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GAMIFICATION, GEOLOCATION AND SENSORS FOR EMPLOYEE MOTIVATION TOWARDS ENERGY CONSERVATION AT THE WORKPLACE

Research in Progress

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Abstract

In an era of significant technological advancements, as well as dramatic changes in the business environment, the state of the workforce seems to remain problematic, with regards to motivation. Albeit prevailing societal clichés, that often seem to promote the idea that 'the modern workplace provides for a far better experience than in the past'; the truth remains that modern employees bear a significant resemblance to their ancestors – regarding the emotional burden their jobs instil on them – and remain, in their majority, unmotivated. Gamification, a relatively new instrument in the "orchestra of motivation", offers a promising alternative to the strict corporate rules and policies that usually dictate the employees' conduct, by adhering to their intrinsic motivation. Simultaneously, two promising technological giants have risen, to invisibly, as well as ubiquitously accompany us in our every move. On one hand, the advancement of geolocation technologies has led to the introduction of location-based services and custom content delivery. On the other hand, sensors of all types and flavours, installed to measure countless parameters of our surroundings, the workplace included. Through our study, we aim to investigate the effect of the application of these three technologies – Gamification, Geolocation and Sensors – isolated, or in concert, on employee motivation towards a common goal – energy conservation at the workplace.

Keywords: Gamification, Geolocation, Sensors, Employee Motivation, Energy Conservation.

1 Introduction

A few decades ago, in 1930, John Maynard Keynes made the bold prediction that the three-hour workday would prevail for his grandchildren's generation. However, several decades later, the question of working time is as pertinent as it was at the inception of the 40-hour week (International Labour Office 2007). Furthermore, according to the World Health Organisation (WHO), the average adult spends one third of their lifetime at work, whilst at the same time facing safety issues, as well as physical and mental adversities (WHO 1995). Additionally, according to the US Bureau of statistics, the time spent by the average US employee at work is the largest portion of their day, sleep included, with other activities consuming less than a third of that time each (Bureau-of-Labor-Statistics 2014). At the same time, Gallup reports that engaged employees worldwide account for a surprisingly low percentage - 13% of the total workforce, or one in every eight workers - in a phenomenon they call "the worldwide engagement crisis" (Mann & Harter 2016). On the other hand, engaged employees worldwide, are more likely to be "thriving", rating their overall lives highly, than those who are not engaged or actively disengaged (Gallup 2013). Moreover, engaged workforces create external benefits to the entire community through increased economic optimism among residents and improved performance outcomes among businesses (Gallup 2013).

If we combine the aforementioned facts, we can deduce that the vast majority of employees worldwide, spend the largest part of their days, as well as their lifetime - unengaged or actively disengaged - at their work environment. On the other hand, the "engaged minority", seems to be "thriving", whilst creating external benefits for their companies, as well as their communities and themselves.

Gamification has been suggested as a powerful way to change behaviour, create motivation, increase and sustain employee engagement and productivity within an enterprise (Webb 2013),(Pickard 2015). Furthermore, it can help companies create an active, engaged, productive team – especially among new hires (Concur 2014). The active use of gamification for the improvement of business processes, results in amplified workers' positive psychology, and strengthens positive emotions, engagement, relationships, the sense of meaning, as well as accomplishment. Therefore, to reverse the disappointing engagement trends, several leading companies are turning to gamification (Uskov & Sekar 2015).

The aforementioned facts inspired us to consider gamification, as a means towards transforming the experience of employees within their workplace. In addition, we want this new gamification-enabled experience to have a significant impact on the employees' behaviour. Our study focuses on the motivational power of gamification-enabled applications towards more energy-sensitive employees within their work environment. Geolocation and sensing technologies shall also be selectively incorporated in the gamification apps, to assess their individual effect in the same context. Finally, we shall also explore whether the users' / employees' profiles moderate the gamification effect.

In the next section, we present background information relative to this research. We begin by examining gamification and continue with geolocation and sensors, in view of the fact that the latter two shall be examined in connection to gamification throughout this research. Then, we discuss our research purpose and approach, analyse our practical and theoretical contributions, and conclude the document.

