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# A method to support gamification design practice with motivation analysis and goal modeling

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**Abstract:** Gamification has been trending in both the academic and industrial domains for around half a decade with gamification design as one of the main focusing perspectives of the contemporary gamification research. The majority of gamification design studies focus on proposing the design frameworks that guiding the design process. However, a limited number of them contribute to the specific methods or techniques that connect the designers and the developers of the gamification information systems, with mindsets of both parties taken into account. This study proposes a method of supporting the gamification design practice with the combination of gamification motivation analysis and goal-oriented requirements engineering modeling techniques.

**Keywords**: Gamification, Design, Method, Motivation, Goal, Modeling, Requirements

## 1. Introduction

Gamification is one of the commonly adopted motivational designs, which support the users' goal achievement with motivational enforcement (Hamari et al., 2018). Particularly, gamification is defined in the way that emphasizes its influence on people's motivation rather than hedonic experiences and behaviors (Deterding et al., 2011; Huotari & Hamari, 2012; Hamari & Koivisto, 2013). Thus, gamification, as well as motivational design, requires the deepened understanding of human motivation; after all, simply making things more fun will not guarantee to achieve the goal of gamification (Rigby, 2015). The intrinsic motivation theories, the self-determination theory (Ryan & Deci, 2000), and the flow theory (Csikszentmihalyi, 2000) have been widely referred to as the backbone of motivation studies regarding gamification. Though their importance is repeatedly emphasized, such theories require a specified implementation technique to ensure their effectiveness.

Gamification design research is one of the main focusing perspectives of the maturing gamification studies domain (Nacke & Deterding, 2017). Therein, many studies propose various frameworks as the guidance of gamification designers towards successful gamification products and solutions in the particular domains (Mora et al., 2017). Despite the fact that motivation analysis is a critical part of the majority of the frameworks, seldom do they introduce the design methods and techniques that explicitly specify the needs of the users and the way to motivate them to achieve such needs with gamification. Gamification is a process of facilitating the utilitarian outcomes of systems towards self-purposefulness with proper and effective motivational affordances (Hamari et al., 2014; Hamari, 2015). Thus, gamification design shall incorporate and optimize both system design and motivational design mindsets. However, one of the current issues in gamification design practice is the disconnection between the gamification design ideas from the domain experts and

the implementation practice of the developers (Herzig et al., 2013). Thus, such methods that facilitate both the requirements (for utilitarian design) and motivation (for gamification design) analysis of gamification information systems are needed.

In this study, I propose a method of adapting the goal-oriented requirement engineering technique with a goal modeling language in the context of gamification system design. It aims to facilitate the gamification design practice regarding the connection between utilitarian requirements elicitation and motivation analysis. The remainder of this paper is organized as follows. Section 2 introduces the related works concerning the other proposed gamification design frameworks and the use of modeling languages in gamification design. Section 3 introduces the method. Section 4 provides an example of using the design method in gamifying a language learning system. Section 5 concludes the paper.

## 2. Related Work

The previous studies on the gamification design frameworks provide a various combination of guidelines, where particular activities are recommended as critical to successful gamification design. For example, Di Tomasso (2011) proposes "a framework of success" including seven steps for gamification design. Therein, he indicates that the designers shall take into account the goals of the business, the users' needs, and the motivational drivers. Kappen and Nacke (2013)'s Kaleidoscope of Effective Gamification emphasizes the importance of motivating user behavior with autonomy, competence, and relatedness. In fact, many studies on gamification design frameworks propose a series of key activities as frameworks in a similar fashion (Werbach & Hunter, 2012; Aparicio et al., 2012; Marczewski, 2013). Such activities include objective analysis, behavior analysis, user profiles, game elements selection, prototyping, implementing and maintenance. Although such design frameworks provide useful guidelines concerning the design process, they all fall short addressing the issues in connecting gamification design with the utilitarian requirements of the systems, specifying how and why it works that way. Comparatively, Morschheuser et al.'s design method (2017) provides a waterfall-like process model with seven steps. The study emphasizes the importance of identifying project objectives and user motivations. However, the objective analysis focuses on the level of project scope and vision when the specification of the connection between the objectives and the motivation is not further illustrated.

For such purposes, modeling languages are used as tools for the specification and documentation regarding gamification design, facilitating the design frameworks in specifying the system requirements and supporting the information transition from the designers to the developers. The gamification modeling language (GaML) provides a set of syntaxes that contains the hierarchy of gamification feature element classes, the instance of which is denoted as a set of pseudo-codes which the developers shall better understand (Herzig et al., 2013). The User-Action-Rule-Entities-Interface (UAREI) connects formal modeling of gamification design and quantitative mechanic simulation, which facilitates the analysis and evaluation of gamification mechanics use (Ašeriškis et al., 2017). Both methods contribute to the design specification connecting gamification elements and system features. However, they lack the connection between motivation affordances and the users' utilitarian needs of the system.

