User-Centered Gamification: The Case of IoT-Enabled Energy Conservation at Work

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ABSTRACT

Gamification is a contemporary powerful means of affecting human behavior. However, its effectiveness relies on both the users’ profiles and non-game context characteristics. This article focused on designing gamified interventions guided by the users’ profiles and the application context, towards increasing the potential for user engagement and behavior change. The authors apply a structured process while designing a serious game for energy conservation in three workplaces. First employee needs for self-actualisation, self-regulation, rewards and recognition, and affiliation are identified as the most prominent motivations to participate in gamification at work. Then their relationships with employee game element preferences and energy-saving behaviors are explored. Additionally, a mechanism producing personalized messages, which can be integrated with the gamified intervention, is proposed. Overall, this research can be useful to future researchers and practitioners that aspire to design successful user-oriented gamified interventions at work as well as different non-game contexts.

KEYWORDS
Design Guidelines, Employee Behavior, Energy Conservation, Gamification, Motivation, Personalization, UCD, User Centered, Workplace

INTRODUCTION

Buildings are responsible for 40% of the total energy consumption and 36% of CO$_2$ emissions in the EU, while one third of this demand can be attributed to non-residential buildings (European Commission, 2017). Additionally, the behavior of buildings’ occupants is considered an important factor in the consumption of energy, as it can add – or save – a third to a building’s designed energy performance (Nguyen & Aiello, 2013). Furthermore, the average amount of energy consumed per employee in the EU was over 5,600 kWh in 2015 (ODYSSEE, 2015). Although the determinants of individual energy consumption behavior are likely different at work compared to at home (Stern, 2015).
2000), limited literature exists on the behavioral aspects of energy conservation at work (Scherbaum et al., 2008), with limited references on employees’ energy use at an individual behavioral level of analysis (Bansal & Gao, 2006). Furthermore, little is known about how organizational context affects employee energy-saving behaviors (Lo et al., 2012), although employee behavior can affect the effectiveness of technical measures implemented to save energy at work (Lo et al., 2012). Therefore, there is a need to investigate employee energy consumption behavior and factors that may affect it towards conserving energy in public buildings.

Gamification – “the use of game design elements in non-game contexts” (Deterding et al., 2011) – has been employed towards increasing occupants’ motivation for energy conservation (Reeves et al., 2012; Knol & De Vries, 2011; Brewer et al., 2013; Geelen et al., 2012; Orland et al., 2014; Bourazeri & Pitt, 2013). A comprehensive review of relevant published studies (Grossberg et al., 2015) reports gamification-enabled reductions in energy consumption in the range of 3-6%, with more than 10% achievable. Hence, gamification, as a form of digital innovation, seems to have the potential to lead to significant changes in human energy-consumption behavior at work and calls for further investigation. More importantly, energy efficiency games have already been deployed in workplace environments, such as “Cool Choices”, “WeSpire”, “Economy” and “Carbon4Square” (Grossberg et al., 2015), or “Energetik” (Energetik, 2019). WeSpire in specific has led to over 9 million positive actions in 146 countries, while Cool Choices has helped >11,000 employees, in organizations across multiple industries, to increase their energy savings through >400,000 energy saving actions, and more than 100 teams have participated in “Energetik” gamified energy-saving challenges at work, having read more than 99,000 eco-actions, and 25,000 energy-saving ideas (Cool Choices, 2019; Energetik, 2019; WeSpire, 2019). Moreover, utilities, government, and commercial entities offer numerous programs and consumer products that feature related gamified apps aimed at encouraging energy behavior change by improving user experience and increasing motivation (Beck et al., 2019). However, a recent review of gamification in mobile energy applications revealed that the average energy-related gamified app heavily underutilizes gamification components and game design elements, as well as the behavioral constructs known to impact energy-related decision-making and behavior (Beck et al., 2019).

The effectiveness of gamification relies on leveraging the psychology of motivation to encourage players to play (Asbridge, 2014). Moreover, in a utilitarian setting, engagement by gamification can depend on the motivations of users and the nature of the gamified system (Hamari et al., 2014). Therefore, understanding the individuals that are involved in a gamified experience is fundamental (Robson et al., 2015) and gamification must be designed to match its target users’ individual characteristics and preferences, towards increasing motivation for specific behaviors (Uskov & Sekar, 2015; Werbach & Hunter, 2012). Towards that end, a user-centered approach should be followed in the design of gamified systems, focusing on the end-users’ needs and desires (Seaborn & Fels, 2015).

Inspired by these insights, we begin by exploring employees’ motivations to adopt gamification at the workplace, as well as their energy usage behavior and game design preferences towards a gamified app that encourages energy conservation. Our potential users of gamification belong to three workplaces that are situated in different EU countries. Our findings highlight the needs for self-actualisation, self-regulation, rewards and recognition, and affiliation as the most prominent employee motivations to embrace gamification at work. We present relationships between the users’ motivations to play and their preferences in basic game elements, as well as specific energy-saving actions. Ultimately, our research approach composes a structured procedure for designing user-centered gamified interventions that target behavior change. Researchers and practitioners can apply this procedure in different non-game contexts for designing gamified interventions that prioritize the satisfaction of the users’ needs and preferences.

Next, we briefly present a review of the relevant literature. Then, we present our research purpose and approach, and detail our findings regarding the users’ needs and preferences. We describe the user-centered serious game we designed, as well as the personalized users’ feedback mechanism that
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