Gamification for sustainable consumption

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Abstract
Plastic waste has become a major issue to our environment, tons of different types of plastic are discarded every year, especially the ones used in packaging. In this paper, the concepts of gamification and smart technologies are brought into a nature-centred approach that seeks to motivate and stimulate a more sustainable consumption behaviour. By optimizing the context in smart stores, a system for a sustainable consumption guide was developed to enhance new shopping experiences. We adopted methods used in user research as personas; behavioural assessment; sketches; prototypes and, simulation tools; and interviews with potential users' using the Self-Assessment Manikin (SAM). Iteration was in place throughout the conception process of the system to justify the design choices through the several cycles of development.

Keywords: sustainable consumption; smart store; gamification; augmented reality, nature-centred design

1. Introduction

In 2019, 368 million tons of plastic were produced worldwide (PlasticsEurope, 2020). The production of plastic started in the 1950s, and now it seems impossible to think about a planet without it (UN Environment Report, 2018). These polymers are not easily discarded, and their end-of-cycle comes down to three different destinations: landfills, recycling, and energy recovery (PlasticsEurope, 2020). "Researchers estimate that more than 8.3 billion tons of plastic have been produced since the early 1950s. About 60% of that plastic has ended up in either a landfill or the natural environment" (UN Environment Report, 2018). Although recycling processes have evolved worldwide, they are not enough to deal with massive production, especially single-use plastics found in packaging (PlasticsEurope, 2020). The main producers are to blame for such practices, but if consumers boycott these products, they can force these corporations to adapt.

In 2015, the United Nations [UN] introduced the Sustainable Development Goals [SDG] that intend to achieve "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations, 1987, p. 43). The SDG translate the urgency of mitigating the impacts of human activity on the environment. With this study, we expect to contribute to the SDG 12 (United Nations, n/d) which regards ensuring sustainable consumption and production patterns, to substantially reduce waste generation through prevention, reduction, recycling, and reuse (SDG 12.2). Additionally, to encourage companies, especially large and transnational companies, to adopt sustainable practices and integrate sustainability information into their reporting cycle (SDG 12.6). By 2030, the UN intends to ensure all the objectives and that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature (SDG 12.8).

To tackle plastic waste, better inform consumers, and contribute to the SDGs, we created an application [app.] to be used while grocery shopping. It will elucidate the impact of buying habits on the environment. The app. provides users with relevant information about manufacturers and packaging materials, for example. The app. utilizes gamification concepts to entertain users while stimulating them to make more conscious buying decisions based on a nature-centred design approach.

2. Theoretical background

2.1 Plastic waste

Almost 40% of the plastic produced in 2019 was destined for packaging (Beeco, 2021). The European Union [EU] has acted against plastic consumption by implementing new laws especially concerning plastic bag usage (European Commission, 2020). It is estimated that 1.5 billion of them are sold in supermarkets worldwide (Greenpeace, 2019). Moreover, according to Greenpeace (2019), roughly 58 billion units of plastic packaging were produced in 2018. Efforts are being made to suppress this uncontrolled source of waste, and consumers have become more alert to these issues (First Insight, 2020), but supermarket chains are not doing enough (Environmental Investigation Agency & Greenpeace, 2021).

2.2 Nature-Centred Design

Nature-centred design puts natured entities in the centre of processes and uses design research tools to achieve remedial interventions in nature (Tarazi et al., 2019). Similarly, environmental-centred design is an approach to product or service development that aims to make products or services environmentally, socially, and economically sustainable by focusing on the needs, limitations and preferences of the target human audience and non-human strategic stakeholders (Sznel, 2020). Nature-centred design involves knowledge and design techniques developed at the intersection of human-centred design, usability, ecology, and sustainability science (Tarazi et al. 2019). For this study, we adopted the term nature-centred design.

