Pure Gamification: An Energy Case

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Dutch energy suppliers are obliged to cooperate in reducing consumption by stimulating energy saving behaviours among their customers. One important strategy for this context is personalized gamification. We investigate how a personalized gamified energy saving application can be designed based on individual preferences within the context of an energy supplier. To design a personalized gamification application the proposed method of Knutas et al. was adapted by leaving out the parts about machine learning and adding an evaluation phase. We show that customization by users can be a valuable alternative for using machine learning personalization strategies. We used this iterative design process to focus on personalizing, in this use case for the three main user types of the customer base of a Dutch energy supplier. The design of the gamified application was adapted using feedback of both stakeholders and customers using interviews (n = 9) and focus groups (n= 4 & n=6). This resulted in two final designs designed to stimulate energy saving behaviour among customers. The design had a dashboard which allowed for personalization within gamified elements, and an energy editor in which users can change characteristics in their households to learn about the effects of actions on their energy consumption. These two final designs were validated using an interactive prototype along with interviews (n = 13). The added value of this study is that it shows that the Hexad framework with its proposed gamification user types is suitable to understand the main motivations of a target group. Results suggest that designing within gamified mechanics based on a user type's main motivation is an effective strategy for personalization. We also propose a generalised framework visualisation of this inside out model involving every user type of the Hexad scale. Motivation-based design is not the only successful personalization design strategy but adapting designs to personal situation and existing energy saving behaviour might also motivate users.

Keywords: Gamification; Personalization; Energy; Sustainability; Game based learning

1 Introduction

Since 2017, energy suppliers in the Netherlands are obliged to encourage energy savings among their customers (Rietkerk and Menkveld, 2017). In the advice given along with new legislation, gamification was cautiously mentioned as a tool for teaching people about and stimulating energy saving behaviour among customers.

Gamification can be defined as *"the use of game design elements in non-game contexts"* (Deterding *et al.*, 2011), or *"a process of enhancing a service with affordances for gameful experiences in order to support users' overall value creation"* (Huotari and Hamari, 2012). It is used as a mean of supporting user engagement and enhancing positive patterns in service use, such as increasing user activity, social interaction, or quality and productivity of actions (Kankanhalli *et al.*, 2012). The concept of gamification consists of three subsequent elements, affordances implemented in a gamified system can lead to physiological outcomes which lead to further behavioural outcomes (Hamari, Koivisto and Sarsa, 2014). Affordances within gamification consists of various elements that structure games and induce gameful experiences.

The recent interest into the potential and interest for gamification within the environmental contexts (Rietkerk and Menkveld, 2017), leads to more insights into the possibilities and effectiveness of gamified applications within this area. A literature review—on gamified applications designed to incentivize energy savings—showed average results from 4 up to 24% in energy savings within households (Iweka *et al.*, 2019). Personalized gamification within this context is more effective than one size fits all solution (AlSkaif *et al.*, 2018; Böckle and Kwaku, 2019; Böckle, Novak and Bick, 2020). Gamified applications that incentivize energy savings have also already been applied in the commercial sector. Consumers can be engaged towards a more sustainable lifestyle by gamification applied to incentivize energy savings (Morganti *et al.*, 2017; AlSkaif *et al.*, 2018; Wee and Choong, 2019). As researching real-life impact is difficult, storyboards with actual designs for prototypes can help to show how perceived persuasion of persuasive strategies are related to different user types (Böckle, Novak and Bick, 2020).

Building on these findings together with a more in-depth look at personalization in relation to energy suppliers described in section 2, we take the next step towards real-world implementation. In section 3 we describe our methodology for investigating how customizable dashboards can be designed. As part of this iterative design in section 4 we describe our first iteration of user research with lo-fi prototypes to investigate the potential of customizable and personalized gamification. In section 5 we present our final study with an interactive prototype to investigate how it could motivate energy saving behaviours within a commercial environment of an energy supplier. The results of the evaluations are discussed within section 6 and in section 7 we provide the main take aways and conclusions This whole study is conducted with actual

customers of a Dutch energy supplier. The focus in this study is part of a bigger whole, earlier on we already investigated to what user type these customers belong (van der Neut, van Delden and Spil, 2022). In our current study we obtain first insights into the possibilities of personalized gamification for green energy suppliers, fitting the following research question:

How can we design a personalized gamified energy saving application based on individual preferences of users within the context of a green energy supplier?

