

Gamification of Sustainable Consumption: A Systematic Literature Review

Georgina Guillen
Tampere University
Georgina.guillen@tuni.fi

Juho Hamari
Tampere University
Juho.hamari@tuni.fi

Jaco Quist
TU Delft
J.N.Quist@tudelft.nl

Abstract

As awareness about the need to shift current individual consumption practices towards more sustainable ones grows, broader sets of methods are being sought to encourage sustainable lifestyles, gamification being one of the most notorious due to its application via apps and other technology-related solutions. Building upon an intention-impact approach, this review used practice-theory to analyze academic literature addressing gamification approaches to shift individual consumption practices into more sustainable ones

1. Introduction

Towards the end of the 20th century, there was an increase in the research related to individual decision-making, consumption, overconsumption, and its impact on the environment and wellbeing of people worldwide [1]. If nothing is done, by 2030 humanity will need twice the Earth's resources to support itself [2]. In 2016, the United Nations introduced the Sustainable Development Goals (SDG) as part of its Agenda 2030; a global commitment to eradicate poverty; providing a better quality of life to today's and future generations while being respectful of natural boundaries and wellbeing of other people. Responsible Consumption and Production (SDG 12) is thus a call to do more with less; where *individual lifestyles* "a cluster of habits and patterns of behavior embedded in a society and facilitated by institutions, norms, and infrastructures that frame individual choice [...], while supporting fairness and prosperity for all" [3] feature as an overarching objective to be met globally. Transitioning to practices of sustainable consumption is challenging. Nevertheless, examples of grassroots movements, policy frameworks, business models, and other practices towards different consumption are emerging worldwide [4]. Acknowledging this diversity of approaches and social agents, the present review focuses on individual consumption, as lifestyle choices at the household level. Henceforth, when mentioning "sustainable lifestyles,"

the authors reference practices of individual sustainable consumption.

"Need satisfaction" is often quoted as the driver of consumption [1]. Understanding human needs as universal, material (i.e. shelter, nourishment) and immaterial (i.e. self-realization, identity); and that satisfiers, the ways individuals choose to meet these needs, are culturally determined and changeable [5], is crucial to identify forms of changing the practices that have led to the current global socio-environmental crisis. This initial consideration, opened different alternatives for individual consumption practices i.e. sufficiency [6] or frugality [7], where human needs are understood as material and immaterial and are universal, while the ways that these needs are satisfied vary across cultures and time [5]. Consumers' behaviors have long been studied from a multidisciplinary perspective, focusing mainly on four areas: i) external topics such as communications, persuasion and culture; ii) internal topics, related to perception, psychological issues and information processing; iii) purchase processes, like brand awareness, choice and decision making; and, iv) miscellaneous, which includes studies about models, preferences and consumerism [8]. Based on the need-centered approach introduced above, and expanding the notion of consumption beyond the act of purchasing, [9] define sustainable consumption behavior as "individual acts of satisfying needs in different areas of life by acquiring, using and disposing goods and services that do not compromise the ecological and socio-economic conditions of all people (currently living or in the future) to satisfy their own needs" [9, p.5]. Besides acknowledging the existence of different consumption phases that also entail individual action-taking, this definition brings about the notion of "areas of life" that comprise practices for "living, feeding, mobility, recreation, and clothing and personal care" [10] as the domains where consumption takes place. Therefore, actions aiming at shifting individual consumption patterns into more sustainable ones, require a systemic, multi-dimensional approach to consumption and the impacts by it derived.

The notion of leading a sustainable lifestyle entails engaging in actions that are both satisfactory for the

action itself and because there is an outcome to be attained from engaging in a specific action, as explained by the “self-determination theory - SDT” [11]. SDT is one of the core concepts behind gamification, or transforming activities, practices, systems, services, and organizational structures towards affording similar experiences and motivations as good as games do [12]. Considering gamification as an approach that has motivating individuals towards more sustainable lifestyles as one of its most relevant applications [13, 14] the overarching research question for this review is: in what ways are the intention and impacts of gamification and individual sustainable consumption understood and related to each other in peer-reviewed academic literature?