We could say that designers have mastered the ways of user-centred design, for which the focus is usability and user experience (Marti & Bannon, 2009). However, we are currently in a situation where it is necessary to redirect this knowledge to stimulate a more sustainable behaviour in individuals. Design has been at the forefront of some of the most innovative ways to improve sustainability introducing terms such as "eco-design," "green-design," or "environmental design" something that Thorpe (2007) denominated the first phase of sustainable design. These initiatives have focused on energy and materials. However, the author calls attention that the second phase requires an additional exploration of the role of design in the economic and social aspects of sustainability. Design strategies that help us meet needs with fewer purchased solutions could lead to more sustainable consumption (Thorpe, 2010).

Designers have introduced new concepts and focuses into their practice. Yet, there are new ways to guide users to further contribute to sustainable development. This usually happens when products are conceived to influence behaviour and not only to be more convenient or user-friendly (Wever et al., 2008). By creating such products there is space for new opportunities to explore existing data from user-centred studies regarding motivations, needs, and frustrations to drive more sustainable practices. The methods used in the usual practice of user-centred design are relevant to nature-centred design.

Companies are not solely responsible for this change; consumers also need to be motivated to join. This idea stems from the concept of Corporate Social Responsibility [CRS] where "business and society are interwoven rather than distinct entities; therefore, society has certain expectations for appropriate business behaviour and outcomes" (Wood, 1991, p. 695). It is necessary to also contemplate consumers' consumption behaviours and habits (Bhamra et al., 2011, p. 430).

2.3 Gamification

Gamification is associated with gamifying interactions. Although the concept has been an important and useful tool for designers to implement in interactive projects, users' motivations for engagement are mainly extrinsic, via badges or achievements to collect and share. Lawley (2012) clarifies that it is not enough to force gamification into an application with these sorts of extrinsic motivations to get users invested or focused. This means that implementing gamification cannot be the last resort to bring or keep users interested. Many gamification-based solutions fail because, mostly, they have been created without a clear and formal design process (Mora et al., 2015). These forced experiences can generate negative consumer impact instead of increased engagement (Lucassen & Jansen, 2014). This suggests that an unexpected element of the interaction is not

necessarily acknowledged by users as a "game element". Besides, if it is presented as an intrusive mechanism in the process it tends to disturb the overall user experience (Lucassen & Jansen, 2014).

To Paharia (2012) it is imperative that the element being gamified has an intrinsic value, a reason for users to engage with, adding gamification to uninteresting content will not help. The direct connection between gamification and the retail usually lies in granting costumers with discounts (Paharia, 2012). If these concepts are successfully implemented customers might not realize they are "playing" a game but believe they have been introduced into a segment of an experience. In this way, the behavioural change is much more friendly and impactful given that users are naturally interacting rather than being forced to. Additionally, user-centred design practices are essential; knowing customers' motivations and needs must be considered throughout the gamification process.

2.4 Smart Stores and Gamification

Smart stores are defined as ones using smart technology, such as radio frequency identification (RFID), and smart shelves, scales, carts, and cards (SmartStores.com, 2008). Shoppers can buy products by placing them into a shopping cart and leaving without having to go through a cashier (SmartStores.com, 2008).

Online shopping has improved the commodity of shopping, consumers can buy goods from the comfort of their homes. This means that physical retailers must compete with other brands and with online channels (Bourg et al., 2012). However, integrating ICT (information and communication technology) services into offline experiences provide customers with part of what online channels have to offer. In this way, they undergo a similar process to e-shopping, by accessing information about products, while still maintaining the in-store experience. Concerning smart stores capabilities, Hwangbo (2017, p.1) explains: "Recently, companies and researchers have paid attention to technologies, such as sensors, indoor positioning, augmented reality, vision, and interactive interfaces, which helped offline retail shops to improve their service quality". This is undeniably an area of expertise in which interaction designers may have a significant impact, as creativity has had a big influence in shaping the contemporary retail paradigm (Kent, 2007).

User-centred design is a part of this discussion as it is necessary to carefully consider the customer experience in this new retail scenario, but with the purpose of producing a more sustainable behaviour (Wever, 2008). As much as users might want to save time and money while shopping, prioritizing sustainable behaviour may contribute considerably to solving the environmental crisis in the future. Gamification can make a difference in this context, this concept has already expanded into the service and retail fields and should also accompany the evolution of smart stores (Lucassen & Jansen, 2014). Following the increasing concern about sustainable shopping (First Insight, 2020) it is reasonable to use gamification to develop an interactive system that prioritizes sustainable behaviour while rewarding users (Mekler et al., 2015).

