# Kristiania

Alma Waagbø Kausland

# Stitching Together a Greener Future:

## An Approach to Design Mobile Applications that Supports Sustainable Actions

Master of Human-Computer Interaction

Supervisor: Siri Fagernes

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# Abstract

With an increasing amount of world-wide waste, a focus on how we can increase circular consumption is necessary. As the clothing industry is wasteful and makes up for about 10% of the world's CO2 emissions, it is not only a relevant field to improve, but also a field in which anyone can contribute by developing more sustainable clothing habits. As previous studies highlight mobile technologies for supporting new behaviour, this study explores how mobile applications can support young adults in choosing sustainable clothing practices (SCPs) through a double diamond process with participatory design activities.

Participants of the target group were inquired in interviews, uncovering that a lack of creativity and motivation, and thinking that their skills were not sufficient hindered them from choosing SCPs. By inviting participants to define problem statements in a defining workshop, and to brainstorm possible solutions to meet these problem statements in a design workshop, the author has combined these ideas to a feasible prototype for a mobile application. The application has been designed by applying persuasive design principles and gamification elements according to relevant literature.

Findings suggests that the mobile application is able to successfully persuade users to choose SCPs by inspiring, motivating, and empowering them, thus meeting the initial user problems. The author argues that the mobile application has persuasive success because the participants were co-designers, which influenced how the persuasive principles and the gamification elements were applied. This thesis presents a prototype of a persuasive mobile application that supports young adults in choosing SCPs in addition to a methodological approach to design mobile applications that supports sustainable actions.

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# Table of Contents

# List of Figures

# List of Tables

# Abbreviations

**DD**      Double Diamond

**HMW**    How Might We

**PD**      Persuasive Design

**PTs**     Persuasive Technologies

**SCP**     Sustainable clothing practice (Upcycling, mending and tailoring of clothing)

**UCD**    User-Centred Design

# Chapter 1: Introduction

The world bank has stated that the world is expected to reach waste generation of 3.40 billion tonnes (Kaza et al. 2018). The clothing industry is responsible for about 10% of the world's $CO_2$ emissions, and 87% of the fibres being used for clothing are either burnt or thrown away (Elster 2021). While there are policies and laws in place to reduce emissions and make communities more sustainable, anyone can strive to develop sustainable clothing habits in order to reduce waste and contribute to the circular economy (Shan, Neo, and Yang 2021). In recent years, there has been a greater emphasis on the overconsumption of clothing, with brands such as Ganni launching a clothing collection entirely made of upcycled materials from previous collections and Patagonia offering free repairs and do-it-yourself repair guides on their clothing items (Southey 2021; Patagonia n.d.). Additionally, businesses focusing on sustainable clothing practices (SCPs) are founded, such as Fæbrik which encourages individuals to sew more and keep personal style (Fæbrik n.d.).

When aiming to promote sustainable practices, it can be difficult to determine which practices can be described as sustainable. Therefore, it is important to establish which practices one aims to promote. Throughout human history, clothing has frequently served as a means of expressing one's individuality. Today, the contradictory ideals of sustainability and microtrends can result in a conflict of interest: a desire to be both environmentally conscious and fashionable can frequently lead to feelings of remorse. *Upcycling* clothing is a SCP that entails giving old clothes a new life by redesigning them for new purposes, allowing individuals to choose sustainable fashion while retaining their individual sense of style. Another SCP is *tailoring*, as tailoring clothing that no longer fits properly or purchasing second-hand clothing and tailoring them to fit is more sustainable than purchasing new clothing. Lastly, *mending* is a SCP that allows individuals to give a garment that would otherwise be discarded a second chance at life. Consequently, upcycling, mending, and tailoring are the SCPs highlighted in this thesis.

According to Shan, Neo, and Yang (2021), people avoid upcycling because they believe it requires too much time, effort, or creativity. This suggests that, if it were easier to get started with SCPs, more people would choose to do so. A preliminary literature review indicates that

there is no current research on how designers could approach these issues from a consumer point of view.

