

Waste No More: Gamification for Energy Efficient Behaviour at the Workplace

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Abstract: Energy wastage in public buildings amounts to an important and not fully addressed cost. The present study is focused on introducing gamification at the workplace, with the overall goal of reducing energy wastage during and past employees' working hours. In the context of an EU Horizon 2020 project, a gamified app and supporting infrastructure will be deployed to assist and motivate employees of three large public organizations in different countries, in reducing energy wastage and adopting energy-efficient behaviour. We conducted semi-structured interviews with selected representative employees, to harness important gamification-related insights and, thus, ensure that we will design and develop a gamification architecture and application which the employees will adopt.

Keywords: Gamification, Energy Wastage, Employee Behaviour, Public Buildings

1. Introduction

The energy that is being consumed in the buildings sector accounts for 20.1% of the total energy consumed on a global level, while it is expected to grow by 2.1% per year from 2012 to 2040 for the residential sector (IEO Report, 2016). Simultaneously, there is a growing need for sustainability and solutions and practices that promote an ecological way of life. Motivated by such facts, this research is interested in gamified ICT solutions that, on one hand, aspire to decrease the overall energy efficiency of workplaces and on the other, intend to make employees more energy aware, towards changing their energy consumption behavior.

More specifically, this research is conducted in the context of a European H2020 project (2016-2019) that aims to develop an IT ecosystem that utilizes Internet of Things (IoT) technologies to interconnect, monitor, control and collect energy-related data from heterogeneous data sources in buildings. The results from the advanced modeling and analytics of this data will feed a gamification application addressed to the buildings' residents, namely the employees of three different workplaces that participate in the project. The gamified app is intended to educate employees towards the benefits of decreasing energy consumption while at work, e.g. through less unnecessary printing, with an indicative goal of changing their behavior and adopting a more ecological way of living.

To ensure that the proposed gamified solution will be adopted by the employees, we have decided to conduct a systematic users' requirements analysis. This paper presents the results of semi-structured interviews conducted with selected users / employees. These interviews provide the first insights on the employees' perceptions on gamification at the workplace, in order to ensure that we will include their preferred game elements in the gamification architecture. We additionally highlight some of the interesting findings that will guide the design of the gamified app: the majority of the interviewees favors team-based gaming scenarios; rewards are optional because the participants believe that energy efficiency is a social responsibility and they don't want to feel guilty for their energy consumption behavior.

The rest of the paper is organized as follows. First, we provide a short overview of related work on gamification and energy efficiency. Then, we introduce the context and methodology of our research study. Afterwards, we present the results of the interviews we conducted to assess the users' perspective. Moreover, we discuss the results and we conclude with our future research plans.

2. Related Work

Gamification is nowadays embedded in our lives, capturing the attention of the industry, as well as the academia. Indeed “The use of game design elements in non-game contexts” (Deterding, Dixon, Khaled & Nacke, 2011) has transformed different phenomena to resemble game-like experiences for the participating individuals. With the use of *points* (Cheong, Cheong & Filippou, 2013; Eickhoff, Harris, de Vries & Srinivasan, 2012; Farzan, DiMicco, Millen, Dugan, Geyer & Brownholtz, 2008; Thom, Millen & DiMicco 2012;), *badges* (Butler, 2013; Li, Huang & Cavusoglu, 2012), *leaderboards* (Butler, 2013) *quests* (Zichermann and Cunningham, 2011), *rewards* (Lounis, Neratzouli & Pramatar, 2013) and additional extant and researched game-elements, companies transform their offerings and processes, aiming towards motivating participants to engage with a solution (Amir and Ralph, 2014; Kappen and Nacke, 2013) and change their behaviours in a given context. A number of gamification frameworks for tailoring game elements to non-game contexts, in a way that they serve business-driven or user-centered goals, have been introduced in the recent years. Additionally, many different gamification frameworks have been identified in the academic world (Mora, Riera, Gonzalez & Arnedo-Moreno, 2015). These game elements and gamification frameworks can guide the creation of gamified solutions that can ultimately provide compelling experiences to the end users of various gamified systems in different non-game contexts.

In this spirit, our research study’s non-game context concerns the workplace and the goal is energy efficiency. The industry has already engaged in games and gamification for energy efficiency at home, developing multiple solutions like Cool Choices, WeSpire, Ecoinomy, JouleBug and Carbon4Square amongst others (Grossberg, Wolfson, Mazur-Stommen, Farley & Nadel, 2015). At the same time, academia has been experimenting with game elements such as feedback, tips, challenges, social challenges and rewards, through the ‘EnergyLife’ gamified app and conclusions included that the users changed their energy consumption habits towards more efficient practices and subsequent savings (Gamberini et al., 2011). ‘Energy Battle’ is another gamified application, aimed at energy savings by employing feedback, rewards and ranking, that also yielded positive results (Geelen, Keyson, Boess and Brezet, 2012). Furthermore, Gustafsson et al. (2009) demonstrated the capacity of games and gamification to motivate participation and, through the use of challenges and energy related tips, succeed in the reduction of energy consumption during gameplay. Thus, it is worth cultivating energy reduction habits to the employees, at their workplace, towards encouraging sustainability. Furthermore, inspired by demonstrated applications of gamification for energy efficiency at home, we focus on the potential of gamification to educate and motivate employees towards reducing energy consumption at work e.g. by turning the office lights off when they have a lunch break.

