (e.g., [9]). For example, one effort to encourage students to use version control using gamification included a social software application, mainly using the notification feature [15]. The researchers reported that using the social features was helpful for many students in achieving an overall understanding of their project. Research was also conducted in the context of using gamification starting at early stages of software development. For example, gamification was used in virtual teams during requirement elicitation, and was found to assist the teams to locate experts and share their knowledge [13]. Dubois and Tamburrelli [5] identified three types of activities needed to be performed when engaging gamification into SE: analysis, integration, and evaluation, and found that students performing these activities had better results in SE.

These research works have mostly focused on measuring the outcomes of embedding gamification techniques in SE processes [5][9][13], but not in revealing the factors leading to motivation and productive behavior among software engineers. In RE, gamification was mainly researched with regard to the early phase of requirements elicitation, and with no special attention to the individual influence of different gamification techniques, or of the combination thereof, on the results.

Much of the research in this area has so far focused on creating gamified tasks, and analyzing their motivational contribution post-implementation. Fulfilling the potential benefits of gamification requires more consideration of the various motivation theories when designing gamified environments [13].

### C. Motivation theories and gamification

Gamification techniques are designed to enhance motivation among participants in the gamified environment. Therefore, it is to be expected that when designing such a mechanism, motivation theories would be considered. Recently an understanding has emerged that these theories should be used for the analysis of the success or failure of gamification techniques [13]. While motivation theories have been used as a basis for game mechanics for several decades, only few empirical attempts explicitly used motivation theories as a mechanism to understand and analyze game players' behavior [13]. This research-in-progress aims at analyzing existing literature on motivation and gamification, and propose a research agenda toward bridging this gap in the field of RE.

## III. LITERATURE REVIEW – PRELIMINARY FINDINGS

### A. An overview

The literature review conducted thus far was not executed according to the principles of systematic literature review (SLR). Rather, a more exploratory, initial search was conducted in order to grasp a first understanding regarding the research questions and the kind of information relevant search could reveal. Since a full SLR research is highly demanding in time and effort, we found it important to first test the water and assess whether perusing this direction of research has merit.

The following sub-sections describe the preliminary search conducted, the results obtained, and a first conceptualization

based on these results. Based on the search attempts and the preliminary findings, we now have a better picture of what we can expect from conducting the full SLR research, as will be elaborated on in the next section.

### B. Motivational and behavioral factors in RE

The main goal of this part of the literature review was to examine whether the literature addresses motivation-related issues in the context of underperformed tasks of RE. The search was conducted in Google Scholar. Google Scholar is acceptable as an exclusive source for reference and cited-by information, in the domain of software engineering [18].

Our criteria for paper inclusion were (a) reported empirical studies, and (b) examination of motivational aspects in RE tasks. Following several attempts to accurately define the search so to identify relevant papers accordingly, the following query string was used as a first screening: “requirement engineering motivation empirical”. This search yielded about 288,000 results in Google Scholar.

Reviewing the first 50 results obtained, only 12 papers were found eligible to be included in the literature review, according to the inclusion criteria listed above. Reviewing results 51-100 yielded no relevant papers, and we therefore did not continue, at this stage, to review results beyond the first 100 listed. Of the included papers, some discussed the behavioral aspects of motivation, and some discussed its cognitive aspects. Fig. 1 maps the topics investigated in these papers to behavioral and cognitive elements, and to the context in which they were investigated in terms of the RE stages (according to [16]). For example, commitment was investigated in the context of performing feasibility study in RE, in order to understand whether the commitment of the experts performing feasibility study is an important factor influencing its success [9R].

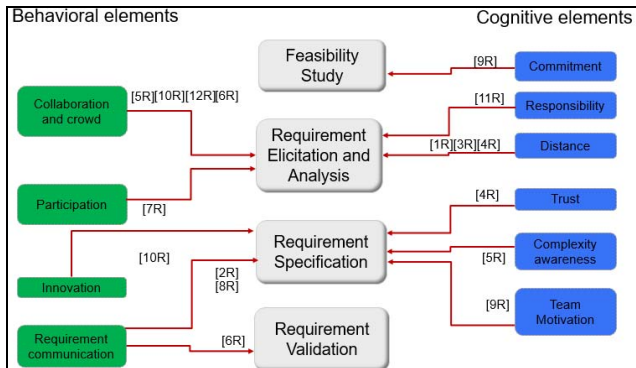


Fig. 1: Cognitive and behavioral motivation elements in RE<sup>1</sup>

Six different cognitive elements related to motivation were examined with regard to RE tasks in the reviewed papers. Most of these elements were examined in the context of elicitation and specification, and one element (commitment) was examined in the context of feasibility study. Examining behavioral elements was performed mostly in the context of

elicitation, in which the work process is more easily monitored and controlled. Some of the papers addressed specification, and one examined communication in the context of validation.