2 Background theory and related work

Marczewski (2015) developed the Gamification User Types Hexad framework which highlights opportunities of personalization of gamification. The user types are not intended as mutually exclusive types but rather profiles where a person can be motivated fitting multiple types to a various degree. These types are described as follows (Tondello *et al.*, 2016):

*"**Philanthropists** are motivated by purpose. They are altruistic and willing to give without expecting a reward.*
***Socialisers** are motivated by relatedness. They want to interact with others and create social connections.*
***Achievers** are motivated by competence. They seek to progress within a system by completing tasks, or prove themselves by tackling difficult challenges.*
***Free Spirits** are motivated by autonomy, meaning freedom to express themselves and act without external control. They like to create and explore within a system.*
***Players** are motivated by extrinsic rewards. They will do whatever to earn a reward within a system, independently of the type of the activity.*
***Disruptors** are motivated by the triggering of change. They tend to disrupt the system either directly or through others to force negative or positive changes. They like to test the system's boundaries and try to push further."*

Looking at the overall picture of energy saving applications several elements seem to be essential for such an application. Alskaif et al. (2018) suggested that the following five categories should be incorporated within an energy saving application: information provision, rewarding system, social connection, user interface, and performance status. Beck et al. (2019) also mentioned feedback as an often used gamified category. An important category is the user interface, to have a positive effect on customer engagement the interface should not only be useful, but as well attractive and enjoyable to improve user experience (AlSkaif *et al.*, 2018; Beck, Chitalia and Rai, 2019).

At the moment, energy companies do not often make use of gamification in their energy feedback systems but instead use data and visualizations like graphs. However, there are many people who do not easily understand abstract numerical data about their energy usage (Karjalainen, 2011). One way to present data more clearly is with the help of metaphors. The research of Melenhorst et al. (2018) and Koroleva et al. (2019) showed how to effectively apply metaphors for three main goals of energy saving, namely monetary, sustainable, and hedonic goals. In which monetary goals imply reducing costs, sustainable goals imply increasing environmental impact, and hedonic goals involve increasing someone's pleasure.

3 Methodology

The global methodology, see figure 1, applied in this study is based on the method proposed by Knutas et al. (2019). The sixth step named *'rapid prototyping'* follows a human-centred design process according to the International Organization for Standardization (ISO) (2010). Meaning that the target users participated in the design process from the very beginning and following an iterative process. The user feedback and opinion of the stakeholders formed new input for the iterative process in which changes were gradually introduced to optimize and improve the design not all these steps fall within the scope of this paper.

4 Results

During the design ideation process, content, features and a first visual design strategy were created using existing theory on energy saving applications and preferences. Specifically, we included preferences of the user types achievers, free spirits, and philanthropists towards gamified elements and their expected behaviour within the environment of a green energy supplier. These were the three main user types among the customers of the Dutch energy supplier (van der Neut, van Delden and Spil, 2022). Based on these findings we set up a design focus for each user type. Our first low-fidelity prototype was based on these user types and other inspirational sources but not yet considering style manuals etc. We used these for interviews with customers (n = 9) to discuss the responses to the various features. We then build a next

iteration and gathered feedback from the client as well as through two focus groups (n= 4 & n = 6). Based on this we build our final prototype that we used in our final evaluation.