3. Harnessing The Employees’ Gamification Perspective

The ultimate goal of our research is to specify the detailed characteristics of a gamified app designed for use at the workplace. Such, that employees will include in their work routine and use daily, in order to become more energy sensitive and adopt habits that favor lower energy consumption. To this end we, first of all, wanted to gain insight into the employees’ perceptions, on the introduction of gamification in the workplace, to ensure the inclusion of the optimal game elements in the global gamification architecture of the gamified platform. Hence, we conducted semi-structured interviews with selected potential users at the three workplaces where we aim to deploy the gamified app. The first site is a municipality’s IT support service in Greece, set in a public office space that hosts 55 employees in 14 offices. The second site is an electricity regulation agency in Spain, hosting 49 employees in an open-space office and 8 separate offices. The last site is a museum in the city of Luxembourg with 100 employees on 4 buildings, exhibition rooms, and 25 administrative offices. All employees in the sites have mainly administrative, technical and back office support roles, while different employees can act upon different energy consuming devices in a separate, but accounted for manner, due to role-related responsibilities. Overall, the most energy offending devices in terms of energy wastage identified include lighting, PCs and monitors, printers, air conditioning units and kitchen appliances.

We interviewed 26 employees in total, with a two-fold gamification focus: First to examine the eligibility of the specific non-game context to be gamified, its potential and inherent limitations; and second to dig deeper into different game elements and their perceived contribution in the overall goal of energy wastage prevention. Questions were also asked with regards to the general energy consuming behaviour at the workplace and daily routine of the individuals. For the present research purposes,

employees from different divisions of each site and with different organizational roles were selected to account for all types of employees extant and in proportion. The sample of 26 employees consisted of both male (46%) and female (54%) participants. Although we interviewed a fraction of the total employees on all sites, selected with careful sampling and a thorough collection technique, a small amount of interviews can produce data capable of addressing the research goal (Holloway, 1997). Indeed, we sampled until there was no production of new information or insights, following the theoretical saturation general rule of qualitative research. In the present research, theoretical saturation was deemed achieved and was satisfactory for valid sampling after 26 employees. Our research is additionally consistent with the suggested valid range of case sampling of more than ten cases (Eisenhardt, 1989). Moreover, all information collected during the interviews was content-analyzed and coded by three independent coders into categories pertaining to the present research. A number of categories were decided upon ahead of time (e.g. Game Element of Point, Badge etc.) while other categories were identified based on the employees' responses (e.g. setup of teams). In the case of disagreement on the classification of any particular statement, the disagreements were resolved through joint discussion.

4. Results: The Employees' Perspective on Gamification

The following in-depth results from the interviews address gamification design insights pertaining to the non-game context and its eligibility to be gamified, overall gamification architecture insights and insights on individual game elements with the overall goal of driving employees toward the common effort of endorsing sustainable and waste-free energy consumption practices.

In relation to preventing energy wastage at the workplace, the interviews revealed a number of interesting insights. Initially, the majority (24) of the participants on all three sites indicated that as they were aware of different energy wasting scenarios currently extant at their organization (e.g. Monitors left on standby after work, air-conditioning set to very high temperature etc.) they believe that the gamified app should be evolved around the actual energy consumed at their workplace, and what they can do about it. Overall, they would be interested in having a support mechanism (that could resemble a game) for motivating all to behave responsibly. Another important outcome was that the sample that admitted to smartphone gameplay habits, was almost equally divided between individuals with (13 participants) and without (12) previous and current experience in playing mobile games. Furthermore, we identified a key intricacy of the present non-game context that is illustrated by the following statement: "Do not make people feel guilty" (Spanish site). Identifying energy wastage, particularly in a workplace environment, may therefore lead to dismay by employees and higher management, and therefore decreased usage of the gamified solution. Lastly, 11 interviewees suggested that they use a smartphone on a daily basis, while explicitly stating that the system's interaction with the users/employees should be via a smartphone app (iOS and Android) and not a PC-based application.