To answer its research question, this literature review has a practice-oriented approach, which has a “focus is on the collective structures of practices and on what guides the practices people perform in their everyday lives” [15], as many examples from analyzing energy-consumption behaviors at the household level [15, 16] suggest. Practice Theory brings together the behavioral angle, emphasizing how norms and values guide individual intentions, with sociological theories that include the individual as part of collective consumer practices [15]. It elaborates that “upstream interventions,” this is, interventions that are “embedded in larger structures of social practices as well as wider regulatory and cultural frameworks” [18] Thus, this analysis of peer-reviewed academic departs from the intention of the proposed gamified solutions as potential upstream interventions, focusing on their means of implementation, expected and reported impact.

The rapid growth of technological solutions such as sensors, meters, apps [20, 21], social [22], and mixed approaches, like living labs [24, 25], led to an increase of research in the area of changing individual behaviors towards more efficient consumption of resources like water and energy [18, 24, 33, 72, 127, 128] which are part of the “living” area of life [10] that also includes gamification to improve education and employee programs to enable sustainable development [19, 20]. Clothing is addressed by solutions that range from endorsing circular business models to the development of new textiles; and personal care is part of the solutions to lead healthier lifestyles [21, 22], which is also among the most addressed topics for both disciplines. The literature about feeding, mobility, and recreation (FMR) [10] is considerably smaller; therefore, this review intends to contribute to strengthening the knowledge in these three areas.

2. Methodology

The approaches related to a Systematic Literature Review (SLR) vary according to the purpose of the review [37] and how they add value to research and its applications [38]. This SLR presents an overview of literature from conferences and peer-reviewed journals to address the intersection of gamification and individual sustainable consumption for FMR; it followed an author-concept approach to categorize the literature [39] according to their relevance to the topics of the study.

Building upon the Sustainable Consumption Behavior Cube (SCB-Cube) [9], which offers an intent and impact-based approach to individual sustainable consumption, this study explores what kinds of gamification mechanics and methods have been employed so far, as well as the effects that gamification has had in individual FMR consumption practices. Thereby generating added value to the fields of gamification, individual sustainable consumption and sustainable lifestyles by providing an overview of existing knowledge and discussing the potential of the analyzed literature for applications with long-term impacts. The review process was carried out in five phases: 1) searching the literature in two databases in August 2019 (SCOPUS and Web of Science) according to relevant keywords; 2) screening the selected literature; 3) applying the inclusion / exclusion criteria; 4) categorizing and analyzing the literature; and, 5) communicating the findings. The database was thus sorted by: author; year; type of publication; main discipline of the publication channel; type of study (qualitative/quantitative /combined); research methods; understanding of sustainability and relevance of the topic as presented by the authors; understanding of gamification and its relevance for individual consumption choices; main consumption areas of expected impact; intention of the solution/intervention presented; gamification elements implemented; results from the gamified activities; and type of outcomes that the papers presented as delivered through the gamified solution. The main key words were the prefixes TITLE-ABS-KEY Gamif* and Sustain* that find any records that include words gamification or sustainability in any form across title, abstract or keywords. In case some relevant studies might not include the keyword sustainability, additional keywords related to topical areas of sustainable consumption (FMR) were added. A key inclusion criterion was the connection to the sustainability impacts on individual lifestyle choices (leaving out publications related to public procurement or production processes, for example) that the gamified solutions / approaches explored in the publication, and their relation to FMR practices. The database comprised

736 entries, 68 of these were repeated, leaving a database of 668 publications. 242 of these were deemed irrelevant because the entry was an editorial introduction or index of conference proceedings or journal; or, the record was not related to gamification or sustainability. Of the remaining 426 entries, 346 publications were classified as potentially interesting because they linked gamification with sustainability-related topics (other SDGs than 12). 24 papers had to be omitted as 1 of them, though having an abstract in English, was only available in Spanish and the others were not accessible due to paywalls or lack of reply from the authors. The final database of 55 articles, comprises: 31 articles from peer-reviewed journals; 23 papers published as conference proceedings; and, 1 book chapter. *Sustainability* journal was the most frequent publications venue (9 out of the 55 articles). Figure 1 presents an overview of the first three phases of the literature review process.