## 3. Support Gamification System Design with Goal-oriented Modeling

Goal, in the context of requirements engineering, is an objective the target system shall achieve, explaining why the system is implemented this way (Van Lamsweerde, 2001). Goal-oriented

requirements analysis is to address the understanding of why a certain feature of the system is needed and how the certain feature satisfies the needs of various stakeholders (Lapouchnian, 2005). Regarding a gamification system, its goals reflect and comply with the goals of its users, who are stimulated with the implemented motivational affordances. Therefore, the core of gamification design is to provide smooth combinations of the utilitarian-goal-satisfying system features and motivation-driving gamification features. Using modeling techniques facilitating analyzing goals in the requirements engineering practice is important, as goal modeling can provide a convenient way assuring the completeness, traceability, and conflicts management of system requirements (Van Lamsweerde, 2001).

To support the motivation analysis of gamification design practice with goal modeling language, the key activity is to use it as a tool to decompose high-level goals and motivations and to document the hierarchic mapping between the system goals and motivational affordances. Based on such mappings, as well as the specified tasks connected with system goals, mechanics and dynamics can be designed accordingly via the combination of system features that enable such tasks and the affordances that drive such motivations. Such goal decomposition or refinement is usually straightforward (Antón et al., 1994) when such activity is facilitated by using models to identify the functions necessary for particular achievements (Sutcliffe & Maiden, 1993). Therefore, the process of this method can be briefly described as the following steps.

**1) Decompose motivation and connect with affordances**

From the highest abstraction level downwards, motivation can be decomposed into intrinsic and extrinsic motivation. Extrinsic motivation can be further decomposed into the classic categories including, external regulation, introjected regulation, identified regulation, integrated regulation when intrinsic motivation can be considered from the perspectives of sources, i.e., autonomy, competence, and relatedness (Ryan & Deci, 2000). Such decomposition shall continue until specified affordance designs are connected accordingly. For example, "*the user shall receive a particular title when he/she accomplish a task*" is a specified gamification design. Its motivation hierarchy is seen as *intrinsic motivation -> competence -> positive feedbacks -> feedback with achievements -> give the user titles as achievements*.

**2) Decompose system goals and connect with features**

The utilitarian requirements of the target system are elicited similarly. The designers or requirements analysts shall decompose the main goal of the system into subgoals based on its vision and scope. Importantly, such goals must reflect the goals of the different stakeholders of the system, especially, the end-users. Similarly, such goal decomposition shall continue until specified system features (requirements) are connected accordingly. For example, regarding a personal training mobile app, the goal hierarchy is seen as *the users want to lose weight -> need to learn exercise -> need to practice following tutorial -> need to watch tutorials*. Thus, a requirement is elicited as "*the user shall be able to watch training tutorials with the app*."

**3) Selective combination of system features and affordance designs**

Subsequently, the designers will obtain the specified gamification design by combining the elicited and specified affordance designs and system features selectively. A simple example is thus "*the user shall be able to watch training tutorials with the app, after watching all tutorials, he/she will receive a title of 'the Watcher.*"'

## 4. An Example of Gamifying a Language Learning System

In this section, I present an example of using the proposed goal-oriented modeling method to gamify a language learning system. The example will be presented following the steps described in Section 3. As the outcome, a list of gamification design proposals will be delivered.

Multiple popular goal-oriented requirements modeling languages are capable of supporting this method, e.g., *i** (Yu, 1997) and KAOS (Van Lamsweerde, 2008). In this study, I select the Goal-oriented Requirement Language (GRL), which has become an internationally recognized standard for goal-oriented modeling (Amyot, 2003; Amyot et al., 2010). It is open-sourced, easy to use and easy to learn. As part of the user requirements notation (URN) modeling tool, jUCMNav1, GRL was originally developed in University of Ottawa as Software Engineering Capstone Project2. The jUCMNav tool is an easy-to-use graphic editor. As an Eclipse3 plugin, the jUCMNav tool has the advantages of its extensibility and capability to integrate with source codes and other features of the Eclipse IDE. A list of GRL elements that are used in this example are listed in Table 1.