As evident from Fig. 1, different cognitive and behavioral elements of motivation were examined in the context of various RE tasks. However, these research efforts seem to be performed in silos, with no commonly agreed upon theory or ontological framework to systematically guide these efforts and their outcomes.

### C. Gamification, motivational and behavioral factors

This part of the literature review aimed at reviewing research works, which examined the associations between gamification techniques and motivational affordances. The main goal of this step was therefore to examine which different gamification techniques are associated with motivational affordances, and which gamification techniques, if any, were examined separately to isolate their individual correlation with, or effect on motivation or behavior. Here, too, the search was conducted via Google Scholar, using the query string: “gamification motivation empirical”, yielding 127,000 results.

Our criteria for paper inclusion were (a) reported empirical studies, and (b) examination of associations between using gamification in any performed business task, and motivational factors. We decided to exclude papers reporting on gamification designed for education purposes, but rather include only gamification for tasks in the workplace, as motivational aspects in educational and work settings differ significantly. In some cases, where the gamified tasks were designed in the context of an organizational task related to SE (such as requirements elicitation or testing), we did include gamification studies with university student participation.

Thus far, over 80 papers were reviewed, 50 of which were found to be addressing both motivational affordances and gamification techniques. Some of the research works discussed the behavioral aspects of motivation, and some discussed its cognitive aspects. Fig. 2 presents the mapping between investigated gamification techniques and their correlations with motivational affordances.

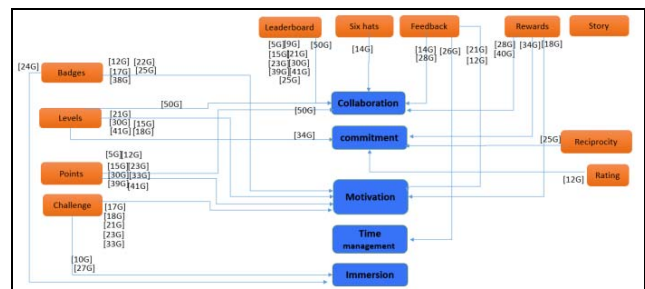
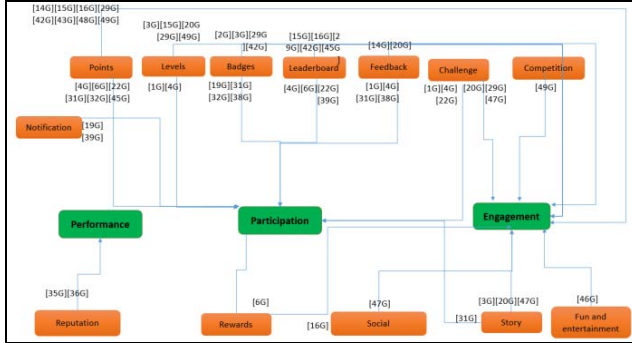


Fig. 2: Gamification and cognitive elements of motivation<sup>1</sup>

As shown in Fig. 2, most reviewed papers addressed the elements of commitment, collaboration or (directly referring to the term) motivation. Several papers discussed immersion, but only with regards to fun, an inconclusive and subjective term [12]. Importantly, most gamification techniques were not discussed with regard to their synergy with other techniques.

<sup>1</sup> Papers cited on arrows are listed in:  
<https://sites.google.com/site/naomiushpigel/gamification>

Fig. 3 presents the mapping between investigated gamification techniques and their effect on behavioral elements. The reviewed papers addressing behavioral elements were almost inclusively focused on participation or engagement, two highly related concepts. Out of the 50 papers, only two referred to metrics of performance, thereby relating directly to the *quality* of the contribution of the participants.



**Fig. 3:** Gamification and behavioral elements of motivation <sup>1</sup>

#### RESEARCH AGENDA

Following the findings of the preliminary survey, we intend to perform a full SLR. The SLR will be based on the previously described queries, but will be possibly widened, depending on the results of the full review as well as identifications of relevant papers using additional search techniques, such as the snowball technique, eliciting additional relevant key terms.

The full paper set will serve as a basis for mapping empirically based evidence for the use of different gamification techniques in order to increase motivation and engagement in the performance of RE tasks. Our goal is to construct a model that ultimately associates RE tasks and gamification techniques, with motivational theories as mediators.

#### IV. CONCLUDING REMARKS

As a basis for a strategic approach for designing gamification for RE, we propose to construct a model associating RE tasks with motivational factors, and motivational factors with gamification techniques. This evidence-based model will serve as association-based mapping between gamification and RE, mediated by motivational factors. It will enable to leverage on the progress of general gamification research to guide RE gamification efforts, directing empirical research on gamification in RE. As the model evolves, it will provide guidance for designing gamification solutions for different RE tasks, according to motivational needs. This will allow for more systematic and informed efforts of enhancing RE via gamification.

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