Sustainable development was defined in the Brundtland Report (1987) as *"a form of development which meets the needs of the present without compromising the ability of future generations to meet their own needs"*. Aiming to allow young adults to be fashionable whilst promoting sustainable clothing practices can be rephrased as "allowing young adults to be fashionable and maintain their personal style without compromising the ability of future generations to be fashionable and maintain *their* personal style". Combined with the consumers' desire to be both environmentally conscious and fashionable, and their varying motivations and prerequisites to choose SCPs presents a wicked problem, which is defined by its lack of definition, scope, and solution.

In recent years, design thinking approaches have been applied to projects to tackle wicked problems. Design thinking as an approach typically involves generating many ideas from a human-centred perspective, which provides holistic ideas that are more likely to produce a resolution for the wicked problem (Pyykkö, Suoheimo, and Walter 2021). Pyykö, Suoheimo, and Walter (2021) specifically highlight the Double Diamond (DD) process as a design thinking framework that is appropriate to tackle wicked problems. The DD process adopts the design thinking principles and consists of two phases (diamonds), in which one 1) defines and 2) designs (figure 2). The define phase can be described as aiming to *design the right thing*, i.e., making sure one addresses real user needs and designs an artefact that can solve real problems, while the design phase can be described as *designing the thing right*, in other words, making sure that the concept and design of the artefact are satisfactory. Co-creation, the act of collaborating with stakeholders, is another method that is often used to tackle wicked problems and when designing interventions aiming to promote sustainable behaviour (Pyykkö, Suoheimo, and Walter 2021).

When attempting to promote SCPs, Persuasive Technologies (PTs) can be a useful field of study. PTs are technologies designed to alter the user's attitude and behaviour without the use of force or deception (Adaji and Adisa 2021). Within technology designed to influence sustainable behaviour, multiple researchers promote mobile applications as they are ubiquitous technologies in the user's life and can therefore help influence the user (Adaji and Adisa 2021). This is consistent with Shan, Neo, and Yang's (2021) article, where they argue

that one of the reasons mobile technologies are relevant to address upcycling issues it the population's widespread mobile use.

In this thesis, the author has explored how mobile applications can support young adults in choosing SCPs and how design thinking and co-creation methods can support designing the right thing, i.e., an intervention that addresses and solves the right problem(s). A DD framework was used to facilitate a co-creation process that yielded empirical data that constitutes the concept for a mobile application. To investigate this methodology, the author has centred the design process around the topic of sustainable clothing practices (SCP) for individuals. Throughout a design process involving users of the target group, the author has investigated and defined the users' needs, desires, and obstacles to generate ideas and ultimately a concept in collaboration with the users.

## 1.1. Research Question

Consequently, the following research question was formed:

1. *How can mobile applications support young adults in choosing sustainable clothing practices?*

   An additional question that is relevant to explore in order to answer this is:

   1.1. *How can applying design-thinking methods support creating the right thing?*

# Chapter 2: Literature Review

As stated in the introduction, this thesis is driven by the notion that more people would choose SCPs if it was easier to get started. This assumption is supported by the findings of Shan, Neo, and Yang's (2021) research, which revealed that people avoid upcycling because they believe it requires too much effort, too much time, or because they lack creativity. This resulted in two research questions mentioned in the previous section. To answer these questions, we must primarily investigate how other researchers have addressed sustainability and what methods have been used to motivate or assist users in making sustainable choices. Consequently, this chapter is two-part. In the first section, research regarding design thinking methods and participatory design will be presented. In the last section, research that explores how we can design interventions that motivate change will be presented.

## 2.1. Approaching sustainability issues

The purpose of this chapter is twofold. First, we must define how we understand sustainability as an issue. This is important, as this understanding imposes guidelines for how to approach sustainability. Second, relevant methods and research for addressing sustainability issues will be presented.