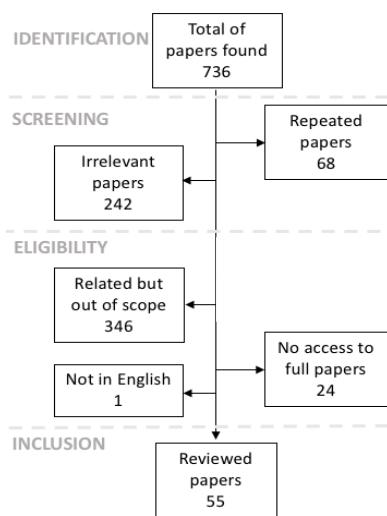


Figure 1. Literature review process

3. Results and discussion

The first phases of the review process provided a description of the field to identify the state of the art about gamification and individual sustainable consumption for FMR practices. Most of articles reported the application of more than one research method, with the design and prototype of solutions and literature reviews as the most popular ones (Table 1). 40 of the analyzed papers reported a qualitative research; while 9 of them were quantitative, and 6 had a combined approach. Table 1 shows that consumer-centered, real-life interactions (i.e. ethnographic observation, interviews) are among the least used research methods, whereas there is a clear preference of research based on the development of technological solutions (most of them mobile apps but not exclusively) and literature reviews.

To find out which gamification aspects were the most used to motivate individuals to engage in actions of sustainable consumption, the papers were reviewed according to the means of implementation of the gamified solution. The development, testing and monitoring of mobile applications (apps) seems to be the most common mean for implementing gamification towards individual sustainable consumption (37 publications). Also, games, both digital and analog, as well as “other” non-app solutions [42, 64], are representing the existing understanding about ways that gamification can reach out to different consumer groups. The one mean of implementation that was largely missing from the papers were wearable technologies, an omission that could be connected to the type of solutions explored in the papers of the study since wearables have been in the agenda of gamification [91, 92] and of sustainable lifestyles for quite some time, particularly for health [93, 94].

Table 1. Most applied research methods

Methodologies	Papers	#
Benchmark	[40]	1
Case studies	[20, 21, 30, 41, 42, 43, 44, 45, 46, 47]	10
Design and evaluation of technological solutions	[20, 21, 29, 40, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 77,88]	21
Ethnography	[43, 60]	2
Experiments	[29, 41, 49, 51, 57, 62, 63, 64, 65, 66, 67]	11
Focus groups	[44, 50, 51, 68, 69, 70,73]	7
Interviews	[49, 59, 70, 71, 72]	5
Literature reviews	[13, 20, 21, 27, 30, 41, 42, 50, 51, 68, 69 73, 74, 75, 76, 77, 78, 79 81]	20
Pilot studies	[44, 54, 61, 69, 74, 77]	6
Surveys	[21, 41, 45, 51, 56, 62, 74, 79, 82, 83, 84]	11
Workshops	[40, 83]	2

There seems to be a missing link between individual sustainable consumption and gamification when it comes to the possibilities that wearables offer for both disciplines, which itself presents as an opportunity to explore the impacts that wearable technologies may have for FMR consumption choices.