The availability of smart technology creates an opportunity to implement Augmented Reality (AR) tools to complement the retail experience. AR is defined as a real-time direct or indirect view of a physical real-world environment enhanced/augmented by adding virtual computer-generated information (Carmigniani et al., 2010). The idea of coexistence between the digital and the real world (Azuma, 1997) creates possibilities for innovation. For instance, in medical contexts, utilizing existing sensors for CT scans and ultrasound, patients could see "inside" their bodies to better understand their health (Azuma, 1997). More recently, AR has proved to be a valuable tool in education in interacting with learning opportunities, especially when it comes to books, becoming an enhanced version of a traditional "pop-up" book". (Billinghurst, 2002). Additionally, in e-commerce and marketing, AR greatly enriches consumer experience by product simulations, bringing innovation and attracting new customer (Carmigniani et al., 2010; Poushneh & Vasquez-Parraga, 2016).

3. Methodology

To collect the most relevant information on users and later create personas, we constructed an online questionnaire, used the information to construct personas. The next step was to create the app.'s interface using sketches and prototyping. Finally, the built prototypes were tested with potential users to test.

3.1 Questionnaire

The information about potential users' motivations, needs, and frustrations was collected through an online questionnaire composed of four parts: an introduction; closed-ended questions (shopping frequency and type of establishment; open-ended questions (main frustrations when shopping, sustainable habits, and top-of-mind innovative sustainable products), and the demographic questions (Annex 1). It was available from March to April 2021.

Based on Hill (1998), we established that the study needed at least 30 answers to have some grounding and there were 38 responses, which was according to that estimate. From the respondents 26,3% were men and 73,7% women. The ages varied from 18 – 38, the mean age was 23 years and were mostly college students (82%) (Figures 1-3).

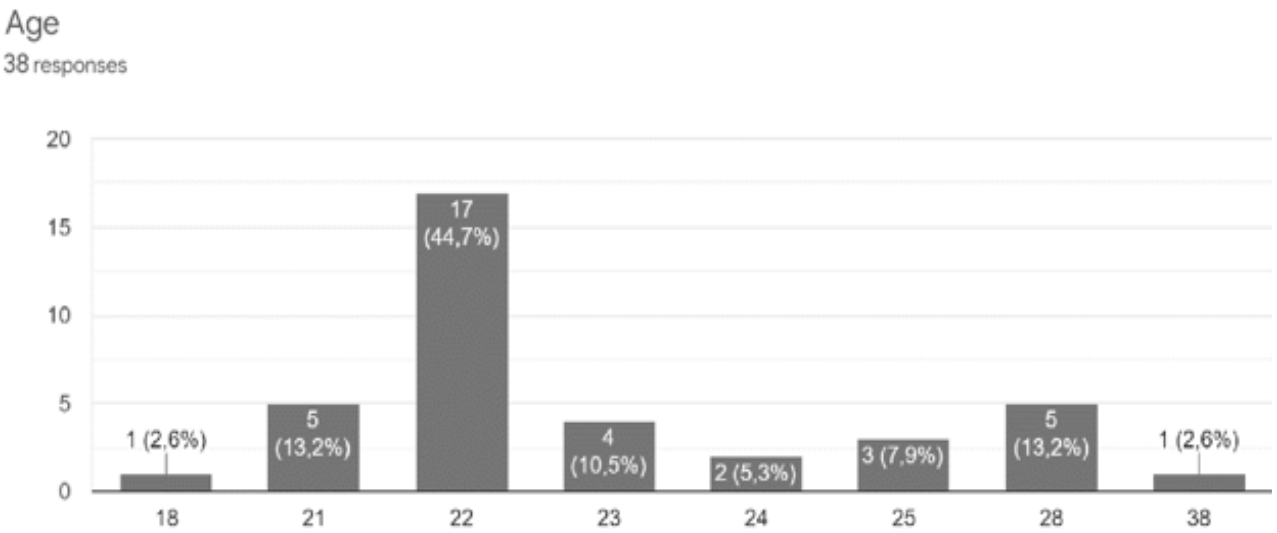

Figure 1. Interviewee's ages (%). Source: Authors.