### 2.1.1. Sustainability as a wicked problem

In order to account for how we can tackle sustainability issues, it is important to account for how we epistemologically view sustainability, i.e., whether sustainability has a definite solution, who can contribute to the efforts, and what contributions can be seen as impactful enough to be a meaningful effort. Sustainable development is often defined *"as a form of development which meets the needs of the present without compromising the ability of future generations to meet their own needs"* (Brundtland 1987). For this thesis, promoting SCPs can be seen as a wicked problem. With SCPs people can, to a greater extent, comply with today's attitude towards clothing and expectation of being able to follow trends without compromising environmental and social sustainability. However, promoting SCPs is a wicked problem because 1) aiming to enable current generations to be trendy and self-expressive without compromising future generation's ability to do so is difficult, 2) young adults want to be trendy and environmentally conscious, which can often conflict with each other, and 3) peoples' motivations and prerequisites to choose SCPs are varying.

Rittel and Webber (1973) first defined what makes a problem wicked and distinguished it from tame problems. A tame problem is one that has one (or more) defined solutions, for example, adjusting the length of a pair of trousers. The first point that makes a wicked problem is that *"there is no definite definition of a wicked problem"* (Pyykkö, Suoheimo, and Walter 2021). Wicked problems are characterised by the fact that it is difficult to define what the actual problem is, either because it is unknown or because stakeholders have different ideas of what the problem is (Suoheimo 2019). The inability to define a problem hinders the creation of a final solution; consequently, wicked problems can only have solutions that can be further improved (Pyykkö, Suoheimo, and Walter 2021).

## 2.1.2. Addressing wicked problems

Tame problems, albeit potentially challenging, have defined solutions if one applies the correct methods. Wicked problems, on the other hand, do not come with a step-by-step method that provides solutions. As such, designing to solve wicked problems might not be as straightforward.

There is, however, research on which methods are appropriate to apply when facing wicked problems. Design thinking is an approach that focuses on creating products and services that are human centred, through a human centred process that empathises with and addresses the needs of the people who will consume the product or service (Brown and Wyatt 2010). Brown and Katz (2011) argue that for the design thinker, the relationship between creator and consumer must be "us-with-them" rather than "us-on-behalf-of-them".

In addition to creating products through empathising with users, design thinking has become increasingly interesting for solving wicked problems as it enables the creation of multiple solutions until one works. Applying a design thinking approach addresses all the stakeholders in addition to including them in the design process. While design thinking models include a final delivery, the iterative nature of a design thinking process allows for continuous improvement throughout the process, which can provide a resolution that tames the wicked problem.

Shan, Neo, and Yang (2021) conducted a study aiming to explore individuals' and businesses' motivation, interest, and participation in upcycling in Singapore. As the potential of upcycling was unclear in terms of local practices and attitudes, the researchers employed a design thinking methodology to identify the needs and frustrations of all stakeholders. Furthermore, the authors state that applying a design thinking method produces user data that provides insights and criteria for the design, or solution.

Another example of a design-oriented methodology being applied to a wicked problem is the project described by  Clune and Lockrey (2014). They applied a design thinking approach to their research, where they introduce a process to develop context-specific environmental sustainability strategies, as they state that design thinking as a process is relevant for solving wicked problems. The researchers explain how design thinking involves bringing together multiple ideas into conceivable solutions (Clune and Lockrey 2014). These ideas can often be different, as design thinking's holistic approach typically requires the involvement of all stakeholders (Shan, Neo, and Yang 2021). Cross (1989) articulates the designer's commitment to generate multiple solutions, often in a quick manner, as a strategy to solve complex problems, which Clune and Lockrey (2014) highlight as another reason design thinking is a suitable approach for wicked problems.