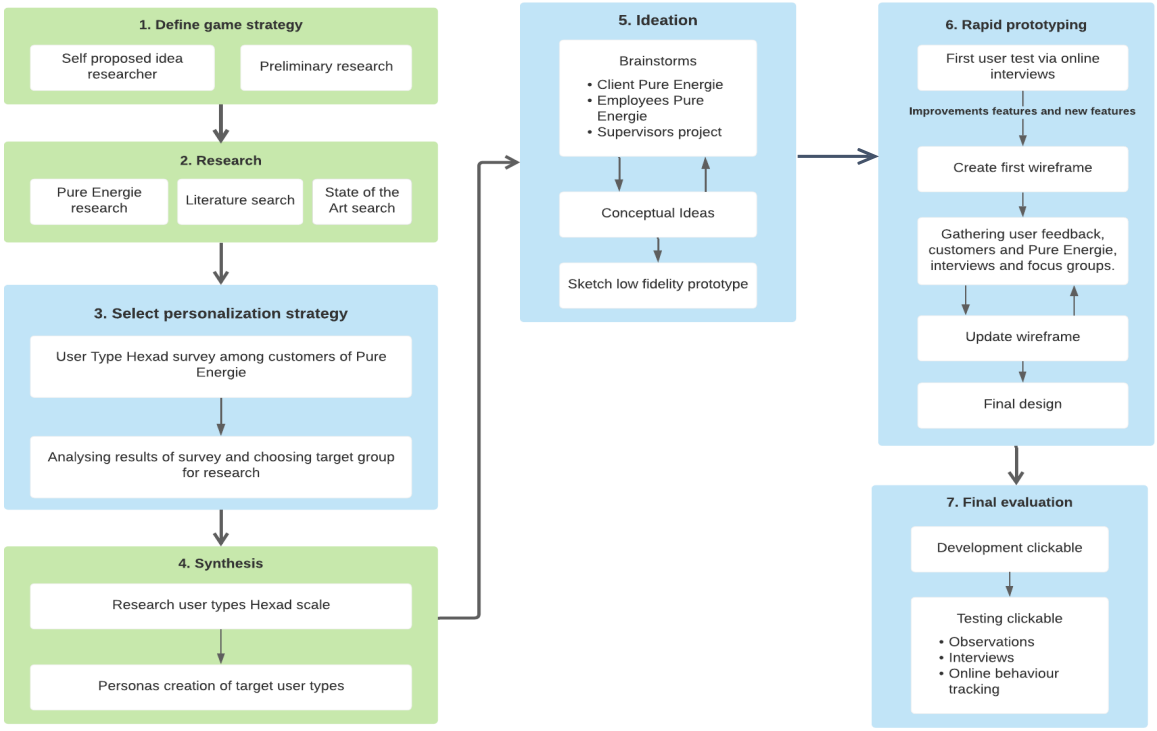

Figure 1: Overview of methos used during this project. Diverse methods were applied across seven different stages. The green parts involved research performed in the preliminary part of this research blue parts for parts of this study.

4.1 Differences towards gamification elements

An overview of the participating customers' motivation towards the different gamification elements is depicted in **Table**1. The motivation towards the gamified elements is the way a participant indicated how they perceived it and how likely it is for them to use the functionality in a real-life application where –, +-, and + are respectively not likely, somewhat likely, and likely.

Table 1: Overview of motivations of the nine participants towards gamified elements based on our low-fidelity prototype

	Ach 1 ♀	Ach 2 ♂	Ach 3 ♂	Phi 1 ♂	Phi 2 ♂	Phi 3 ♀	Fr Sp 1 ♂	Fr Sp 2 ♀	Fr Sp 3 ♂
Points	+-	+	+	-	-	+-	-	+-	-
Hints	+	+	+	+	+	+	+	+	+
Feedback numbers	+	+	+	+	+	+	+	+	+
Profile	+-	+	+-	+-	-	+-	+	+	+-
Energy editor	+-	+	+-	+	+-	+	+-	+	+
Competitions	+	+	+	-	-	+	-	+	-
Comparisons	+	+-	+-	+	+	+	+-	+	+
Personalisation characters	+-	-	+-	+-	+-	+-	-	+	+
Challenges	+	+	+	+	+	+	-	+-	+
Levels	+	+	+	+-	+-	-	+	+-	-
Personalisation data	+	+	+	+	+	+	+	+	+
Metaphors	+-	+	+-	+	+	+	+-	+-	+-

4.2 Final prototype design

The final prototype design consists of a dashboard and an energy editor. The dashboard includes several different motivational affordances which are fixed element on the dashboard. Each affordance has multiple designs, allowing the participant to choose between the several elements during the final evaluation and create his or her ideal dashboard. Figure 3 shows the dashboard at the start in which some elements are not yet shown as the participant could choose the design option by clicking on the white boxes. The different design options for each element are listed in table 2. For instance, Figure 2 shows the four final designs for the visual challenge. The second page forms the starting view of the energy editor, depicted in Figure 4. The energy editor has a menu which changes the top left block. Several elements have already been implemented in the house, showing what a situation could look like.