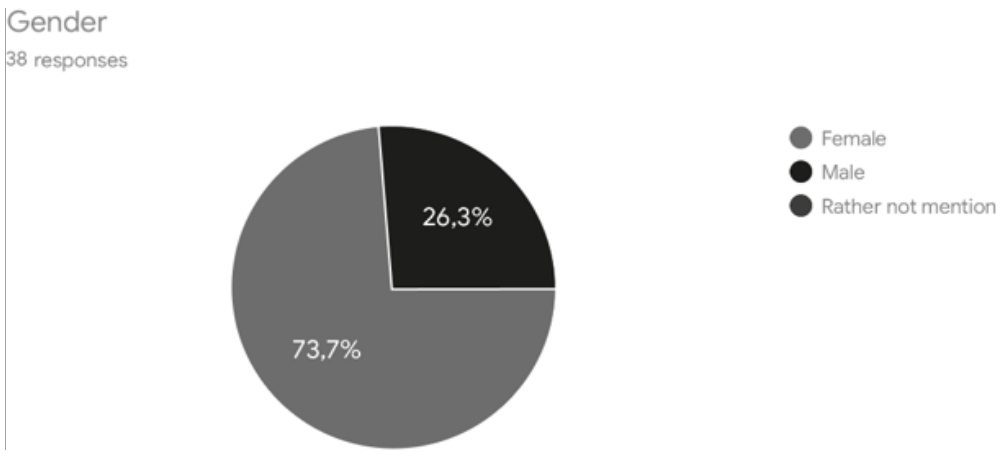

Figure 2. Interviewees' gender distribution. Source: Authors.

The answers to the questions regarding the needs and frustrations was divided into two groups:
Group A: individuals concerned about time inefficiency while shopping. Waiting in line to pay and the self-checkout machines were among their complaints. Most of them were male respondents, over 22 years (26%).

Group B: respondents who expressed their difficulty to locate the sustainable products in supermarkets and mentioned that these products are more expensive. They were more against using plasticized products and had some idea regarding innovative and alternative products.

From the characteristics of Groups A and B, we created two personas: Ricardo, 27 years old (Fig. 4) whose major concern is to go shopping as quickly and conveniently as possible, and Raquel, 22 years old (Fig. 5), worried about the environment.

3.2 Project Definition

To include the nature-centred concept into our project we decided to develop a sustainable consumption guide whose objective is to inform users of the consequences of their shopping habits. The guide not only suggests "greener" products but gives examples of the impact of more sustainable choices on the environment. An effort was also made to comprise the motivations of both personas. Group B sees grocery shopping as time consuming. So, to shorten the time taken supermarkets, we included a map to indicate the location of the products on users' shopping lists. The functionalities will be further explained in section 2.3. of this paper.

The gamification component of the app. is composed of a scoring system related to the users' product choices. Each product is given a sustainability score regarding its material, origin, distribution process, composition, packaging and so on. Groups of users compete with others based on their scores from recent shopping trips. Each group receives an overall score, calculated from the average of all the participants. Including this mechanism into the system strengthens the gamification concept, improves group motivation, and aims to promote individual betterment. The real reward is the activity not the achievement itself (Lawley, 2021).

The next step was to decide the interface. After considering options like tablets, smart glasses, and smart watches we concluded that the most convenient device would be a smartphone due to its popularity of use.

3.3 Functionalities

The app. was designed to have the following functionalities:

Home: the main menu, users can access the relevant functions before starting their shopping trip, like shopping lists, groups, and receipts.

Shopping list: create and name different lists and add products to them accordingly. Users can also access, edit, or delete any previous shopping lists. In this way, they would not have to start a new list every time they go shopping. The products are displayed by type rather than by brand or quantity of a specific item, the system suggests sustainable options.

Groups: customers can form groups with friends, family, colleagues to compare and improve their sustainable consumption scores.