Clune and Lockrey (2014) note that the underlying philosophy of their research is that *we are all designers*, which supports their decision to include a participatory approach in their design process. Participatory design differs from user-centred design (UCD) in the way that participatory design projects are driven by an ongoing reflection on how one can involve the users as partners and how this partnership can develop during the project (Robertson and Simonsen 2012). While UCD traditionally entails observing the user in order to design for them, participatory design entails communicating with the users to design with them. The meaning of participation then becomes to explore, reflect on, understand, establish, and support mutual learning processes that emerge in the "reflection-in-action" during the design process. Reflection-in-action was first coined by Schön (1991) who describes our ability to do the right thing as "knowing-in-action", reflection-in-action is the reflective counterpart that describes our ability to meet challenges with improvisation. Clune and Lockrey (2014) use reflection-in-action to explain their view on the creative process of design, in which their research included participants, which allows for reflection-in-action to happen.

Clune and Lockrey (2014) highlight Herbert Simon's (1969) notion of design: design does not just create new objects and artefacts; designers attempt to "change existing situations into preferred ones". Acknowledging that users are domain experts, the researchers go on to argue that "ideas are most powerful when developed from the 'inside out'" (Clune and Lockrey 2014). Furthermore, Robertson and Simonsen (2012) argue that involving the users, who understand the practises and environments where the product will be used, increases its flexibility and robustness in use. In other words, incorporating participatory into a design project can increase the product's availability and likelihood of success by involving, listening to, and comprehending the voices of actual users.

As previously stated in this chapter, design thinking methods are appropriate for tackling wicked problems because the methodology permits the combination of multiple ideas into a feasible solution that meets the needs of all stakeholders (Clune and Lockrey 2014; Shan, Neo, and Yang 2021). Correspondingly, Pyykkö, Suoheimo, and Walter's (2021) literature review on the evolved double diamond model uncovered that co-creation and listening to the end-users are key elements in terms of addressing wicked problems.

Sanders and Stappers (2008) distinguish co-design and co-creation, defining co-creation as any act of collective creativity and co-design as the application of collective creativity throughout the design process. The researchers argue that users can play co-creating roles throughout the design process, thereby becoming co-designers, but this is contingent on the user's expertise, passion, and creativity (Sanders and Stappers 2008). Co-design and co-creation are terms that can describe *how* participatory design happens. By viewing people's lives, we can distinguish between four levels of creativity: doing, adapting, making and creating (table 1) (Sanders and Stappers 2008).

| Level | Type | Motivated by | Purpose | Example |
|---|---|---|---|---|
| 4 | Creating | Inspiration | 'Express my creativity' | Dreaming up a new dish |
| 3 | Making | Asserting my ability or skill | 'Make with my own hands' | Cooking with a recipe |
| 2 | Adapting | Appropriation | 'Make things my own' | Embellishing a ready-made meal |
| 1 | Doing | Productivity | 'Getting something done' | Organising my herbs and spices |

*Table 1. "Four levels of creativity" (Sanders and Stappers 2008)*

An individual possesses various types of creativity throughout their lives, which vary depending on what they are doing. For example, if this individual is in need of a new pair of jeans, they may be on a *doing* level if they simply purchase a pair of jeans. If the individual purchases a pair of jeans and hems the lining so that the length is tailored to them, the individual is on an *adapting* level of creativity. The *making* level could mean that the individual has a sewing pattern and sews a pair of jeans, while the *creating* level means that the individual, free from patterns, chooses to sew their own jeans. Addressing the levels of creativity is important, as the user's creativity decides whether they can become a co-designer (Sanders and Stappers 2008). Accordingly, it is imperative that the designer gives the user's the appropriate means to take on a co-designer role.