**Table 1. The Elements of GRL used in this Study**

| Elements | Description |
|---|---|
| ***Softgoal*** | A goal without clear objective measure of satisfaction. |
| ***Goal*** | A quantifiable goal in binary way. |
| ***Task*** | A solution to goals or softgoal. |
| ***Decomposition link*** | Allows elements decomposed into sub-elements |
| ***Contribution link*** | The desired impact of one element on another |

### 1) Motivation Analysis

In a simplified way, I focus only on the intrinsic motivation branch of the motivation hierarchy tree and adopt the same decomposition as in Section 3. Furthermore, in order to further simplify the motivation model, the connections between motivation sources and affordances will be made presumably. The result of the motivation analysis is shown in Figure 1. In the motivation GRL model, the softgoal "intrinsic motivation" is decomposed into the subgoals of "Competence", "Relatedness" and "Autonomy". Then we focus on the "Competence" goal, which is decomposed into several gamification elements (Aparicio et al., 2012). Furthermore, the elements can be further specified into subtasks.

### 2) Utilitarian Goals Analysis

The main goal of a language learning system is to facilitate the language learners' improving their "communicative competence" (Oxford, 1990). Oxford's language learning strategy provides an explicit hierarchic structure regarding what individual activity facilitates the improvement of a particular aspect of communicative competence. Thus, herein I adapt Oxford's language learning

[1] http://jucmnav.softwareengineering.ca/foswiki/ProjetSEG
[2] http://jucmnav.softwareengineering.ca/foswiki/ProjetSEG/SEG4910
[3] http://www.eclipse.org

structure into a goal-oriented model. Figure 2 shows the system features specified from the grammatical competence subgoal.