Store map: map of the supermarket based on the products on the shopping list. It is possible to find the products' locations and trace a map of the aisles, guiding the customer through an optimized route (product-wise). The purpose is to provide the users with a map to sustainable products eliciting a more conscious consumption.

Sustainability heatmap: in-shop AR experience. Each product is highlighted according to its sustainability score. Inspired by heatmaps, it indicates how sustainable a product is by colour.

Green Receipt: is a visual proof of users' more sustainable choices. It is composed of a list of the purchased items and their score depending on how sustainable they are, and the amount of time saved for our planet. Users receive a mean score for the whole of the shopping trip. For each product there is a short explanation to demonstrate the opportunities for a more sustainable purchase.

RICARDO, 27

"The problem is not the plastic, but the the way we use it and waste it."

Hi! My name is Ricardo, I live in Lisbon where I study Engineering Informatics in Faculdade de Ciências. Me and my childhood friend share a home and we usually alternate between us for who gets to go shopping. I like to go to the furthest supermarket as there are more tills, this way I don't lose as much time and come back home quickly. I carry my reusable plastic bag and I think that's a good enough effort to reduce the plastic waste in the oceans. I'm doing my part!

I am

Introvert — Extrovert

Think — Feel

Judge — Understand

I buy

Coca-Cola

I want to

- A void lines
- Find the products I want
- Apply discounts and promotions

I hate

- When the self-checkout machine isn't working
- Lines that take too long
- When products change locations

Context of Use

Another day of shopping! I ask my roommate to use his car, as our families are visiting, but I need to hurry, they're almost here. As I arrive to the supermarket I open my app and my list is already saved there, I already know it will guide me through all the process. As I've gone through the list, my shopping cart is full and I go through the tills without having to stay in line. I'm done shopping in half the time as I normally would!

Figure 4. Persona 1. Source: Authors

RAQUEL, 22

Plastic is the problem."

Hello, I'm Raquel, come from the center of Portugal, and I'm studying Journalism in Lusófona University, in Lisbon. Currently living by myself in a rented room, I need to try and save money in any way I can. I usually shop in a market close to home and I already know some of the salesmen, as they tend to learn what I'm looking for and there's never a hassle. When I need more specific products, hypermarkets are the only places that have them, although most of their products are not environmently-friendly. Not only I struggle to find the products I'm looking for, but they are also expensive, compared to their "normal" alternatives.

I am

Introvert — Extrovert

Think — Feel

Judge — Understand

I buy

TOMS patagonia LUSH FRESH HANDMADE COSMETICS

I want to

- Avoid plastics
- Find bulk products
- Buy products that won't harm the planet

I hate

- When I have to plastify fruit and vegetables
- When there's not alternative to plastic containers
- That the sustainable products are the most expensive

Context of Use

Altough I'm not a fan, this time I need to go shopping at a big supermarket chain. I'm looking for specific items not usually found in local groceries. As I'm not an experience costumer here, I look for a device that guides me in the products' location while at the same type leading me to greener alternatives. As I'm shopping I have the confidence that I'm consuming products that put the planet's health on the same level as me!

Figure 5. Persona 2. Source: Authors.

Figure 6. App functionalities. Source: Authors.

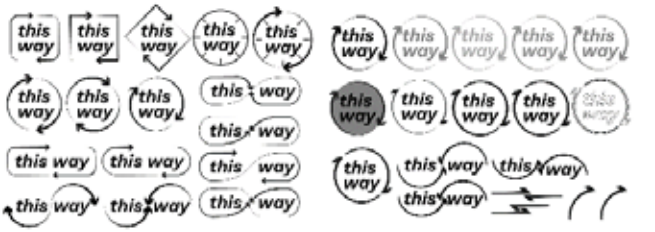

Figure 7. Logo Studies. Source: Authors.

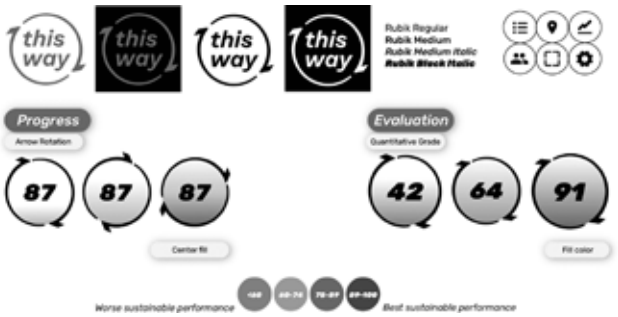

Figure 8. Final brand components. Source: Authors.