Although the search keys were gamif* and gamification, the analysis showed a mixed understanding between games and gamification. This happened mainly in the publications reviewing gamification as a communication strategy [56, 76] or systems where gamification was suggested as an approach for engagement [52, 67, 71]. In some cases, the publication mentioned “game activity” or “solutions like loyalty programs” providing vague descriptions [34, 46] and, in some other cases, the publication was about the development or testing of a game [71]. This finding invites researchers, practitioners and experts of sustainable consumption to learn more about gamification and games, a distinction that may facilitate the design of solutions according to their expected impacts. The prevalence of the environmental aspects was clearly reflected in the way that “sustainable lifestyle” was defined, with terms such “eco-friendly” [42, 65, 69] “low carbon” [10, 34], “green lifestyle” [82] or even described as “pro-environmental behavior” [70, 72]. While technically oriented towards sustainability, these definitions may imply a linear relationship between humans and the environment, rather than a more systemic understanding that conveys relationships between individuals, institutions, communities and even interactions with other species within and across ecosystems. This systemic understanding is relevant as it helps to address individual habit-forming models and how they are contextualized through gamification affordances.

Cooperative approaches were slightly more reported than competition-oriented ones, reinforcing the argument that, though being promoted through leaderboards and other means of social comparison, competition may not be always reported [100]. Another

way to interpret this finding is that sustainability has a collective nature that calls for cooperation. Individual lifestyles are largely determined by our social context, while consumption choices have an impact on the wellbeing of other societies and the environment in general. Although downvoting and emoticons, features that are characteristic of social media interactions and some of the most-commonly used approaches to engage citizens, were absent, the relatively strong presence of “social media” descriptions, and a more personal interaction with other players/ users, is a reflection of this community-oriented notion as well as quick-access to data that can help improving the design of solutions and generating deeper engagement among the users [48, 63, 69]. The absence of virtual reality as an affordance, opens the question about the awareness of the potential benefits that immersive technologies may convey, for example for classrooms or consultations with citizens. Some of the most common observations about the application of VR / AR relate to the fact that these experiences block out distractions and allow participants to gain a deeper understanding of the subjects they are experiencing, reduce costs to achieve immersion and even help users to understand their roles as consumers or producers [79, 93, 94]. This result presents itself as an opportunity to further explore the impacts of immersive technologies for shifting consumption practices, a field that is currently emerging [107]. Immersive elements, for which technological devices may not be needed, such as role play, personalized stories, images and narratives, were also present, mainly as conduits of empathy [64, 83, 84] needed to generate positive engagement, willingness to cooperate with other participants and interact with nature.

As Table 2 shows, when it comes to the design of the gamified experience, goal-setting, particularly in terms of missions and challenges, was the element most use or mentioned, followed by leaderboards, rankings and points. This also poses a challenge to gamification designers: what alternatives to point collection can be used as motivational factor?

Table 2. Most used gamification affordances

Affordance	Papers	#	Affordance	Papers	#
Achievements, badges, medals	[21, 30, 42, 43, 45, 47, 48, 49, 51, 57, 59, 63, 67, 69, 74, 76, 78, 89]	18	Points	[20, 21, 29, 41, 42, 45, 47, 48, 49, 58, 62, 63, 66, 69, 70, 71, 73, 77, 78, 89]	20
Augmented Reality	[20, 40]	2	Playing boards	[29, 50, 68, 77]	4
Avatars	[48, 49, 59]	3	Notifications	[41, 48, 51, 57, 70, 85]	6
Chatbots	[70, 71]	2	Punishment	[77, 78]	2
Competition	[20, 21, 42, 44, 51, 59, 65, 70, 89]	9	Progress bars and levels	[73,74, 45]	3