2 Background

2.1 Introducing Gamification and defining "Gamification Quotient" (GQ)

According to Deterding et al., the term "Gamification" originated in the digital media industry. The first documented use dates back to 2008, but the term did not see widespread adoption before the second half of 2010. They have proposed the following, widely accepted definition (Deterding et al. 2011): "Gamification" is the use of game design elements in non-game contexts". The basic and most well-known gamification elements are points, badges and leaderboards (also referred as PBL). The

PBL triad forms a useful starting point for gamification efforts. Beyond PBLs, there are a number of different game elements that can be incorporated to gamification applications (Werbach & Hunter 2012). Single elements can fulfil different functions, but in interaction with each other they can have varying and complex motivational effects (Sailer et al. 2013). The MDA (mechanics-dynamics-aesthetics) framework is widely used to categorise the wide range of gamification elements (Zichermann & Cunningham 2011).

The most commonly stated objective behind using gamification is to encourage behaviour change in end-users, whether that behaviour change involves increased participation, improved performance, or greater compliance (Seaborn & Fels 2014). In a work environment, 'gamified' experiences can focus on business processes, or outcomes, which can also involve participants, or players, outside of a firm and/or within it, to improve employee satisfaction (Robson et al. 2015). There is a recent first attempt to define workplace gamification as "the adaptation and application of game design principles and game interaction elements to workplace processes and behaviours" (Oprescu et al. 2014). Furthermore, gamified workplaces are defined as organizations that use gamification to transform some of their work processes into a game-like experience for the employees (Oprescu et al. 2014). When organizational goals are aligned with player goals, the organization achieves its goals as a consequence of players achieving their goals, and employees can become fully engaged with new company initiatives (Dale 2014).

To our knowledge, no measure has been defined, to assess the content of a gamified app in terms of game design elements. Therefore, for the purpose of our research, we define a new measure, which we have named "Gamification Quotient", or "GQ". This metric expresses the gamification level of an app and will receive its value, depending on the gamification design elements included in the app under examination. Furthermore, it will answer the simple question "How gamified is an application?". The value of GQ will indicate the cumulative weight of the game design elements an app includes.

2.2 Theories to Explain Gamification's Motivational Power

Gamification instigates behavioural change, through positive emotional feedback. It can break up existing habits, update them with new behaviours by providing positive emotions, and support the stabilization of new behaviours by continuously setting appropriate stimuli (Blohm & Leimeister 2013). A variety of theories have been adapted to explain the motivational power of gamification, in an effort to harness its effects and allow for a more efficient deployment of gamification initiatives. They include: Maslow's hierarchy of needs (Ashridge 2014), (Richter et al. 2015) & (Reiners & Wood 2015), Expectancy theory (Richter et al. 2015), Goal Setting theory (Reiners & Wood 2015), Fogg's motivation wave theory, Reiss's theory of 16 Basic Desires (Lewis 2014), William James' theory of internal desires (Gears & Braun 2013), Malone's theory of intrinsic motivation in games, as well as Calleja's model that emphasises on the social aspects that influence the gaming experience (Iacovides et al. 2011), Theory of Reasoned Action (TRA) and Technology Acceptance Model (TAM) (Rodrigues et al. 2013).

However, the majority of researchers suggest that Ryan & Deci's Self Determination Theory and its sub-theories should be used to explain and harness the motivational effects of gamification. This theory suggests competence, relatedness and autonomy as the basic antecedents of intrinsic motivation (Ryan & Deci 2000), (Ryan et al. 2006), (Vansteenkiste & Ryan 2013). Moreover, there is a general wide recognition of Csikszentmihalyi's Theory on Flow (Csikszentmihalyi 2009), (Schacht & Schacht 2012), (Killian 2013) that supports the design of appropriately challenging gamification applications for all users. Finally, Skinner's Theory on Operant Conditioning (McLeod 2015) is applicable to choosing appropriate reward schedules in any gamified system. We intend to examine gamifications' influence on employee motivation, based on the principles of these three motivational theories.