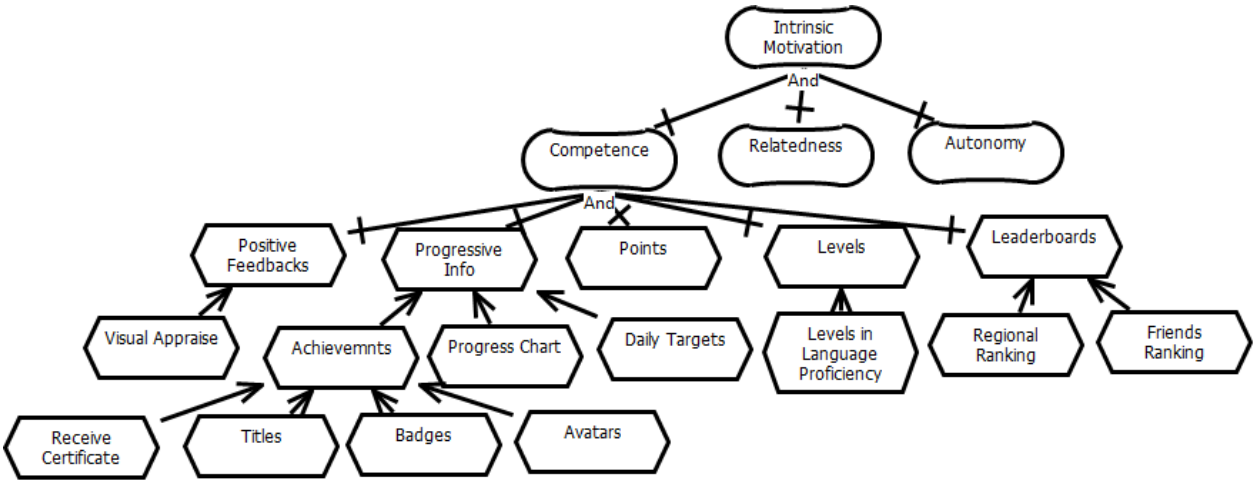


**Figure 1. Example of Motivation Analysis**

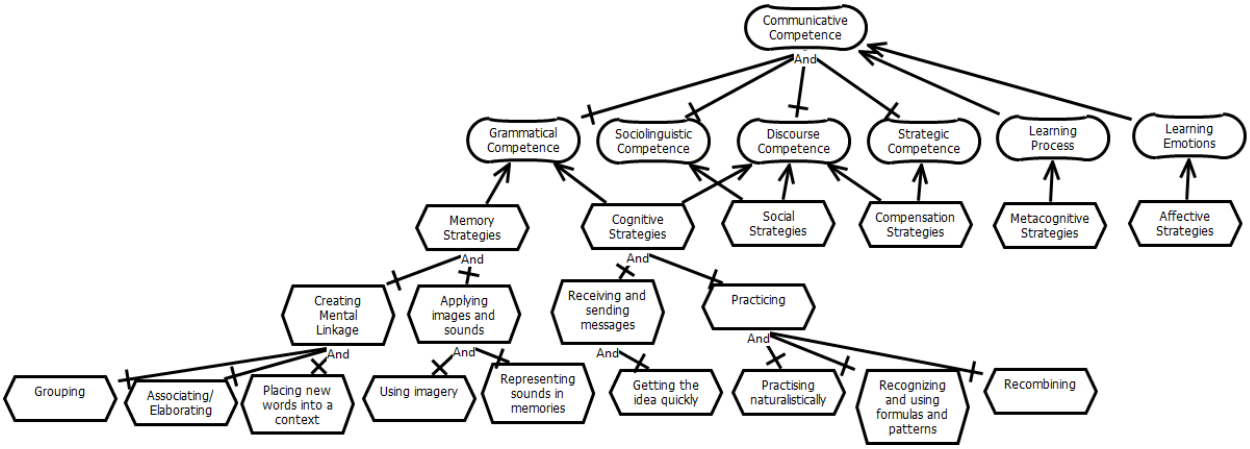


**Figure 2. Example of System Feature Specification via Goal Modeling**

## 3) Design Proposals via Combination

Based on the motivation and goal analysis, a set of gamification design requirements can be elicited via the selective combination system features and motivational affordances. A list of such examples is presented in Table 2.

**Table 2. Examples of Gamification Designs based on Goal and Motivation Analysis**

| Features | Affordances | Design Proposals (User Requirements) |
|---|---|---|
| Grouping | Titles | The user shall receive a relevant title when finishing learning the words from a movie (grouping). |
| Placing words in a Context | Visual Appraise | The user shall receive a context related visual appraise when finishing learning the words from such context (e.g., comics). |
| Sounds in memory | Levels | The user shall receive extra progress in leveling when finishing a pronunciation (sound) related task. |
| Getting idea quickly | Daily Target | The user shall be given a daily target to quickly recognize in which movie scene a word appears. |

The combination of system features and motivational affordances shall be done via brainstorming or requirements analysts' expert opinions. A particular feature or affordance can be further decomposed and specified in order to further specify the requirements. For example, the "Grouping" feature can be decomposed regarding how the vocabularies are grouped when the according affordance "Titles" can also be decomposed regarding what particular titles to select that are more relevant to the group categories. On the other hand, the requirements can be also proposed as user stories (Cohn, 2004) in agile development projects.

## 5. Discussion

This proposed method is not a stand-alone gamification design process and framework, but rather a technique supporting the existing design process. Therefore, the limitation of this method lies majorly in the fact the method requires the support of suitable processes as well as other relevant techniques. For example, Morschheuser et al.'s design framework (2017) is thus an example where this method can be implanted. The motivation analysis and system goal analysis of this method can be implanted into the "*Analysis*" phase. The motivation analysis shall directly facilitate the "*Identify user motivation*" activity while the goal analysis, together with the project vision and scope, will support *identifying user needs*. Moreover, with the results of both steps, the "*Ideation*" phase shall be well guided. Therefore, the verification and evaluation of the proposed gamification design ideas shall then be performed in the following phases of the framework, i.e., "*Implementation*" and "*Evaluation*" phases.

Furthermore, this method shall also be supported by taking into account other relevant techniques. For example, the technique of user story prioritization can be adopted facilitating this method (Cohn, 2004). The designers can use the *urgency* and *business value* as the factors to determine the priority of each proposed design proposal. On the other hand, the designers can also prioritize the system features and the motivational affordance respectively, when the priority of design proposals shall be determined by the combined priority value of both parts. Another way of extending this method is to use scenarios to support the analysis of the use of a target system in requirements acquisition and validation, in order to gather stories, search for generalities identify and analyze the needed behavior of software (Sutcliffe, 2003). As GRL is supported by the user case map (UCM) notation in the framework of URN, scenario modeling can be thusly performed. Furthermore, user profile, which has been studied in both requirements engineering (Junior & Filgueiras, 2005) and gamification design (Marczewski, 2015), can be also used as facilitation of this method. GRL also supports the goal and motivation modeling of different stakeholders. Thus, the future work of this study is to evaluate the method in real-life gamification design process, and also improve the method by taking into account the techniques mentioned above.

## 6. Conclusion

This study proposes a method of using goal-oriented requirements analysis techniques to support the gamification motivation analysis regarding gamification design practice. The key to this method is to connect the utilitarian goals of the target system and the potential motivational affordance with a unified goal-oriented modeling language (e.g., GRL). With the close cooperation of designers, requirements analysts, and developers, this method will support the design and development of gamification systems ensuring both the achievement of the system goals and the working motivational affordances.

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