Digital playing boards	[20, 41, 42, 50, 51, 52, 62, 68]	8	Reputation systems	[47, 51, 58, 88]	4
Cooperation, teams	[44, 49, 50, 58, 62, 64, 65, 68, 70, 77, 88]	11	Rewards, prizes, incentives	[43, 44, 54, 57, 62, 65, 66, 78, 86, 90]	10
Narratives	[29, 49, 52, 54, 59, 61, 62, 64]	8	Role playing	[64, 83, 68, 77, 88]	5
Feedback	[20, 30, 40, 41, 48, 49, 52, 56, 57, 59, 62, 68, 70, 78, 89]	15	Social Media Features	[30, 40, 43, 45, 57, 60, 70, 78, 86, 82, 90]	11
Goals, challenges, missions	[20, 29, 40, 41, 42, 45, 49, 51, 52, 53, 57, 59, 61, 63, 65, 69, 70, 73, 76, 77, 78, 82, 86, 89, 90]	25	Leaderboards and rankings	[30, 41, 42, 44, 45, 49, 50, 51, 57, 59, 60, 63, 67, 71, 73, 74, 78, 82, 89, 90]	20
Images and Memes	[20, 40, 70, 82]	4	Rules	[21, 29, 41, 77, 59]	5
Interface design	[20, 30, 49, 52, 53, 59, 69, 82, 86]	9	Stories, characters	[20, 29, 53, 61, 77, 78]	6
Sharing (blogs, posts, comments)	[30, 48, 51, 58, 65, 68, 72, 78]	8	Location tagging	[20, 45, 53, 58, 65, 69]	6
Time limits	[40]	1	User profiles	[20, 42, 48, 45, 51, 53]	6
Downvoting and Emoticons		0	Virtual reality		0

Rewards and badges featured with warnings such as the need to make sure there is clarity on who will be providing these rewards (particularly monetary ones) and for how long would the scheme go [35, 53, 70]. These gamification elements can lead to potential rebounds (i.e. the user is rewarded with savings that can be spent on unnecessary clothes) but also offer the possibility of facilitating different social dynamics (i.e. badges help to identify skills that can be traded under sharing economy schemes). Purpose-giving elements such as missions and goals, combined with collaborative set-ups, feedback and social media features, proved to be among the features that prompted more engagement from the users [40, 56, 69]. None of these elements is reward-based; thus, a question for further discussion is: how can these elements be leveraged to enable long-term impact from the gamified sustainable practices?

To identify what kind of impacts were expected and/or achieved in terms of individual consumption shifts, the papers were analyzed using the SBC-Cube [9] and how the results of the gamified solutions were reported. Most of the papers intended to explore playful approaches to motivate shifts in individual FMR practices towards more sustainable ones. The grey zone between positive (36 papers) and negative effects (0 papers) of gamification included publications that presented mixed results (10 papers), although all of them tend to have a positive outlook with a strong cautionary component, with notions such as “gamification may not be a suitable tool to educate individuals about sustainability challenges” [41] or “there exists a potential for the use of game-mechanics in real-world transportation problems” [66]. The papers that did not have a clear “in-between” stance, were considered inconclusive (4 articles) and they tend to mention gamification as a promising approach for which

more research is needed [75] or are ongoing activities for which there are no concrete results yet [59, 60]. A third group of papers (3 of them) did not report any results of the gamification experience as they are presenting proposals [67, 71] or relate to topics for which gamification was a rather marginal issue [83].

The impact-intent approach was applied in relation to the lifestyle area they were addressing and what kind of outcomes were expected: environmental, socio-economical, behavioral, as user experience, or recommendations to specific stakeholder groups. Only one publication [61] proposed a framework for measuring 4 impact areas (Society-People, Society-Governance, Economy, and Environment) including projections for the long-term. Rather than looking into the performance of the app users, the authors looked into chains of causality considering temporality and contexts, in order to facilitate the replication and scaling of the evaluation framework into different cities.