While both Shan, Neo, and Yang (2021) and Clune and Lockrey (2014) incorporated a design thinking approach into their research, their respective conceptual frameworks were distinct. Shan, Neo, and Yang (2021) employed the Stanford d.school Design Thinking Process as a framework, which consists of the five stages: empathise, define, ideate, prototype, and test (figure 1). During the empathise phase, the researchers conducted interviews and a survey to gain a better understanding of businesses' and individuals' attitudes and practises regarding upcycling. During the define and ideate stages, the researchers analysed and envisioned the data from the interviews and survey to ultimately produce a prototype aimed at businesses. To test the prototype, the researcher conducted user tests.
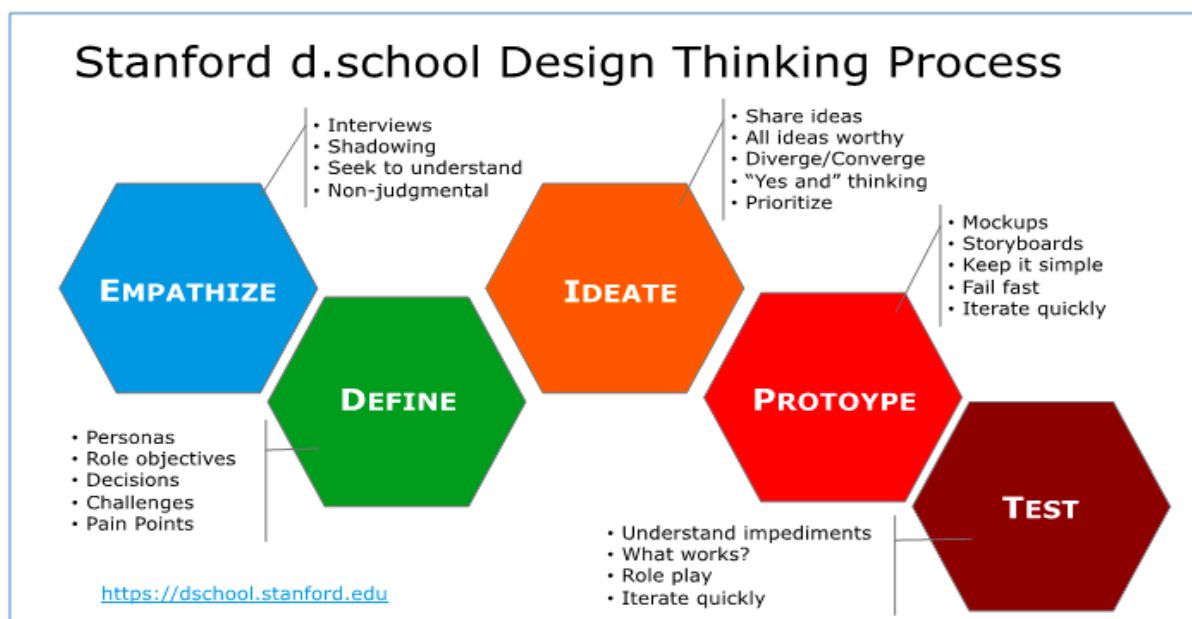


*Figure 1.* Stanford d. School Design Thinking Process.

In contrast, Clune and Lockrey (2014) conducted their research using a double diamond (DD) process, which allowed them to centre the process around their four research questions. The DD includes the philosophy of empathising with the user and ideating multiple ideas, but it differs from the Stanford d. School's process by having a visualised divergent and convergent thinking phase in the process (Pyykkö, Suoheimo, and Walter 2021).

Clune and Lockrey (2014) prefer the term "unsustainability" because it allows us to recognise and critique practises that are not sustainable, as opposed to defining what sustainability is and how to find a solution. For this thesis, the unsustainable practise that will be highlighted is clothing practises.

## 2.2. Promoting sustainable behaviour

In this section, literature pertinent to the promotion of sustainable behaviour will be presented. The RQ *"How can technology support young adults in choosing sustainable clothing practises?"* suggests that consumers may need to modify their behaviour, which can be accomplished in numerous ways; however, the objective of this thesis is to promote SCPs via motivation and empowerment. Persuasive Design (PD) and PTs have been utilised to alter the user's behaviour toward a more sustainable one (Adaji and Adisa 2022). Consequently, literature regarding PD and behavioural change will be presented.

