

## 論文の内容の要旨

## Thesis Summary

論文題目 Increasing engagement for societal challenges via gamification based user interface evaluation

(ゲーミフィケーションを活用したインタフェース評価による社会課題解決のためのユーザエンゲージメント向上の研究)

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In our current, global society, we face novel challenges that cannot be solved by appealing to traditional means, such as motivation to profit economically from solutions. The fulfillment of sustainable development goals is impeded by low engagement, the tragedy of the commons, or monetary incentives that might lead to a backfire effect.

Recently, gamification has been proposed to engage people by appealing to our innate desires to compete, collaborate, and seek for status. In this thesis, we aim to leverage the power of gamification as a solution to societal challenges.

Current studies on gamification have examined gamification elements such as points, badges, and leaderboards, as well as their impact on the engagement metrics recency, frequency, duration, virality, and ratings. However, these studies conflate various gamification elements and the effect of a particular element is unclear, especially considering the context in which gamification is used. Furthermore, user groups are conflated as well, which might prove that engagement via gamification goes up overall, however, only a subgroup may be highly engaged while another group might suffer in engagement metrics.

To address these issues, we propose a model for a user interface rating regarding gamification elements that considers the nature of the service as well as the characteristics of the subgroups of users. With this

approach, we can rate an existing user interface and suggest improvements to increase engagement for a societal challenge.

Our approach consists of four steps: (1) We decide on the category of a service and take reference user interface data to evaluate the user interface of a service that we want to improve. (2) We set our targets: Which user segment do we aim for and what level of engagement do we wish to achieve? (3) Now we can evaluate our current status according to the target, (4) if the target has been met, we store the results for future comparison and end, otherwise (5) we choose to implement a set of gamification elements according to our prioritization, (6) determine a user interface to be used for A/B tests, (7) obtain the results and go back to step 3 iteratively.

The evaluation of the user interface is made possible initially by examining best practices of reference systems in different categories. We score the current system that we want to improve by the implementation of gamification elements as well as their position and size on the service. If we find that the current system lacks gamification elements, or their position could be improved, we propose to implement these changes. If the current system is too gamified, we propose to remove gamification elements.

The impact of our proposed solution can be measured by calculating the relevant gamification metrics before and after our changes. Performing these comparisons over several iterations leads us to the best possible configuration of gamification elements for specific user groups and new reference systems.

For the type service, we examined five categories: Education, e-commerce, airlines, banking, and messaging applications. We found that they employ different gamification elements between categories but stay consistent within their category.

A user profile can be calculated from existing user data. Ideally, we aim to obtain users' psychological profile in the dimensions of the Big 5 personality factors openness, conscientiousness, extroversion/introversion, agreeableness, and neuroticism. As these data are not available usually, we approximate them with existing data, such as age, gender, country, language.

As case studies, we have been examining solutions to two current societal challenges in particular: (1) Shortage of potential hires in science, technology, engineering, mathematics (STEM) and (2) the rise of carbon dioxide (CO<sub>2</sub>) emissions, which might result in irreversible climate change. Our approach is to develop applications that raise awareness and interest in these issues to cause changes in the right direction. First, we must address the question whether our applications are effective at tackling our stated goals, then we concern ourselves with increasing engagement.

A way to reduce carbon dioxide emissions is to improve our awareness and capability of driving in an eco-friendly manner. Therefore, we developed an application called "iCO<sub>2</sub>" at the National Institute of Informatics in Japan, which allows users to practice eco-driving. It is the first massively multiuser 3D eco-driving game that can be controlled by common mobile devices. To answer the research question whether we can improve the eco-driving behavior of players, we used a mobile games promoter to attract 2455 players to the game, 42% of which finished our task. We calculated their eco-driving behavior throughout the game with our factor<sub>eco</sub>, performed a clustering analysis to determine different types of drivers, and analyzed their eco-driving evolution over time. We found that regular drivers and reckless drivers improve

their eco-driving behavior significantly over a timespan of four minutes and remain stable until the end of the game.

However, we face issues with engagement. We had to attract players with a mobile games promoter and only 8% of players had the intrinsic motivation to keep playing after the requirements of the promotion have been fulfilled. Again, the inclusion of gamification elements is suggested to increase engagement. iCO<sub>2</sub> already uses a points system as currency for upgrades, our system suggests the inclusion of further gamification elements, which should be the focus of future studies.

For our third case study, we developed our own app called “Water the flower” and decided to include the element of “Winning Streaks”. Streaks are being used in e-learning platforms to encourage daily use to master a skill. We evaluate the changes in the gamification metrics duration, virality, and ratings in relation to three different user interface designs.

In conclusion, we leverage the impact of gamification on engagement to solve current societal issues, such as a shortage of STEM-graduates and anthropogenic CO<sub>2</sub>-emissions. We show that our solutions can address these issues. As engagement to solve these issues is low, we suggest a user interface rating to increase engagement for targeted user groups, apply it to our previous solutions, and measure the effects on engagement.