Gamification of Persuasive Systems for Sustainability

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***Abstract*—This work in progress presents some initial findings concerning the use of gamification and persuasive technology in the domain of reaching a set sustainability goal by using persuasive systems. Both gamification and persuasive technology have become more pervasive elements in the research community in the domain of human-computer interaction (HCI) and information systems. This paper argues for research addressing the designing of these systems since we currently have a vague understanding of the important underlying mechanism. Sustainability is genuinely complex and the designer of a persuasive system with a set sustainability goal must consider numerous parameters when designing the artefact.**

***Index Terms*—Design, Gamification, Persuasive systems, Persuasive technology, Sustainability**

I. Introduction

We live in an uncertain world today with sustainability perils like lack of water, deforestation, pollution, endangered species, global warming, and inequality. Sustainability could be seen on different levels of the analysis, a macro level e.g. global, nation, society, or on a micro level, e.g. household, family, and individual. Global problems connected to sustainability are experienced, e.g. health is endangered by obesity [1] and climate change [2]. When global collaboration, e.g. the Paris agreement to amend global warming, seems to fail, the importance of giving individuals and organisations information to make a better and well-informed choice to change their behaviour towards sustainability is of uttermost importance.

Persuasion has probably been used since the beginning of humankind in order to change an individual's behaviour. One of the oldest techniques is to use coercion to change behaviour. The development of technology has created the possibility to efficiently and effectively use technology for persuasion. Fogg, a pioneer in persuasive technology defines persuasion as "an attempt to change attitudes or behaviour or both (without using coercion or deception)" [3]. The developed persuasive systems should follow this principle. When searching (2017-10-03) for design guidelines and frameworks, etc. using Web of Science, Scopus, and Google Scholar, none was found that addressed the gamification of persuasive systems for sustainability. Thus, an uncharted but important domain was found to explore. What important issues need to be considered and addressed when designing gamification of persuasive systems for sustainability? In the following text, some identified problems and preliminary findings will be presented.

II. Background

A. Persuasive system and sustainability

The definition of sustainability is dependent on the context and area of research. Sustainability could be derived from The World Commission on Environment and Development (WCED) which defines sustainable development: "... development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [4]. Organizations have in the past prioritized the economic interest of sustainability, but a holistic view and understanding that includes the environmental and social impact are equally important. Hence, sustainability could include, for example, health issues (e.g. smoking, drinking, reducing sugar intake, exercise, and eating nutritious and balanced meals), work conditions (e.g. stress, noise levels, physical environment, and safety), environmental (e.g. home, deforestation, endangered species, and climate change), and social (e.g. equality and distributed justice).

The designing of experience to influence the behaviour of people can be labelled persuasive design [5] and persuasive technology, e.g. computers can be used to support persuasive design [3]. In previous research on behaviour change support systems (BCSS), Oinas-Kukkonen (2013) showed that the persuasive system-design (PSD) could be used as an advanced tool for designing and evaluating BCSS [6]. The individual's behaviour could be changed by using PSD into reaching a set goal. In previous research, persuasive systems have been used to alter the behaviour of users towards reducing the use of resources e.g. reducing electricity or water consumption [7]–[9]. For more, see the review by Matthews et al. [10] on persuasive mobile applications to promote a healthy living.

B. Gamification

Gamification as a concept became adopted and spread around 2010 [11], although the concept is much older. One of the first commonly shared major theoretical definitions of gamification is that "gamification" is the use of game design elements in non-game contexts [11]. Another way to describe the core of gamification is, as Werbach and Hunter write, "At its core, gamification is about finding the fun in things that we have to do." [12]. Unfortunately, sometimes gamification design is simplified into only adding points, badges, and leaderboards (PBLs) into a previously non-game environment [12], [13]. Using and including gamification in the design of

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persuasive systems could increase the chance of success to reach sustainability goals. To succeed using gamification in persuasive systems puts a lot of demand on the design.

III. Problem statement

Some persuasive systems are not allowing the user to get a holistic understanding of the sustainability problem the system intends to solve. Depending on the scope, actions taken could be seen as just a reduction of resources, e.g. reducing fuel consumption and greenhouse gas emission in the context of eco-driving, or alternatively be more of a fundamental change of lifestyle and the underlying system, more in line with "sustainment" [14]. The users of the persuasive system that gives incentives towards eco-driving behaviour could be thinking that they, by eco-driving, are contributing enough to sustainability, instead of critically evaluating their habits and changing them towards less driving and more biking and walking. This calls for a holistic view and a multifaceted solution. The gamification should absolutely not just be to iterate the game concept and to tick boxes, i.e. just add badges, points, and leaderboards. The design of the gamification should include a true understanding of game mechanisms, e.g. storytelling, feedback, difficulty, and game rules.

Brynjarsdottir et al. [15] and Knowles et al. [16] criticised the narrow view on sustainability that it is only focusing on "individual consumer behaviours" i.e. not taking us towards any invention. Thus, present patterns of persuasive technology have been criticized as not being satisfactory for sustainable system-design solutions. We need to go beyond this prevalent limitation that exists in research if we want to be able to successfully reach sustainability goals.