Totem: it is an external item of the app. It replicates the results on the receipts so give them more visibility, placed at the exit displaying score of a shopping trip.

3.4 Sketching

In this step all the main interfaces of the app were defined: the homepage, the AR, and the also the navigation. Below we describe each of these components.

Homepage: The homepage is composed of two sections: home and shopping. In the home section users can choose among 4 options (saved shopping list, group, shopping history, settings) and in the shopping sections there are also 4 options (new shopping list, shopping map, AR aisle and report) (Figure 4).

Augmented reality: The biggest challenge in this phase was how to design the Augmented Reality interface and the report section. Two options were created and tested to verify users' preference.

Brand: To create the logo we carried out a study of possible names to represent the sustainable consumption guide. The starting point was based on the statement "this is the way for sustainable consumption". « That statement was shortened to "This Way" related to: "This is the way to change

Figure 9. Totem. Source: Authors.

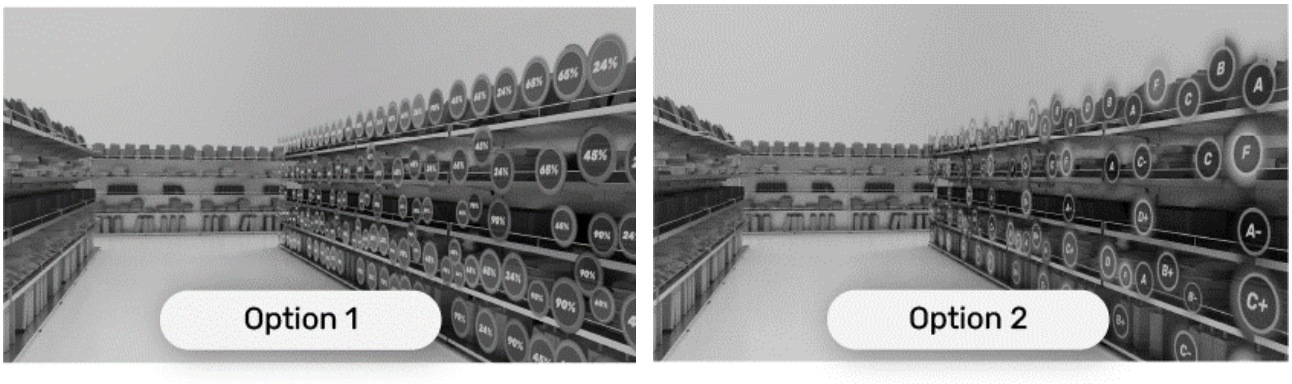

Figure 10. AR Option 1 (left) and Option 2 (right). Source: Authors.

the world" and "This is the way to turn back the clock". "This way" can also relate to someone giving direct instructions, which also expresses the idea of education and information. Figure 5 shows the logo studies and Figure 6 the final brand components.

Totem: the design of the totem was originated from the brand logo, it is composed by a central screen that resembles a lens, and a support for implementation of the digital system.

3.4 Prototyping

The prototyping phase was divided into two moments: constructing the high-fidelity prototype and designing the AR in-store experience.

High fidelity prototyping:

Prototyping began with a low to mid fidelity version using Adobe XD to start organizing the interface and navigation system.

One objective for this stage was also to include real-time feedback, representing the progress and evaluation of the users' shopping trips. This not only improves the overall user experience but also incorporates de gamification component into the system. Most of the design choices were based on Nielsen's (1994, p.153) Usability Heuristics while respecting the brand expression.

Prototyping also enabled a better understanding and improvement of the user flow while interacting with the application, improving navigation.