Motivational theories have also been recruited, to explain pro-environmental, as well as energy conservation behaviours, in various environments. McDonald (Mcdonald 2014) has synthesized the leading models and theories explaining general and pro-environmental behavior and proposed an integrated framework for environmentally friendly behaviour in the workplace (Mcdonald 2014). At the same time, Scherbaum et al. have specifically examined individual-level factors related to employee energy-conservation behaviors at work, based on the Values – Beliefs – Norms theory. According to their conclusions, environmental personal norms and environmental worldviews are factors that can be leveraged in organizational interventions concerning employee energy use (Scherbaum et al. 2008). Finally, to instigate the conservation of energy in a workplace, efforts should focus on self-regulation, as defined by A. Bandura. (Bandura 1991) and not – military style – command & control processes.

2.3 Applying Gamification in the Workplace

Introducing games into the workplace has a considerable history. Two notable, relevant research areas include using games as human resources tools or as entertainment interfaces for repetitive tasks like computer process management (Nikkila et al. 2011). Furthermore, at least two precursors to the gamification-of-work movement have been documented in the literature. The Soviet Union conducted extensive experiments with workplace-based "socialist competition", aspiring to use the power of games and competition as a more humane and engaging replacement of traditional capitalist competition, which would, at the same time, lead to high productivity. In contrast, the 1990s-2000s American management trend of "fun at work" proposed re-imagining the workplace as a fun and playful locale, encompassing an intrinsic, child-like play. In practice, this trend included many game-like elements (Nelson 2012).

We emphasize that, the analysis and design of gamification applications require different approaches in corporate than in consumer environments. Simultaneously, gamification often involves storing and processing of personal, as well as potentially sensitive data. This is especially a challenge within company boundaries, where gamification could lead to "transparent employees" or where inappropriate extrinsic incentives might crowd out intrinsic motivation (Blohm & Leimeister 2013). Gamification in the enterprise also needs to apply to long-term objectives in addition to initiative-specific objectives (Reiners & Wood 2015). Additionally, in a corporate setting, players are more invested in intra-group competition than in inter-group competition. As a result, focusing on design components that reflect in-group dynamics may have a greater impact than emphasizing game attributes revealing inter-group activities (Nikkila et al. 2011).

It has been suggested that gamification might contradict with some personality types and cultural norms (Shahri et al. 2014). Therefore, it is important to design gamified applications that would match the profile of their target users. To do so, we must distinguish between different types of end-users and their respective characteristics. The game mechanics that are incorporated into a gamified application have a different impact on different user types (Uskov & Sekar 2015). Additionally, when designing gamified applications for the workplace, we have to consider the level of engagement of the participating employees – engaged, non-engaged, or actively disengaged (Prakash & Rao 2015).

Companies like Microsoft, IBM, Oracle, Adobe, Cisco, Siemens, SAP, Google, Accenture, American Express, Caterpillar, and Ford, are already using gamification techniques and gamified applications to support their main business functions, processes, and activities (Uskov & Sekar 2015). In addition, gamification has also successfully been used in a business environment to promote employee motivation by the Deloitte Leadership Academy (Huang & Soman 2013), British Gas, Volkswagen (SODEXO 2016), Target stores and Ford Motor company in Canada (Hein 2013), IBM (Erenli 2013), Microsoft (Schacht & Schacht 2012), Google, SAP (Dale 2014), Canon, Cisco, L'Oreal, Lexus, FedEx, Sun Microsystems and UPS (Schawbel 2013).

2.4 Geolocation

Simply put, the term "geolocation" denotes the position of an object (or person) in space. ISACA (Former known as Information Systems Audit and Control Association) has suggested the following formal definition: "a geolocation system is an information technology solution that ascertains the location of an object in the physical (geo-spatial) or virtual (Internet) environment. Most often, the object is a person who wants to utilize a service based on location, while maintaining his/her privacy." (I.S.A.C.A. 2011). The popularity of geolocation changed dramatically only after the 1st of May 2000, when US President Bill Clinton announced the removal of selective availability of the GPS signal, which led to a significant improvement in the accuracy of simple, low-cost GPS receivers (6 to 10 meters radius in normal conditions, in contrast to roughly 100 meters before) (Haklay & Weber 2008).

More specifically, indoor positioning, the notion of defining the geolocation of an object, or oneself, in the confines of a closed space, is constantly growing in popularity (In-Location-Alliance 2015). With the adoption of new indoor navigation solutions, new indoor mobile applications are being developed at a phenomenal rate, based on the fact that people spend about 89% of their time indoors. In addition, there is a strong trend to extend LBSs indoors (Elhamshary & Youssef 2015). Sharing one's location and knowing the whereabouts of others is a practical tool for coordination and communication (Cramer et al. 2011). Furthermore, research has also shown that users share information more willingly and show less privacy concerns when the network's spatial scope is limited (Möller et al. 2014).