The different options for the gamified elements from table 2 are designed for the three user types: achiever, free spirits, and philanthropists. It also shows the expected preferences of user types towards the game design elements. These expectations are made based on the earlier gained results and the expected main motivation of each user type towards an energy saving application (van der Neut, van Delden and Spil, 2022). Meaning that achievers will be focused on competence and saving money, free spirits on autonomy, gain a lot of information and having fun, and philanthropists on increasing their own impact as they are motivated by purpose. For every element the accompanying goal is shortly described. Metaphors allow for comparing energy savings with information more understandable for individuals. Comparisons allow for comparing your energy consumptions compared to different categories. Profile shows a user's name and the user can choose a profile picture by creating a character, choosing location, or adding a picture. The visual challenge is coupled to points in the design and allows for playing for something interactive and growing within this challenge. Challenges consists of goals and the type of challenge. Goals can help individuals to increase savings and receive feedback, challenge types are different approaches to start energy saving behaviour. Ranking is done via a leader board which can show your position compared to friends, the region, or all customers. The *"Learn more"* triggers users about learning about their energy usage and this can be done through a quiz, hint or *"Did you know?"* approach. The level can be shown as number or in a progress bar. Lastly, badges can be shown per three or only showing the last badge.

5 High-fidelity prototype final evaluation

The final design was developed within Axure, which allowed for creating an interactive prototype that could be shared online and connecting the Hotjar[1]. Hotjar is a is a tool to get insight into how visitors are really using a website and allows for collecting user feedback. In total fifteen customers participated in this study. For each user type (philanthropist, achiever, or free spirit as main user type) we selected three males and two females. We held a semi-structured interview via Microsoft Teams. Looking at the average clicking behaviour we clearly saw that free spirits (199) performed more clicks than philanthropists (123) and achievers (122). Supporting our hypothesis that free spirits would show more clicking behaviour than the other user types. Suggesting that they really explore the application. Free spirits were really interested in what was behind each element and whether there was more information for both the dashboard and energy editor: *"what does this show or do"* was a quote often made by this user type. Free spirits also choose more different options than the other user types.

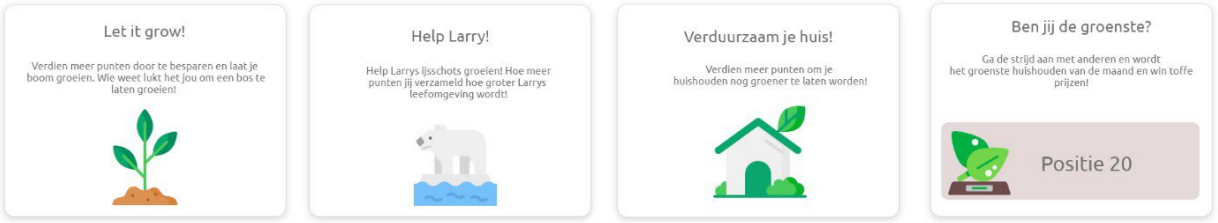

Figure 2: Final designs of interactive visual challenge game element mostly in Dutch, including *Let it grow*, *Help Larry!*, *Make your house more sustainable!* and *Are you the most green?* (i.e. durable).

