Special Section on Gamification and Software Engineering

Gamification concerns the use of game elements and mechanics in non-gaming contexts. Gamification has been successfully applied to boost certain behaviors and attitudes in many fields including education, healthcare, marketing, management, and recruitment. This theme section is motivated by the observation that the current literature provides little knowledge on the relationship between gamification and software engineering.

The call for papers was devised to accommodate two main themes: (i) *gamification for software engineering*: how can gamification be employed to foster engagement and performance in software engineering?; and (ii) *software engineering for gamification*: how can the software engineering discipline contribute towards a systematic, and effective, development of gamification applications?

There was a very positive response to the call: circa 30 prospective authors contacted us and communicated their intention to submit a paper by sharing a tentative abstract. We discussed thoroughly each case to ensure fitness to scope, and this eventually resulted in a total of 16 within-scope papers which then went through the peer review process. At the end of the process, four papers were accepted to this theme section, while the other 12 were rejected. Most of the non-accepted papers were of good quality, but many had a generic treatment of gamification or did not address the specifics of software engineering.

The submitted papers have multidisciplinary foundations, including psychology and economics concepts in relation to perception, behavior, personality, behavior economics and group dynamics. In addition, the papers generally presented an amalgamation between the classic software engineering techniques and activities on one hand, and usability and HCI concepts on the other hand. This reflects well the human-intense nature of gamification and the role of users, better named as subjects, in its acceptance and effectiveness.

1. Gamification for Software Engineering

Two of the accepted papers focus on gamification for software engineering. In particular, they both analyze the use of serious games and gamification in the context of software engineering education: one proposes an educational game for security requirements engineering, while the other describes a systematic mapping study for software engineering education in general.

The paper "*Design and Preliminary Evaluation of a Cyber Security Requirements Education Game (SREG)*" by Lin Liu, Affan Yasin, Tong Li, Jianmin Wang, and Didar Zowghi tackles the topic of security requirements education within organizations. The paper presents a serious game for security requirements education that mimics real-life problems in an easy-to-comprehend fashion. This paper relies on solid theoretical foundations which yielded a comprehensive meta-model for security requirements on the one hand, and the translation of such conceptualization to game mechanics making them more presentable and easy to grasp by the non-expert personnel, on the other hand.

The paper "*A Systematic Mapping Study on Game-related Methods for Software Engineering Education*" by Mauricio Souza, Lucas Veado, Renata Moreira, Eduardo Figueiredo, and Heitor Costa sheds light on the current status of games for enhancing software engineering learning. Given the limited number of papers using gamification, the paper explored the use of game-related approaches including games and serious games. The paper shows the focus areas in terms of the used game elements and also the specific software engineering activities being taught. The authors draw insights on the status of the field, trends, and limitations.

2. Software Engineering for Gamification

The remaining two papers study how software engineering principles can be applied for the creation of gamified applications. The presented approaches rely on classic techniques from the field: one paper builds a method using state-of-the-art techniques from method engineering, while the other paper proposes model-driven engineering to semi-automatically derive gamified systems.

The paper "*How to Design Gamification? A Method for Engineering Gamified Software*" by Benedikt Morschheuser, Lobna Hassan, Karl Werder, and Juho Hamari consolidates a comprehensive method for developing gamified software. The method development and evaluation rely on interviews with domain experts and supporting statements from the literature. This work addresses the urgent need for engineering methods for adding gamification as an empowerment layer to software and information systems. The paper is informed by various disciplines including psychology and behavioral science, user experience, and software analysis and design.

The paper "MEdit4CEP-Gam: A Model-driven Approach for User-friendly Gamification Design, Monitoring and Code Generation in CEP-based Systems" by Alejandro Calderón Sánchez, Juan Boubeta-Puig, and Mercedes Ruiz focuses on enhancing the usability and user experience with

gamification design. It provides a model-driven approach to translate a graphical design of gamification to code. This novel approach provides an editor, automated reasoning based on well-established design patterns, and the automatic derivation of monitoring mechanisms for the performance of gamification.

We note that some important areas of the intersection between gamification and software engineering have not been covered. The papers on gamification for software engineering address education, but do not study how gamification can support the software engineering practice. The empirical evaluation of the effectiveness of the presented approaches is still partial and would need to cover a wider range of variables for a longer time. This testifies that the research at the intersection of software engineering and gamification is still in its infancy, but also offers opportunities for future research.

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