Gamification has been combined with geolocation in a number of cases in the literature. Examples include: KORT Game (OpenStreetmap.org 2014), Towns Conquer (Castellote et al. 2013), AiRCacher (Tursi et al. 2014), Ubiversity (Möller et al. 2014), Ori-Gami (Schwering et al. 2014), Waze (Fitz-walter & Tjondronegoro 2011), Accident Bucket (Law et al. 2011). An example of the utilisation of indoor geolocation information with gamification is in improving the hand-hygiene compliance of nurses in a hospital ward. (Lapao et al. 2015).

2.5 Sensors

Sensors can be used to power-up, or shut down devices, machinery, or lighting, or even to facilitate indoor geolocation functionality. They can also measure environmental variables like temperature, humidity, luminescence, or wind speed, as well as utility consumption like electric energy, or water. Furthermore, they can measure the time an employee spends working in a facility (like RFID punch-card clocks), as well as sense the presence or absence of a person or object from a specific room or facility. They can essentially form an interactive mediator between human and machine/device.

We are interested in sensors because they can enable gamification applications with design elements that can adjust to the users' sensed context. Sensors can also provide cues for gamified applications, such as entering a context, leaving a context or while in a context. Gamified services delivered on smart phones, such as Foursquare, utilise mobile phone sensors to capture user contexts as a means of triggering game elements. By interpreting user behaviour when a user interacts with the gamification system, we can dynamically determine which game elements should be triggered. Furthermore, by using the sensors found in smartphones, a range of different user inputs can be captured and used to power gamified services delivered in mobile environments (Fitz-walter & Tjondronegoro 2011).

Furthermore, when successfully utilized, sensors can be used to instigate motivation. However the perception of surveillance tends to diminish feelings of autonomy, prompt a change in perceived locus of causality from internal to external, and undermine intrinsic motivation (Gagne & Deci 2005). Therefore, in a gamified application, they must be utilised in a way that will not create a perception of surveillance to the participants.

Examples of gamification applications that feature the use of sensors include: Munzee (Clark 2012), Aurnhammer's BeaconCrawl (IndoorGeo 2014), and Museum Assistant – MusA (Rubino et al. 2013).

3 Research Goal & Methodology

The main goal of our research is to investigate *if and how gamification applications can motivate employees towards a more energy-sensitive behaviour in the workplace.* This unfolds into the following research questions:

a. Do user / employee profiles have an impact on gamification applications' effectiveness on employee motivation towards reducing the consumption of energy in a corporate environment?
b. Does the introduction of geolocation information in a gamification application enhance the effect on employee motivation towards reducing the consumption of energy in a corporate environment?
c. Does the integration of gamification with sensing technologies enhance the effect on employee motivation towards reducing the consumption of energy in a corporate environment?
d. What is the combined effect of the integration of both geolocation and sensing technologies in a gamification application, on employee motivation towards reducing the consumption of energy in a corporate environment?
e. How does the Gamification Quotient (GQ) of an application affect employee motivation towards reducing the consumption of energy in a corporate environment?

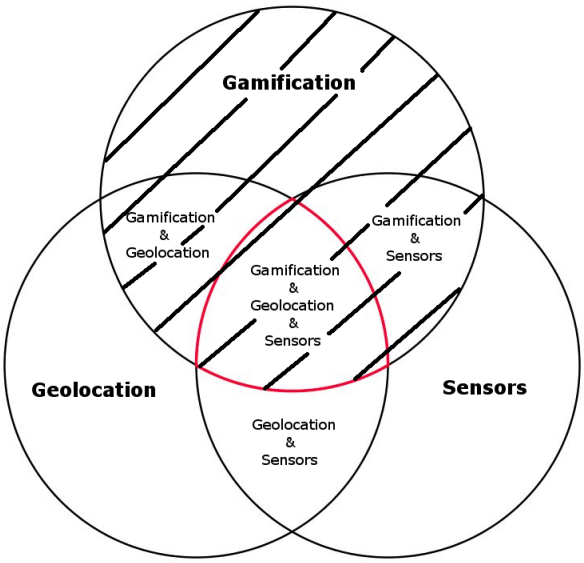

Figure 1.Visual representation of the combinations of applications that we will be examining