[1] Hotjar, basic version, https://www.hotjar.com/

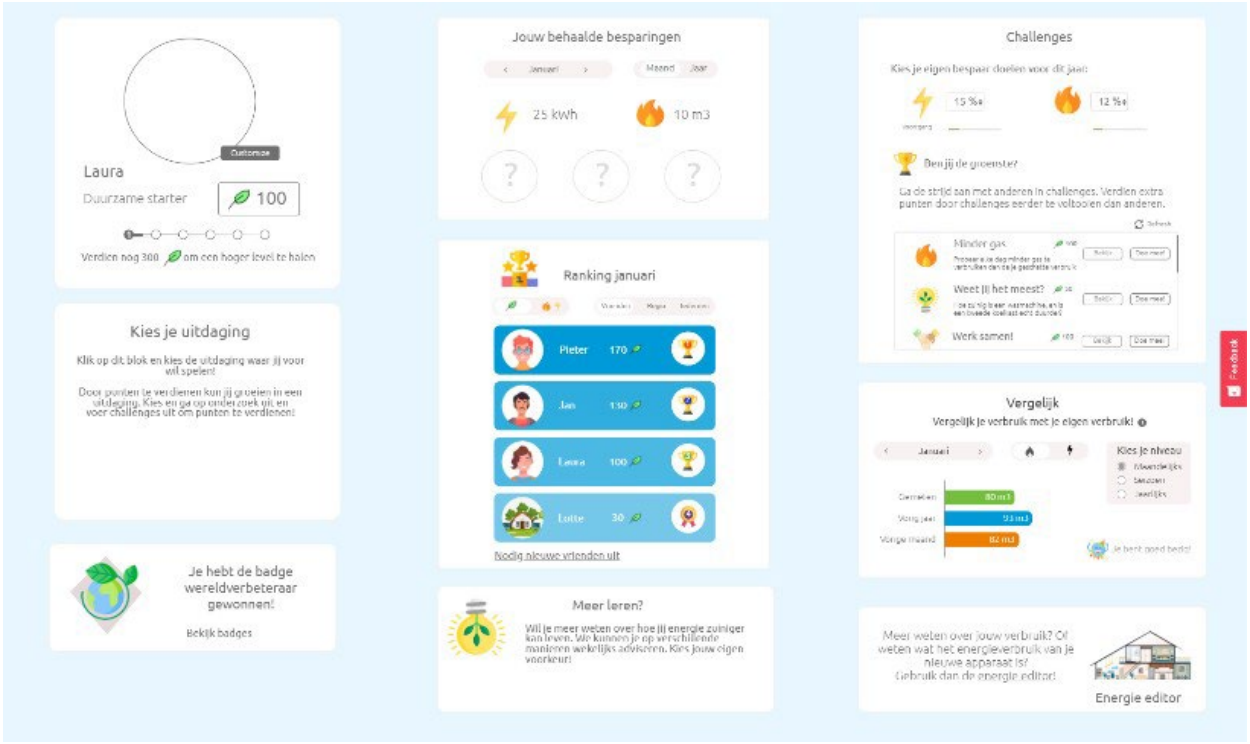

Figure 3: Final wireframe design of the dashboard. The following elements are included: a description of the profile (e.g. sustainable-oriented starter house owner with given name), choosing a challenge, badges, achievements, leader board, an overview of open and completed challenges, comparing use, and a link to an energy editor (see Figure 4).

