MOTIVATIONAL GAME DESIGN AND PRO-ENVIRONMENTAL ELEMENTS IN SUSTAINABILITY APPLICATIONS

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ABSTRACT

Sustainability applications aim at changing behavior to a more sustainable direction ot informing about sustainability. According to our research, information sharing seems to be the key pro-environmental element used in sustainability applications, even though also other elements, such as commitment, comparison, feedback and rewards are often utilized. Badges, points and levels are commonly found game design elements for feedback and reward purposes. Sharing one's action with friends and teams can create commitment and comparison, whereas usage of a story creates commitment through emotions.

INTRODUCTION

Sustainability and its three categories – environmental, economic and social – are ways to ensure that also the next generations have possibilities to enjoy our planet. Even small actions can have an effect on changing the attitudes of people. Many websites and applications share information and advice on sustainability. In this paper, we will take a closer look at the existing sustainability applications and explore how elements from gamification and pro-environmental psychology are used in them.

BACKGROUND

Pro-environmental behavior can be seen as conscious actions taken by individuals to lessen the negative human impact on the environment (Kollmuss and Agyeman 2002). Several theories are commonly used to explain the environmentally sustainable behavior (Froelich 2010: Sawitri 2015). According to the theory of planned behavior, behavior can be predicted from the behavioral intentions. In norm activation theory, the intention is not enough, but also knowledge of consequences, ascription of responsibility and personal norms predict the behavior. The Values-Beliefs-Norms - theory emphasizes the importance of person's values and beliefs.

To motivate pro-environmental behavior, several popular means are used to affect the elements that precede the behavior according to the theories (Froelich 2010).

Information can be provided in several ways, e.g. campaigns and websites, which are assumed to make people act in more environmentally beneficial ways. Another way to motivate people is *goal-setting*, which can be made by individuals, groups or e.g. external coaches. *Incentives and disincentives* are motivation techniques, which come before the action, whereas *rewards and penalties* are coming after the action. When people express their *commitment,* it increases the probability to pursue that behavior. Similarly *comparison* between individuals and groups can be useful in motivating an action. In order to be effective, these motivation techniques are often used together with *feedback*.

Gamification can be defined to be the application of game design principles for the purpose of engaging users with other products or services than a game (Deterding et al. 2011). Besides engaging users, gamification is used to motivate people to participate and even to create loyalty.

One way to apply and research gamification is through the usage of different motivational game design (Weiser et al. 2015). These elements can be seen to address different motivational perspectives: trait perspective, behaviourist learning perspective, cognitive perspective, perspective of self-determination, perspective of interest and perspective of emotion (Sailer et al. 2013). Even though several definitions for game elements used in gamification exist(Weiser et al. 2015; Sailer et al. 2013; Hamari et al. 2014), they all have some common elements, such as assignments, quests and goals; points, credits and levels; achivements and/or badges; and leaderboards and collections.

RESEARCH METHOD

The aim of this research was to understand *what kind of gamified mechanisms are used in sustainability applications* and *how they relate to ways to motivate pro-environmental behavior.*

The research articles provide one view on the gamified ways used for creating pro-environmental behavior. The two strongest themes presented in the research articles were electricity and transport, and in total of 6 articles were selected to this research. The research-oriented applications are usually designed for the purpose of research, and thus they are utilized only by a small group of research participants and only for the period of the research. To gain a wider view about the design of sustainability applications

also Google Play applications were considered. The 30 first applications with a search word "sustainability" was reduced to ten applications by taking into account only thost that had more than 1000 downloads. The search was conducted in March 2018 from Finland, from the researcher's computer and the google search algorithms have an effect on the applications the search found. Thus the applications can be considered as a quite random presentation of the existing applications.

RESULTS

The vast majority of applications, including all six research applications, aimed at encouraging changes in behavior through recording sustainable actions of the users or at least giving information about the possible actions. The rest of the applications focused on sharing information about sustainability in general or sustainability of a company. Two of the applications, ShareBuddy and the application by Brewer et al. (2015), included minigames and their motivational elements are listed in the table in parenthesis, but not taken into discussion and conclusions.

Sustainability Applications in Research Articles

The applications in research articles (in Table 1) inform users how to be more sustainable, which seems to translate into environmental-friendly actions taken by the participants (Jylhä et al. 2013; Froehlich et al. 2009; Dillahunt et al. 2008; Brewer et al. 2015) or can be seen in opinions of the participants (Nguyen 2014; Kjeldskov et al. 2012). Social activity is seen to be one of the key components to commit people to sustainable choices, and it is either empirically investigated (Nguyen 2014; Brewer et al. 2015) or theoretically discussed (Froehlich et al. 2009). Typically, these applications are related to changing personal behavior, such as household energy usage (Dillahunt 2008, Kjeldskov et al. 2012; Nguyen 2014; Brewer et al. 2013), or transport methods (Froehlich at al. 2009; Jylhä et al. 2013).