AR in-store experience simulator:

To initiate the design and evaluation of AR in-store experience, we needed a narrative that would guide. For this we simulated a product search at a supermarket where the users were able to experience AR on a smartphone through a 30-second video. However, a rendered 3D software improved both realism and quality of the image. Using a 3D modelling software (Rhinoceros 6.0), and open-sourced supermarket shelves in .STL, the aisles layout and the different layers for each product defined.

Since the rendering aspect was crucial for better results of the evaluation stage, Keyshot 9.0 software was chosen to mimic materials for each 3D element and run test renders. This offers the designer an approximate estimate of the rendering quality and the required time for a full animated render.

After completing the 3D environment, we started developing the AR interface of the in-store experience. Two options for the interface were developed to be tested, they were composed by the products' sustainability score, represented by both colour and quality.

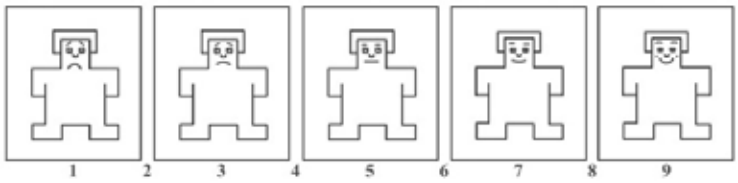

Figure 11. SAM Scale. Source: Bradley & Lang, 1994.

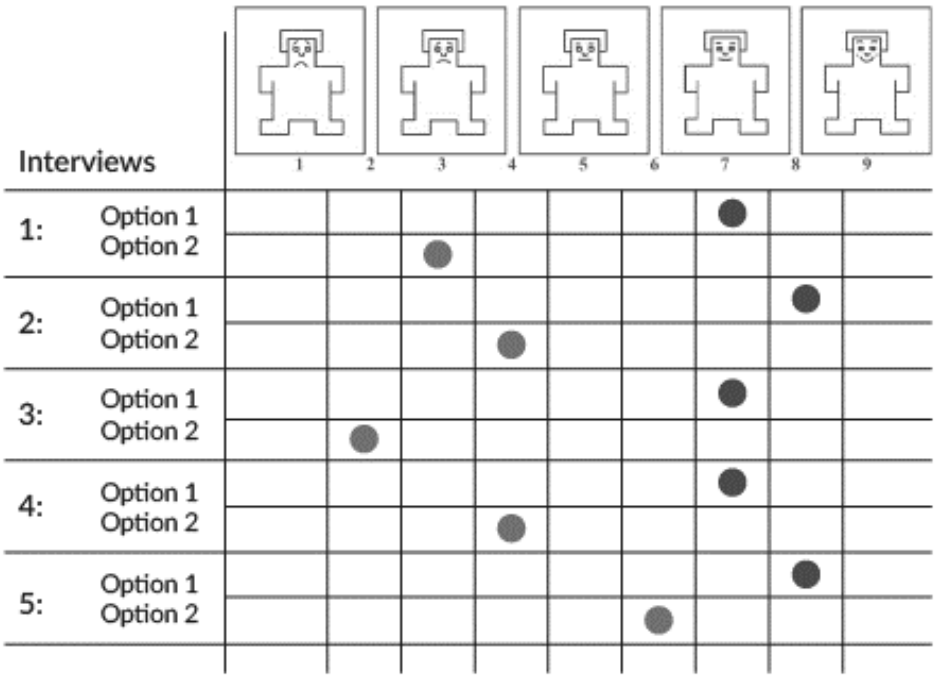

Table 1. Results of the AR Evaluation. Source: Authors.

The first option used a number categorization, from 0% to 100%, where 0% is the least sustainable and 100% is the most and primary colours (from red to dark green) in the background. Whereas the second option used an alphabetical categorization (where A is the most sustainable, to F the least sustainable) and using different tones of green.