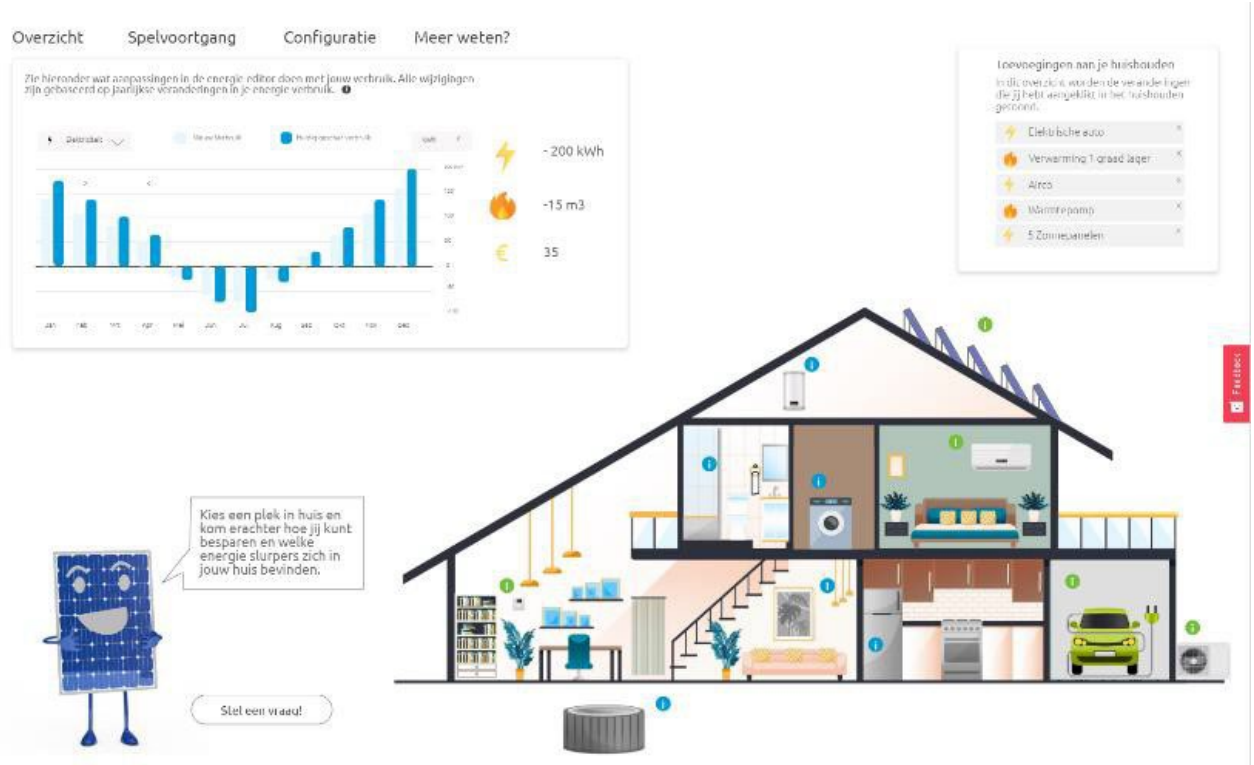

Figure 4: Final design of the energy editor. The proposed overview dashboard has four elements: overview, game progress, settings, and learn more. The solar panel character hints to investigate how you can save energy and find the most energy consuming household items. In the topright several changes can be simulated (e.g. adding solar panels, lowering the thermostat, adding a jacuzzi or an electrical car). An overview of the changes made in the house is shown in the block in the right top of the screen.

As expected, the most obvious differences between user types are visible within *"challenge type and goal"*, *"learn more"*, *"ranking"*, and *"visual challenges"*, see

Table 2. We did not expect philanthropists would choose elements about money. However, this happened for both the metaphors and challenge goal. The philanthropist choosing for this explained that this was because it is something you can directly relate to and understand easily. However, the focus of this

participant was still saving energy and they did not have a big monetary focus: *"I easily understand the concept of money, although saving money in the case of energy usage is not a motive for me*". This might suggest that even though a metaphor or depiction might be related to a specific motivation, the underlying mental model can be different. In this case this occurs for metaphors and goals involving a monetary focus as it provides a comprehensible comparison between saving money and saving energy.

The designs involving competition scored highest for the achievers. The challenge involving competitions was even only chosen by achievers. There are also some unexpected choices, such as a philanthropist choosing an element matching competition, or the earlier mentioned money, might be explained by users forming a spectrum of user types and not just depending on a single motivation. By inspecting for example the profile of the philanthropist choosing the elements involving price we saw that the achiever type scored second highest within their user spectrum. Although participants from certain user types sometimes made different choices for designs deviating from the expectations, their main motivation was still the same as the motivation of their main user type.

Finally, we observed that every user would like to change the energy editor to his or her personal home situation. These results suggest that designing for personal situation is important: *"It is really interesting if you could simulate your own household if this allowed for more comprehensive and personal advice on energy savings, it would even be better if it takes into account the measures that I already take*". This also implies that not only personal home situation is an important personalization factor, but also existing environmental behaviour, which was supported by the answers of multiple participants.