Citation	Motivational elements
Froehlich et al. 2009	Points, badges, feedback, progress. Commitment, rewards&penalties, feedback.
Jylhä et al. 2013	Point, badge, goals, challenge, feedback. Information, goal-setting, incentive, comparison, feedback.
Dillahunt 2008	Achievement, progress, story. Rewards&penalties, commitment, feedback.
Kjeldskov et al. 2012	Achievement, badge, friends, feedback. Information, commitment, comparison.
Nguyen 2014	Goals, achievements, leaderboards, friends, feedback. Information, goal-setting, commitment, comparison.
Brewer et al. 2015	Avatar, points, leaderboards, progress. Information, commitment, comparison, feedback.

Table 1. Motivational Elements from Gamification or Pro-environmental Psychology in Research Articles.

Dillahunt et al. (2018) designed an application with a virtual polar bear in "tamagotchi" style to find out whether virtual pets could have positive impact on environmentally responsible behavior. A story was used to develop attachment to the pet (for one of the groups in the research) and the amount of environmental actions was visualized through the increasing and decreasing size of the ice below the polar bear.

Power Advisor by Kjeldskov et al. (2012) provides information about power consumption in a household through an additive automatic meter reader. The application includes relating user's consumption to similar households, comparing to user's historical data, advice messages from experts as well as community messages. Used motivational elements included e.g. smiley faces as badges and visualization through comparative speedometer and charts.

Similarly to Power Advisor, the mobile application utilized by Nguyen (2014) is following energy consumption through a smart meter in a household. The application gives the user feedback about the hourly energy usage in form of charts and comparison to previous usage. To create commitment and enable comparison, a newsfeed provides information about the user's friends and their consumptions, goals and personal records. It is also possible to compare oneself with others through leaderboards. (Nguyen 2014)

ShareBuddy does not focus only on reducing electricity and water usage, but also encourages players to shift the electricity usage throughout the day. The players get feedback from their behaviour in form of resource points, which are used to advance in the game itself and to play minigames. Players have an avatar which can walk and take actions (e.g. showering, cooking). Players can also compare themselves to others in a leaderboard. The game design elements in minigames are similar to the main game, e.g. points. (Brewer et al. 2015)

UbiGreen consists of an application and a motion sensor to detect different kind of transportation automatically. UbiGreen provides feedback visually either in form of a tree growing leaves, or in the form of new polar bears and seals representing the achievements of the user as a background image in a mobile phone. The graphical illustrations are accompanied with badges, which inform the users their recent green activities. (Froehlich 2009)

Similarly to UbiGreen, MatkaHupi sums up the CO_2 emissions produced by the automatically detected transportation method (walking, cycling, bus/tram/metro, driving a car). The application includes information about more sustainable choices for the trip, a journey planner and a set of challenges. Visual feedback on the CO_2 emissions of the current and last three weeks are presented. As gamification elements, the users get points and badges from their trips and completion of challenges. (Jylhä et al. 2013)

Popular Sustainability Applications

The sustainability applications (in Table 2) found in Google Play can be divided into two categories. "*Habit changing*" applications encourage users to take small actions, and two of the five applications include saving or even informing other players about the actions taken. "*General information*" applications are only providing information about sustainability in different areas, and do not give advice on changing personal habits.

Application	Motivational elements
JouleBug	Goals, points, badges, leaderboards, friends, feedback, rewards. Information, goal-setting, rewards, commitment, comparison, feedback.
sustainability@BU	Goals, points, badges, leaderboards, friends, feedback, rewards. Information, goal-setting, rewards, commitment, comparison, feedback.
SDGs in Action	Assignments, friends, story. Information, goal-setting, commitment.
Carbon3R	Information.
Sustainable Seafood Guide	Information.
Sustainable Canned Tuna Guide	Information.
Sustainable Development Goals	Information.
Sustainable Development Goals (regional)	Information.
SDG Game & Quiz	Points, leaderboards, (avatar, virtual goods). Information, comparison, feedback.
ITC Sustainability	Story. Information.

Table 2. Motivational Elements from Gamification or Pro-environmental Psychology in Google Play Applications

Habit Changing Applications
JouleBug has developed two similar sustainability applications, sustainability@BU and JouleBug. They include several actions categorized into habits, energy, water, waste, transportation, food&drink, shopping, office, outdoors and advanced. The users can complete actions, track their progress and share their progress with their friends (including Facebook and Twitter). Thus, feedback is given not only by the application, but also by other users. Information about the possible ways to be more sustainable is presented through the description of a quest. Upon completion of a quest, points and badges are received as rewards. The users can compare themselves with friends through leaderboards.