To provide a more holistic and systemic approach to the challenges posed by today’s individual consumption habits and the existing opportunities for shifting them into more sustainable ones, the present literature review was designed to have a practice-oriented approach to gamification instead of a behavioral-change angle. Practice theory distinguishes between three “pillars” that should be addressed together in order to lead a dissolution of habits, in this case, the ones that lead to overconsumption and overall wasteful lifestyles. These pillars are: the social world (settings, values, institutions and norms), the material world (technology and infrastructure) and the “body” (behaviors, cognitive processes and physical dispositions) [111, 112] Habits are formed by repetition, which leads to automatic behaviors that are context dependent [18, 113] Only few papers reviewed presented outcomes (either intended or

achieved) that address all three pillars. The practice approaches were presented in terms of what can engage citizens in actions of change beyond raising awareness [20, 48, 68] by “leveraging ethical behaviors” [43] and catalyzing individual engagement, through encouragement and exemplification [45]; measuring impacts in relation to context and temporality [61] and providing recommendations for policy-development, design of education programs, and development of campaigns [54, 85, 101]. The large majority of papers had the intention to motivate different behaviors or learning more about them, in many instances specifying these behaviors in the context of one or two of the other focus areas (user experience, social practice, environmental impacts), thus providing discussion points such as the relevance of infrastructure to make individual consumption shifts possible [58, 69, 79, 88]. In terms of practice theory, behavior belongs to the pillar of “body”, although various of the analyzed papers touch upon psychological conditions and cognitive processes, none of them addresses the topic as a direct outcome in terms of intention or impact, rather as part of the theory behind gamification [52, 55, 64, 66, 73] or a component of a larger model [82]. This could be explained by the way that this study was designed, as the targeted literature illustrates gamification in consumption areas with a relatively smaller body of research than energy or health. Identifying practice-oriented examples within these two sectors could be an interesting contribution to the harmonized development of gamified approaches towards sustainable consumption in general.

After “behavior change,” the second most expected outcome reported were recommendations to different stakeholder groups (46% of publications) ranging from suggestions to design gamification approaches according to social norms [88] and informing about sustainability [78], to data mining [55] and improvement of education programs and efficient use of resources [42, 72, 76]. 23 publications clearly expressed that the intention of their gamified solution was to provide an environmental benefit, either for reducing pollution [21, 51, 82] climate change communication [83] and managing waste [47, 54, 69] at the individual level. As mentioned earlier, 37 publications focused on Apps (developed-19, tested -8 and monitored- 11) with the oldest paper on the topic of app development dating back to 2013 [45]. The monitoring of app functionality covers publications between 2017 and 2020 and is the mean of implementation that addresses the three areas of sustainable consumption of this study as cross-cutting, considering other topics such as CSR [73, 41], Internet of Things and Machine Learning [20, 63].

Individual behaviors, user satisfaction and achievement of the established objectives of the

gamification activities (i.e. CO₂ reduction) were highly documented. However, the impacts of the activities after these took place, particularly after the initial testing period, were largely missing. This could be because most of the studies related to recent experiments and activities, and the time between the implementation and the publication was often quite short. Nine of the reviewed studies were published before 2016; of these, 4 were about specific apps, games or gamified platforms to promote a specific practice change [45, 53, 86, 89], all of them related to mobility solutions. Of all these, only one – MatkaHupi [89] was cited in a later study [78]. To track other apps, an online research showed that the Lively Suite [85] a goal-based application that aims at strengthening positive individual habits, was reported as being under development in 2014, and that, until 2017 had an online presence as a “project into personal sustainability of the university of Auckland” but its website (www.livelysuite.com) hasn’t been updated ever since. Of all the searched apps, only “Ducky” [48] evolved from a “Beta version” in 2016 into the services and products of a full-fledged social enterprise in 2020 (www.ducky.eco). There was no evidence if any of the other initiatives presented before 2018 were ever implemented. Within the articles published between 2018-2019 it was possible to identify various that relate to the same solution, like “MUV” [59, 61] and GoEco! [51, 57] for transportation choices, and WasteApp [69, 74] for tourist behavior, providing a comprehensive picture of the rationale behind the apps, their features, indicators, and early results of the testing and monitoring sessions.