In terms of overall gamification potential architecture, the valuable insights relate to the need for utilizing real energy consumption data in the gameplay, and the process of attaining the goal of preventing energy wastage. Through the interviews we identified important differences on three major gamification design elements with implications in supporting the aforementioned process: (a) team formation and subsequent collaboration in teams (b) rewards for completing energy wastage goals and (c) social aspects of the gamified process. Concerning the gameplay mode, the interviewees in their majority opted for a team-based scenario of pursuing goals in a collaborative form (16), as opposed to a single player mode of pursuing goals (10). At the same time, both for team and single player modes, the results for the rewards for completing a goal are split; 9 participants believe that rewards are deserved for being energy efficient at work, while 17 don't because they feel that it is their responsibility to be energy conscious. This finding will guide the design of the gamification architecture towards optimal rewarding. A final important result that differs in the present non-game context (workplace) is that a segment (5 out of 26) of the employees explicitly stated that they did not want the game to feature a connection with social media (e.g. Facebook).

5. Discussion and Conclusions

The focus of the semi-structured interviews, in terms of gamification, was to garner employees' perceptions on gamification and sustainable energy usage in the workplace environment, as well as identify the potential benefits from the introduction of gamification in the process. Results indicate a potential benefit from the introduction of gamification towards energy wastage prevention.

Additionally, in relation to the non-game context at hand, it was found that it is eligible for the introduction of gamification. Furthermore, a number of intricacies of the specific non-game context were identified, like the need for disaggregation of energy consumption through shared appliances (e.g. printers and office lights) and subsequent inclusion of their effect (energy reduction), on specific game rule-sets (e.g. Award points per team member's behavior on commonly utilized printer). Another interesting fact is that not all employees are allowed to act upon commonly consuming devices. An example of that issue can be illustrated by an HVAC unit, that consumes a disproportionate amount of energy than the light in an office, while not all employees can control the HVAC. This leads to the problem of an employee that behaves consistently in a sustainable manner over the lights, not being able to produce a large scale reduction in energy consumption, compared to an employee that acts upon an HVAC that may not be behaving in an energy friendly way as often. Therefore, the need for the gamification solution to also account for individual behavioural change and normalize rewards taking into account the effect of energy reduction at the same time, is created.

On the gamification element of teams, the main findings include the need for team formation in different setups. Initially teams should be formed in a way that reflects organizational structures and organization divisions. Users on all sites belong in divisions that share energy consuming devices and have different energy consuming requirements (e.g. Accounting prints a plethora of reports, whereas IT doesn't, leading to an inability of accounting to reduce energy consumption through printers). Another team formation insight is that teams could be formed on an ad-hoc basis, supporting global goals (e.g. Reduce 10% energy wastage on monitors on the first floor). Regarding the preferred way of team interactions, it was found that individual contribution towards the achievement of the goal should be acknowledged and rewarded, as illustrated by the following statements: "In a game for our purpose, I would prefer a common goal, not individual goals." and "If the common goals are attained, any benefits should be divided according to individual efforts if possible. Everybody should win something in any case." (Greek participant).

Regarding the rewards structure, the interviews showed that employees were divided between those opting for rewards and those that did not want something in return. Building on that, and to account for both, different rewards could be introduced that may be pursued selectively. Example rewards could include physical rewards as illustrated by the statement: "let's reduce energy consumption and win a free coffee" (Greek participant) and virtual representations of achievements (i.e. Badges). An important factor that will play a role in the ability to introduce physical rewards is the ability of the organization to provide bonuses.

Further on and in relation to the game element of a scoreboard an interesting finding was that, as the context is of organizational nature, many users were skeptical towards their energy related behaviour being monitored, as well as its potential impact on their work (e.g. HR evaluation based on energy efficiency). Therefore in the present non-game context it is prudent to further examine the eligibility and potential a scoreboard may have on incentivisation. Lastly, in relation to the basic building block of gamification, the points allocation mechanism, taking under consideration the results of the interviews it is evident that points should be allocated based on actions that can be validated by the system. Additionally, in team-based scenarios, they should be proportionate to the contribution of each participant / team-member in the common goal.

Overall, this paper presents the first efforts of a research study that aspires to design, develop and evaluate a gamified app, and supporting infrastructure, aimed at changing the behavior of employees towards adopting more energy efficient habits. The presented user interviews are the first step in our identification of the future employees/ users' requirements and needs. We intend to utilize the interview insights to formulate a questionnaire and conduct a users' survey to collect more detailed information on their energy consumption practices, willingness to change their energy behavior and, certainly, the global game elements they prefer to see in a gamified app. We will utilize all these results to ensure that we will develop a gamified app that matches the needs and preferences of the users; and, thus, they will effectively use it. Then, we will conduct pilot applications of the gamified solution in the three sites and evaluate the results in terms of real energy consumption and employees' behavior change. Our ultimate goal is to provide design and evaluation guidelines to future researchers and practitioners that are interested in gamified apps for energy efficiency purposes.