Where JouleBug has readymade actions, SDGs in Action encourages people to create their own actions and invite others to join them. The creator of an action must link it against one of the United Nation's Sustainable Development Goals (SDG). Social sharing is an integral part: in addition to inviting other users to participate in an action, the

applications includes also likes and shares. Despite all the gamified approaches, information sharing is the largest part of the application, including detailed information about the 17 SDG's and their targets as well as explanatory videos and latest sustainability development news. The videos can be considered as using stories for information sharing.

Carbon3R-Sustainable Lifestyle is an application which gives information about eco-friendly lifestyle through three categories: reduce, reuse and recycle. It has only textual information about the actions to be taken, excluding features for saving or sharing the actions. In addition, the application includes integrated news feed from Tree Hugger, Yahoo Green and New York Times Green Living. There are some logos used for different actions such as recycle or compost, and widely thought these could be considered as badges.

Sustainable Seafood Guide is an information sharing application for Australia and Sustainable Canned Tuna Guide is for Canada. The idea is similar: information about different tuna marks is provided in form of traffic lights. More information about the data behind the color, e.g. how and where the tuna was caught, is also available. The traffic lights can be considered as a gamified design element, closest to badges. At the time of testing the applications, Sustainable Canned Tuna Guide did not work at all, so the information is based on the figures in Google Play.

Informative Applications
Three out of four informative applications focus on United Nation's Sustainable Development Goals (SDG). Each one has a different aim and approach. Sustainable Development Goals is aimed for people who need to check the information about the SDG's regularly. It includes the goals, their targets and indicators in textual form. The aim seems to be a quick check-up place for the information. The second Sustainable Development Goals application is aimed for local and regional governments. There, the relevant targets for local and regional governments in each of SDGs are selected and their practical meanings explained textually.

SDG Game & Quiz has two distinct parts: a game and a quiz. Before or after the game, user gets textual information about SDGs and sustainability issues around the world. In the game itself, "good" and "bad" things drop down, and user catches the "good" things by touching them. These are actually logos representing different issues in SDGs. The other part of the application is a quiz about facts related to SDGs and by answering the quiz the user gains extra lives for the game. There are leaderboards for both the quiz and the game.

ITC Sustainability is an informative application of an Indian company called ITC. In addition to the company's sustainability goals, there are multiple topics on where the company is active in the community: e.g.renewable resources, forestry, water, e-commerce for farms, education, women empowerment, recycling, training, health and hotels. The form of sharing this information is short stories accompanied with photos, and possibly links to videos or other related material such as pdf files.

DISCUSSION AND CONCLUSIONS

Motivational game design elements and **ways to motivate pro-environmental behavior** have several overlapping themes. *Feedback* is found in similar role in both of these models. **Goal-setting** is presented in form of *quests, goals and challenges*. **Incentives and rewards** can be expressed e.g. through *points, badges and rewards*. **Commitment** can be expressed through *avatars* and *progress*; to *friends*, *teams* and *groups*; or even in form of **competition** through *leaderboards*. **Information** is an important way to motivate people in pro-environmental psychology, but has no direct counterpart in gamification. Perhaps a *story* or a *theme* can be utilized for this. In general, we can see, that game design elements are more practical and can be considered as ways to implement the motivational ways described in pro-environmental psychology.

Points, badges and leaderboards are typical elements in gamified applications (Hamari et al. 2014) as was found in our research also. In addition to these (basic) elements, social interaction with other people was also highlighted. One interesting factor is also the utilization of a story, which was used successfully to create commitment and as a way to share information about possible or actions taken. In addition to text based information, also charts, figures or even videos were used for information sharing. Information was the only element always present and for some applications the only element used, especially for popular applications. We can summarize our findings as follows:

- **Information** sharing can be found in all the applications and thus be considered as a key element.
- *Feedback* from user's current sustainability is an important way when the aim is to encourage behavior change.
- *Points, levels and badges* are typically used as **rewards** from the recorded sustainable actions.
- To create **commitment** and **comparison**, social networks are used for sharing the results with e.g. *friends* or through *leaderboards*. Also a *story* can be used to create commitment through emotions.

Our research higlights elements that are currently used in both scientific and popular applications giving guidance to application developers. The absence of only information sharing applications in scientific research brings up a question that is information sharing enough, or does it need to accompagnied by feedback and social elements.

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