3.6 Evaluation

To evaluate the two AR layout options and the motivations of users to use the app. we carried out a set of interviews. To obtain users' assessment we chose to apply the Self-Assessment Manikin scale [SAM] (Bradley & Lang, 1994). The SAM scale consists of 5 humanoid representations, each one represents a different emotion, and a numeric scale from 1 to 9 (unhappy to happy) (Figure 7). The interviews (Annex 2) started with a brief introduction about the project, then simulation videos of the two AR options were shown to the participants. After each video, the interviewees were asked to select an option on the SAM scale. A pilot interview took place to identify possible adjustments. After the pilot, we made the necessary modifications to the script. We conducted 5 interviews, our sample was composed of four men and one woman, aged between 21 and 26 years. All the interviews were conducted via videoconference. The AR simulation videos, and the SAM scale were shared using the "screen share" tool, and the interviews were recorded for future reference.

Applying the scale allowed us to compare and improve the simulations presented to the users. From the results, it was clear that the users preferred AR Option 2 (Table 1), it gave users a better perception that the products were being evaluated. For the remaining questions about motivation to use the app., users considered the context as the main condition for adopting it. On one hand, 4 out of 5 respondents expressed that in a long shopping trip (<30 minutes), the application would be very useful. On the other hand, short shopping trips were not considered the best context of use, as it was seen as more of a distraction and might slow down the customers.

4. Discussion

This project adopted iterative design processes, in the early stages, users were interviewed to construct personas and then to support the prototyping design decisions. Finally, they evaluated the high-fidelity prototype. Iteration allows for designs to be refined, to revise ideas considering users' feedback (Preece et al., 2015). The final version of the prototype contemplated the results of the evaluation phase, it was a combination of Options 1 and 2. This choice enabled us to incorporate the scoring concept into all the functionalities so users have access throughout the experience. Working with users (and for users) in different phases helps designers to support their decisions throughout the process, especially regarding interaction features that deal with behavioural matters (Wynn, 2016).

One issue to be addressed is to make the in-shop experience less intrusive, respecting users' usual behaviour while shopping. For a product or a system to have good usability, it must consider the context of use (ISO, 2010). For designers to develop interactions such as this, there needs to be extra attention to the users' original context of use. Usability deals with the suitability between the product and the intended tasks, the suitability with the user who will use it, and the adequacy to the context in which it will be used (Moraes, 2013, p.7).

Additionally, implementing the app. could present a few challenges as obtaining the collaboration of supermarkets, producers, and distributors. Their participation is paramount to collect the necessary product information for determining the scores.

Adopting a nature-centred concept supports the idea that sustainability prioritizes context over the object. An approach to design that is "ecologically responsible and socially responsive" (Papanek, 1984, p. 346). Papanek (1984) harshly criticizes industrial design that responds only to the demands of consumer culture and calls designers to their responsibility for their creations. Designing for sustainability is designing against consumerism, in a context where most design is for consumerism, promoting sustainability is a huge challenge (Micklethwaite, 2019).

5. Conclusions

Managing the focus and concepts approached in the theoretical background proved to be a challenge, as there were some constraints in of trying to achieve a usable product, but also be innovative and promote sustainable behaviour. This is mostly due to the usability premises of knowledgeability, given that customers are used to having certain interactions with a smartphone app. Gamification is usually thought to only offer rewards such as achievements badges, and discounts, but the process of introducing intrinsic values to this application had to be relevant.

The extent of the behavioural change and bigger scale implications on nature must be tested with a large sample of users to provide empirical prove. The accessibility of information through this channel is one of the many opportunities surrounding this area of development.

The iteration process had the most impactful influence on the outcome of the final product. The many versions created permitted us to continuously evolve. This made for a much more enjoyable design experience, motivating the team to proceed. What began with a smartphone app. evolved into a whole experience around sustainable consumption, because of the iterations.

Moreover, systems that contribute to fighting against waste, enhancing, and stimulating a more sustainable consumption are increasingly necessary if we intend to achieve any of the SDGs or climate-neutral projects. Companies and consumers alike, are responsible for making the change happen and we believe designers have the utmost possibility to influence those actions and must continue to be the providers of sustainable changes.

Limitations & future work

For future work it would be ideal to increase the sample size of potential users to reduce the error margin and enable the implementation of the project (Hill, 1998). Also, the product was tested with a homogeneous sample, mostly university students, to really understand the possible issues it is necessary to test with individuals of different backgrounds and age groups.

Conflict of Interests

The authors declare that there is no conflict of interest.

Acknowledgements

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