Acknowledgements

This research study is partially funded by the project ChArGED (CleAnweb Gamified Energy Disaggregation), that receives funding from the EU Horizon 2020 research and innovation programme, under grant agreement No 696170.

References

- Amir, B. and Ralph, P. (2014). Proposing a theory of gamification effectiveness. *Systems Research*, 3, 1, 60-95.
- Antin and Churchill. (2011) Badges in Social media: A Social Psychological Perspective. *In Proceedings of CHI 2011*, May 7-12, 2011 Vancouver, Canada.
- Butler, C. (2013) The Effect of Leaderboard Ranking on Players' Perception of Gaming Fun. *In Ozok A.A. and Zaphiris*. pp169-136.
- Cheong, C., Cheong, F., Filippou, J. (2013) Quick Quiz: A Gamified Approach for Enhancing Learning. *In Proceedings of PACIS 2013*, June 18-22, Korea. Paper 206.
- Deterding, S., Dixon, D., Khaled, R., Nacke L., (2011). From Game Design Elements to Gamefulness: Defining "Gamification". *MindTrek'11*, September 28-30, Tampere, Finland.
- Eickhoff, C., Harris, C.G., de Vries, A.P., Srinivasan. P. (2012) Quality through Flow and Immersion: Gamifying Crowdsourced Relevance Assessments. *In Proceedings of SIGIR 2012*, August 12-16, Portland, Oregon, USA, pp 871-880.
- Eisenhardt, K. (1989) Building Theory from case study research. *Academy of Management Review* 14 (4) , 592–611.
- Farzan, R., DiMicco, J.M., Millen, D.R., Dugan, C., Geyer, W., Brownholtz, E.A. (2008) Results from deploying a participation incentive mechanism within the enterprise. *In Proceedings of the twenty-sixth annual SIGCHI conference on Human factors in computing systems*, pp. 563-572.
- F. Grossberg, M. Wolfson, S. Mazur-Stommen, K. Farley, and S. Nadel. (2015) Gamified Energy Efficiency Programs. *ACEEE Research Report B1501*, February 2015.
- Gamberini L, Corradi N, Zamboni L, Perotti M, Cadenazzi C, Mandressi S, Jacucci G, Tusa G, Spagnolli A, Björkskog C, Salo M, Aman P. (2011) Saving is fun: Designing a persuasive game for power conservation. *In Proceeding Proceedings of the 8th International Conference on Advances in Computer Entertainment Technology*, ACE'11. 1-7; 2011.
- Geelen D, Keyson D, Boess S, Brezet H. (2012) Exploring the use of a game to stimulate energy saving in households. *Journal of Design Research* 2012;10:102–20.
- Gustafsson, A., Katzeff, C., and Bang, M. (2009). Evaluation of a pervasive game for domestic energy engagement among teenagers. *ACM Computers in Entertainment* 7, 4, Article 54 (December 2009), 19 pages.
- Holloway, I. (1997) *Basic concepts for qualitative research*. Wiley-Blackwell.
- Kappen, D. L. and Nacke, L.E.. (2013) The kaleidoscope of effective gamification: Deconstructing gamification in business applications. *In Proceedings of Gamification 2013*, 1–4.
- Kuntz K, Shukla R, Bensch I (2014) How many points for that? A game-based approach to environmental sustainability. *In Proceedings of the American Council for an Energy-Efficient Economy Summer Study on Energy Efficiency in Buildings*, 2014 ACEEE; 2012. 126-137.

Li, Z., Huang, K.W, Cavusoglu, H. (2012). Quantifying the Impact of Badges on User Engagement in Online Q&A Communities. *In Proceedings of the International Conference on Information Systems, ICIS 2012*, Orlando, Florida, USA.

Lounis, S., Neratzouli X., Pramataris K. (2013) Can Gamification Increase Consumer Engagement? A Qualitative Approach on a Green Case, *In Proceedings of the 12th IFIP Conference on e-Business, e-Services, e-Society*, Doulgieris, C., Nineta, P. Karantjias, A., Lamersdorf, W. (eds.), Athens, Greece, pp. 200-212.

Mora, A., Riera, D., Gonzalez, C., & Arnedo-Moreno, J. (2015). A literature review of gamification design frameworks. *In Games and Virtual Worlds for Serious Applications (VS-Games)*, 2015, pp. 1-8. IEEE.

Energy Information Administration (2016). *International Energy Outlook 2016 report*. Report Number: DOE/EIA-0484(2016), 11 May 2016. Retrieved from <http://www.eia.gov/outlooks/ieo/buildings.cfm>.

Thom, J., Millen, D.R., DiMicco, J (2012) Removing Gamification from an Enterprise SNS. *In Proceedings of the ACM 2012*.

Zichermann, G. and Cunningham, C. (2011). *Gamification by Design: Implementing Game Mechanics in Web and Mobile Apps*, O'Reilly Media.