To address our ambitious questions, we are fortunate enough to participate in two EU research projects that include designing and developing gamification applications. Their specific aim is to motivate employees into reducing energy consumption within the different buildings they work in. We intend to monitor the consumption of energy within these buildings by installing specialised equipment. Furthermore, we are planning a series of experiments with apps of different GQs, which shall selectively incorporate geolocation and/or sensor functionality, to assess their respective effect on employee motivation towards reducing energy consumption.

We are in the process of executing the first research step. Namely we are conducting interviews with the participating employees, in order to ascertain their personal characteristics, game preferences, as well as energy consumption and environmental awareness profile.

We will additionally acquire baseline data on the current consumption of energy by the participants, before any gamification methods are applied. This data will be gathered, using specialised equipment, in an initial period, where no gamification methods will be applied. We need these data, so that after the application of our methodology, we have the opportunity to compare the baseline / control data with the resulting energy consumption, and draw conclusions.

A series of experiments will be implemented, in order to answer our research questions. To avoid bias, the experiments will be executed simultaneously in the six different pilot sites, with different groups of users. The different contextual characteristics of the various pilot sites will be considered in the analysis of the results. Furthermore, the collected results will be the users' perceived impact of the apps on

their energy consumption, as well as the compared actual energy measurements before and after the application of gamified services.

During our experiments, we plan to assess the effect (variance) on the consumption of energy between groups of employees, each of which will be using a different gamified application, selectively equipped with the different combinations of gamification, geolocation and sensors. By using different combinations of tools (e.g. gamification with geolocation on one group – gamification without geolocation in another) in the design of our gamification initiative, to be used by each group, we will be in a position to compare their respective effects on employee motivation. Then, the results shall be analysed, grouped, and / or contrasted, to reach useful conclusions regarding the research questions we initially set out to answer. If more questions or parameters arise from this phase and adequate time and resources remain, a second phase of experiments could follow, in an iterative way.

In parallel to the above, we also plan to conduct a survey with gamification experts to 'grade' the available design elements that can be used in gamified apps. They shall be asked to prioritize the existence of the different game elements in a potentially gamified app, in terms of their significance. The results of this survey, in combination with an extensive review of published gamified apps, will guide us to calibrate the GQ. According to the classification of design elements by the experts, the more advanced and significant gamification design elements an app includes, the higher GQ it will receive.

4 Practical & Theoretical Contributions

Through our research so far, we have managed to uncover the research gap that exists in the bibliography, with regards to the effect of the combination of Gamification, Geolocation and Sensors on employee motivation towards energy conservation.

We aspire to contribute to theory by defining a new term, named "Gamification Quotient", or "GQ", which characterizes the weighed content of a gamified application in terms of game design elements. It is our belief that this measure must be further investigated and enriched, as it can provide a standardised indexing solution for gamification researchers, as well as developers. Moreover, we believe we will complement the theory on employee motivation by assessing the motivational power of new, innovative technological means (gamification, geolocation and sensing capabilities) towards specific goals such as employees' energy conservation in the workplace. In addition, we plan to contribute to the available studies on employee behaviour, by identifying how the employee profile is associated with the effect of such technologies on employees' behaviour towards energy conservation.

At the end of our study, we expect to be in a position to additionally provide guidelines into the application of gamification techniques, selectively combining geolocation and sensor functionality. Specifically, based on the context within which our applications will be deployed and the users' profiles, we expect to derive guidelines into the application of gamification towards energy conservation, especially in a business environment. These guidelines shall assist future researchers, as well as practitioners, in developing gamified apps, as well as energy conservation apps in specific, for use in a workplace environment.

5 Conclusion

A large number of gamification applications have been implemented in various contexts over the past few years. However, there is a need for further investigation into the application of gamification in a corporate environment, especially combining geolocation functionality and sensor technologies. We expect this combination to have a significant impact on employee motivation, powered by the synergistic effect of the gamification constituents utilised. Our study is specifically focused on employee motivation towards energy conservation in the workplace.

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