Table 2: Chosen designs in dashboard during final evaluation by user types (n=15, 5 per user type)

Metaphors	Piggybank money	Number of trees	Kg of Co2	Generation time windmill	Performance against others	km car ride
Achievers	**33,33%**	16,66%	16,66%	-	**33,33%**	-
Free spirits	**26,66 %**	13,33 %	13,33%	20%	13,33%	13,33%
Philanthropists	8,33 %	**33,33%**	**33,33%**	-	8,33 %	16,66%
Comparison	Own usage	Households region	Friends	Comparable household	Other type households	
Achievers	-	**50 %**	16,66%	16,66%	16,66%	
Free spirits	**38,46%**	15,38%	7,71%	23,07%	15,38%	
Philanthropists	**50%**	-	-	**50%**	-	
Profile	Character	Google maps	Character house	Upload own picture		
Achievers	25%	-	-	**75%**		
Free spirits	-	-	20%	**80%**		
Philanthropists	**75%**	-	25%			
Visual challenge	Larry ice bear	Plant growing	Competition	Make sustainable house		
Achievers	-	25%	**75%**	-		
Free spirits	**60%**	20%	-	20%		
Philanthropists	25%	**50%**	-	25%		
Challenges goal	kWh and m3 in %	Euros In %	No goal			
Achievers	-	**75%**	25%			
Free spirits	**100%**	-	-			
Philanthropists	**50%**	25%	25%			
Ranking	Friends	Region	All customers			
Achievers	**100 %**	-	-			
Free spirits	20%	20%	**60%**			
Philanthropists	25%	**75%**	-			
Learn more	Did you know that	Quiz	Hint			
Achievers	-	**75%**	25%			
Free spirits	**80%**	20%	-			
Philanthropists	-	**50%**	**50%**			

Challenge type	Are you the greenest	Save for impact	Create own challenge
Achievers	**75%**	25%	-
Free spirits	-	20%	**80%**
Philanthropists	-	**100%**	-
Level	Progress bar	Mystery level	
Achievers	**100%**	-	
Free spirits	**60%**	40%	
Philanthropists	**100%**	-	
Badges	Show last 3 badges	Show last badge	
Achievers	**50%**	**50%**	
Free spirits	**60%**	40%	
Philanthropists	**75%**	25%	

6 Discussion

6.1 Adapted method for designing personalized gamification

The method applied in this study is based on the proposed method by Knutas et al. (2019) for machine learning algorithm based personalized content selection. We selected this due to our interest in future automatization and the model's overarching overview while also connecting personalization to the Hexad framework. However, the findings of this research did not focus on applying machine learning for personalization, but on customization by the user for personalisation. Therefore the method was adapted leaving the parts focusing on the machine learning algorithm. Furthermore, we added a novel step, namely the final evaluation phase as a last step in the method to be able to validate the design and final hypothesis. Lastly, we advise to use follow a human centred design approach (I. O. f. Standardization, 2010) for iteratively improving the gamification designs during the ideation phase. This study suggests that this adapted method is effective to create personalized gamification by allowing the user to customize their own gamification solution. Future work could investigate whether a population for a specific gamification design prefers choosing their own gamification designs as done in this study or rather would want to have a suitable gamification design provided by an algorithm or a mix of them.

6.2 Motivation-based personalized gamification or element-based personalization

The results of this study support the earlier findings from the literature, that personalized gamified solutions are more effective than one-size fits all approaches (Deterding, 2014; Tondello *et al.*, 2016; Orji, Oyibo and Tondello, 2017; Mora *et al.*, 2018). The different preferences of the participants for gamification elements and their preferred focus show that personalization is a key feature to make an energy saving application fitting more to an individual. However, participants were only confronted with interactive pages and no long-term preference or behaviour was researched. Future work should focus on how the findings of this research are still matching on a longer period of time.