What metric is suitable to use when assessing and evaluating the persuasive system and its sustainability goal? There exist several metrics that could be used. The UN Department of Economic and Social Affairs (DESA) found approximately 140 indicators that cover environmental, social, institutional, and economic aspects of sustainable development [17].

The gamification of persuasive systems for sustainability could probably create unintended outcomes; some might actually be in the opposite direction of the intended sustainable goal. The system development of the persuasive system should be adaptive and evolve, depending on the assessment of the system and contextual changes. What motivates users of the persuasive systems to do the targeted behaviour is important to understand.

Gamified persuasive systems entail socio-technical systems since the system artefact and its interaction is not limited to technical implications, but could also have an impact on policies, user practices, and cultural meaning.

The identified problems could be sorted into three domains (see Figure 1):

- Holistic view/complexity
- Metric/assessment
- User participation/designing

In order to design a successful gamification of persuasive systems for sustainability, it is necessary to examine all three of the identified domains as they all contribute to an understanding of the complexity of designing these socio-technical systems and the need for the systems to be able to evolve and change over time.

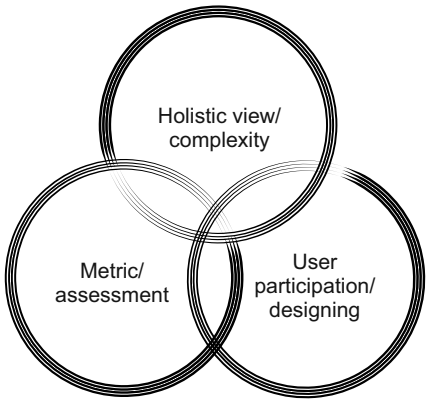

Fig. 1. The three problem domains in gamification of persuasive systems for sustainability.

IV. Preliminary findings

Werbach and Hunter identified two metrics in gamification that could be used when measuring the target behaviour: win state and points [12]. The PSD model has been developed for designing and evaluating persuasive systems [18] and could be useful. Perhaps these metrics could be combined with other indicators and be used for assessing the success of reaching sustainability. Knowledge regarding design space could be derived from previous information system research regarding the design space for sustainability (see Mustaquim and Nyström [19]).

Some recent research concerning unintended outcomes and backfiring of persuasive technology [20] confirms that this topic is a valid consideration that must be managed by the designer of the persuasive system. The persuasive systems could as all information and communication technologies (ICT) have both a negative and positive impact. The ICT hardware production brings emissions, the use of some very rare and toxic resources, and the use of the ICT system will have an impact on energy. Although it seems that the positive impact of ICT aggregated globally outweighs the negative impact, once a threshold level of ICT development is attained [21]. In the design of the persuasive system, the anticipated negative and positive impact must be identified and considered. Knowledge concerning the negative and positive impact can change and the system should be adaptive to such changes.

The phenomenon labelled Jevons paradox could be linked to these positive versus negative impacts. Jevons paradox stipulates that when individuals change to more resource-efficient technologies, these same individuals could, in the long run, end up using more resources [22]–[24] (e.g. buying a fuel-efficient car leads to saving money that could make it possible for the individual to buy more air-flight travel). Gamification of persuasive systems could bring the same kind of problems

e.g. a game that just gives points, badges, and leaderboards for driving the car eco-efficiently could result in increased car driving since the users might have an incentive to break the previous record, level up, or beat each other's high score.

A proposed "Development life cycle for persuasive design for sustainability" [25] could be used as a starting-point to remedy this problem. For the system development life cycle (SDLC) to succeed, active user participation and understanding of the context is important, and some adjustments might be necessary when using gamification. The SDLC was inspired by sustainable interaction design (SID). SID considers both the material aspects of a system's design and the interaction throughout the life cycle of the system [26].

It could likewise be beneficial in the design process to consider the first-, second-, and third-order effects [27] of the persuasive system.

- First order: direct effects of the production and use of the system.
- Second order: indirect impact through the change of processes, products, and distribution.
- Third order: indirect impact through a change of value systems and lifestyle.

The change of lifestyle and behaviours towards one that uses less natural resources has been emphasised by Nyström and Mustaquim [28]. The user-centered design could have potential benefits in the design process of gamification of persuasive systems.

V. Conclusion and future work

In this work, the designing of gamification of persuasive systems with sustainability goals is identified as critical to reaching a successful outcome. Some of the perils have been acknowledged such as persuasive systems that could be seen by the user as deceptive. A distinct large problem is that when users stop using the persuasive system, they change their behaviour back to the initial patterns. Another topic that needs to be addressed is unintentional outcomes and Jevons paradox. New pervasive connected technology, i.e. internet of things (IoT) that surrounds us, gives new opportunities (e.g. sensors) and challenges (e.g. privacy) for persuasive systems. This calls for further research that could include, but not be limited to, the development of frameworks and guidelines when designing gamification of persuasive systems for sustainability.

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