Through the analysis of the publications, it was possible to identify various other aspects related to gamification, individual sustainable consumption and potential impacts for shifting individual practices in the areas of food, mobility and recreation choices which some of the researchers emphasized that were not common across the literature collected, rather the exception. One publication [40], focused on the aspect of food safety in terms of understanding the products’ labels, a strategy that is widely promoted among researchers of sustainable consumption as one of the most relevant to support consumer decision-making processes [123, 124]. This finding is worth discussing in terms of a question for future research: how might we gamify products’ labels in a way that can fulfill their promise of informing and triggering action towards sustainable consumption?

Another paper focused on the exploration of Sustainable Social Shopping Systems [85] conveys a “life-dimension” approach to address habit-forming models, elaborating on the areas of health, finance and environment in an effort to connect product suppliers, government regulations and consumers, an angle that no

other of the papers of the study analyzes even though understanding the impacts on/of lifestyles are relevant for the design of strategies to enable practices of individual sustainable consumption [126]. Some discussion points that stem from this argument relate to how these habit-forming models are contextualized, as individual consumption choices are strongly linked to aspirations and values, as well as external circumstances for which a more nuanced understanding of gamification and sustainable consumption are needed in order to provide nearly individualized solutions.

4. Conclusions and further research

A systematic review provides an added value by making explicit some of the existing gaps in research and help to the planning of further research in the area of the study [38]. While exploring gamification for individual sustainable consumption is not an entirely new concept [27, 73, 107] the research looked into ways to relate the two disciplines of study, gamification and individual sustainable consumption, particularly in the living areas of mobility, food and recreation by analyzing how the research about these two disciplines is carried out. The scientific novelty of this research lies on its design and conceptual model, as it builds upon the notions of Practice Theory as main analytical focus and has an intent-impact three dimensional framework [9] as a reference. Gamified systems are strongly linked to individual's actions, which lead to the development and implementation of a wide array of incentives to motivate active participation. When it comes to rethinking their consumption practices, individuals need to be not only aware of their responsibility but also about their capability to produce an outcome with a wider impact than their mere individual need satisfaction. To this end, mapping the incentives within gamified systems, should explore ways to visualize the results of the choices made and facilitate comparison, either as part of an individual progress-check (gamified health-tracking apps normally rely on this feature) or within social frameworks. The energy sector has plenty of examples with historical references, even goal comparison between family/neighbors, and mixed approaches that allow consumers to set their own level of ambitions and individual goals for their consumption. The learning from these gamified approaches to energy and water consumption can be explored for developing and improving existing interventions towards more sustainable consumption of food, transportation and leisure activities. A potential avenue for future research is to explore more real-time interactions, as they may help to identify consumers' behaviors and attitudes at the time of making their choices.

It is also important to acknowledge the limitations

that this research faced, like the potential bias to perform the analysis of documents, as it was carried out by one person, even though the design, findings and results were discussed among the authors of the paper. The time between the collection of literature and the completion of the analysis, also conveys a limitation in relation to the findings, particularly the analysis of impacts, as potentially more updated data could have emerged in the lapse of time between the initiation of the research and its finalization.

As Table 2 showed, there is plenty of room for exploring ways in which gamification through interactive technologies, including wearables, can be applied to advance individual sustainable consumption, while aiming at making these technologies sustainable themselves (i.e. bear in mind the planned obsolescence of the technology and circular considerations for their life cycles) as part of their contribution to sustainable development as well. Since most of the literature reviewed was less than 9 years old, it was not really possible to analyze aspects related to the long-term impact of the gamified solutions therefore, other areas for further research that can stem from this review, include the development of a typology system to understand more detailed aspects about the gamified solutions in terms of their intention and impact, for example: what kind of solutions emphasize on individual's internal aspects (i.e. motivations, values, psychological dispositions) and which ones build upon external characteristics (i.e. socio-economic contexts, demographic). Having also a collective perspective (what solutions work when implemented with multiple participants) can help to further understand what happens in the gamification of solutions towards sustainable consumption and practice shifts; it may also facilitate the identification of power structures and discourses that influence consumption practices, so that the designs of gamified solutions can lead to further reflection about the consequences and long-term impact of the consumption choices made

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