The Hexad scale building on Marczewski's Gamification User Types Hexad framework (Tondello *et al.*, 2016) was designed to understand more about user psychology in a gamified context. However, correlation analysis also showed the usefulness of the Hexad model as measure of predetermined design elements (Tondello *et al.*, 2016, 2019). Research on the Hexad scale for stimulating energy saving behaviours also suggested that the Hexad model can indicate the preference of end-users towards specific gamification design elements (Böckle, Novak and Bick, 2017; Kotsopoulos *et al.*, 2018). In general, personalization with use of the Hexad scale is also often performed through applying different gamification elements for each user type (Osbaldiston and Sheldon, 2003; Tondello, Mora and Nacke, 2017; Kotsopoulos *et al.*, 2018; Wee and Choong, 2019). However, this study showed a different approach for personalization within a gamified application, namely a motivation-based approach instead of the often used element-based approach. Designing within a specific element based on the main motivation of an end-user was proven to be successful showing that within a gamified application personalization can be applied in another way as well. As participants preferred game mechanic designs matching their motivation behind using an energy saving application we suggest that this is a suitable approach for personalized gamification in an energy saving context. As the main motivation of a user type forms the attitude and expectations towards a gamification solution, designing for this motivation can also be applied in other contexts rather than only for an energy saving goal. Therefore, we suggests that within motivation-based design for a gamification solution within the context of energy saving forms a suitable personalization approach. However, this finding

does not imply that the Hexad scale is irrelevant, since it still helps to understand the psychological motivations of individuals and therefore works inspiring for creating a fitting design space. Besides it cannot be proven that the Hexad model is not functional for element-based personalized design.

Although most participants acted as expected during the final evaluation, some choose designs that were not matching the expected preference of their main user type. A possible explanation for this can be that individuals form a spectrum of users which can make them interested in motivations of other user types as well (Tondello *et al.*, 2016). However, it can also suggest that the Hexad scale is not a holy grail when it comes down to predicting design preferences for gamification. Van Houdt et al. (2020) findings even suggest that particularly intrinsic motivations towards the environment predict preferences for gamification strategies whereas user types fall short. However, their research made use of one design version with different gamification elements and looked at how different user types interacted with the design. Meaning that there was not such a design approach as designing specifically for a user type. Based on our results we do not agree that the user types of the Hexad scale fall short in predicting gamification strategies, as the model helps to explain the main motivation of users within an energy saving application.

7 Conclusion

We iteratively designed personalized gamified solutions based on user feedback. Different from previous research assuming that using different motivational affordances per user type allows for personalization, this research suggests that motivation-based designs within a gamified element is an effective personalization approach for an energy saving application. For our study regarding philanthropists, this comes down to designing for purpose which can be incorporated by giving them insight in their own impact and by allowing them to increase their impact. Where achievers have a need for competence which they want to see back in energy saving applications through competitions with others, mostly with friends. Lastly, free spirits are motivated by autonomy, resulting in designing for having fun and learning about energy savings by allowing multiple options instead of one single defined route.

The iterative design process for personalization resulted in a gamified design consisting of two pages. It contains a dashboard and energy editor tailored towards a customer portal of a green energy supplier. Customers can choose the look of their dashboard by choosing between the different designs for each game mechanic. The energy editor can be adjusted to a customer's home situation and shows where energy savings can be reached or what decisions will cause extra usage. The option for allowing users to choose between different designs for the elements on the dashboard creates a feeling of autonomy. Although autonomy is most important for the user type free spirits, philanthropists and achievers were also liking the opportunity to create their own environment. This suggest that autonomy is an intrinsic need which is to some extent an important motivator for each of the three user types within a gamified solution.

Personalization cannot only be achieved by designing for different motivations of user types, but also by adjusting designs to match personal situation and already existing energy consumption behaviour. This approach gives users the feeling that the application is really giving them personalized advice. Furthermore, building on related work the elements information provision, progress, interactive user interface, and feedback were found essential within an energy saving application. As they help to create a basic understanding within an energy saving application and increase user involvement.

This research with actual customer of a green energy supplier provides a broader view into the possibilities of personalized gamification design for an energy saving application. The findings of this research propose a method on how to introduce the technique of gamification in such organisations and a framework that describes the main user types present and how to design for them.

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