### 2.2.1. Persuasive Design to influence behaviour

Aiming to motivate the user to make sustainable choices, i.e., changing their behaviour and/or attitude, requires exploring literature pertaining to behavioural change and PD. PTs are defined as technology that aims to reinforce, shape, or change attitudes, behaviours, or both without using coercion or deception, and PD is defined as the design of features by analysing the way they are perceived by the users (Oinas-Kukkonen and Harjumaa 2009; Thomson, Nash, and Maeder 2016). Since PD uses established phycological, sociopsychological and behavioural theories, PD is relevant when designing persuasive application that aims to change behaviour (Thomson, Nash, and Maeder 2016). When aiming to create a change in behaviour or attitude through motivation, one can separate between intrinsic and extrinsic motivation. Intrinsic motivation pertains to motivation from within, while extrinsic motivation relies on external factors.

Oinas-Kukkonen and Harjumaa (2009) presents a list of PD principles as 28 persuasive software design features, in which they categorise them as primary task support, dialogue support, system credibility support and social support. Principles under the primary task support category describes how to design a system that supports the user in carrying out the primary task, the dialogue support category describes how to design feedback to the user, the system credibility category describes how to design a system so that it is credible, and the social support category describes how to design a system that motivates users by social factors (Oinas-Kukkonen and Harjumaa 2009). Without diminishing the PD principles' significance, Thomson, Nash, and Maeder (2016) argues that simply applying the principles to a design is not sufficient for persuading, motivating and changing behaviour related to physical activity; the designer must carefully consider *how* the PD principles are applied in order for the application to be as persuasive as possible.

In their literature review of behavioural change, Rapp, Tirassa, and Tirabeni (2019) describe change as multiple in the sense that participants describe quite different interpretations of similar experiences of change. For this thesis, this could imply that the end-user's motivation for choosing SCPs could vary; by acknowledging that change is multiple, the technology can address multiple user scenarios and support multiple ways of bringing about behavioural change. *Personalisation* of the technology and its information, content, and notifications takes into account the user's uniqueness, thus creating motivation and increasing the technology's persuasiveness in terms of changing behaviour (Rapp, Tirassa, and Tirabeni 2019; Thomson, Nash, and Maeder 2016; Oinas-Kukkonen and Harjumaa 2009). In order to support long-term use of the technology and consequently increase the chance of successfully changing the behaviour, it is equally important to address the fact that the user's needs and motivation change over time. Therefore, the technology for change has to evolve with the user. As such, when implementing personalisation of a technology, the designer has to acknowledge the maturing of the user and adapt the technology accordingly (Thomson, Nash, and Maeder 2016).

While many behavioural models describe change as an isolated phenomenon only linked to a specific behaviour change, Rapp, Tirassa, and Tirabeni (2019) conclude that change is holistic in the sense that the behaviour change is connected to the user's other facets of life, meaning that the target behaviour change can have other side effects. For example, an

increased motivation to choose SCPs could potentially lead users to be more conscious of their consumption or environmental impact in other areas as well; if so, the authors suggest that the technology picks up on this and gives recommendations through more holistic data (Rapp, Tirassa, and Tirabeni 2019). Another way technology could support this would be by including the user's friend or network if the user wants to practise SCPs in a social context as well; *social support* can also be seen as a technique that increases the chance of successful use in addition to increasing the persuasiveness of the technology (Thomson, Nash, and Maeder 2016; Oinas-Kukkonen and Harjumaa 2009).

Lastly, Rapp, Tirassa, and Tirabeni (2019) describe change as continuous because the participants emphasise their own subjective perception of time rather than how long they have chosen to, i.e., upcycle clothing. This is because the boundaries of change can be difficult to navigate; for example, is it ethical to buy a fast fashion piece when trying to upcycle more clothing? For users that aim to reduce their carbon footprint, it can be, however, for users that look at upcycling as more of a pragmatic hobby that slightly reduces their footprint, it might not be. Technologies can prevent users from diverting from the desired behaviour by allowing them to buy new clothing or discard a sewing project if it ends up being too difficult or their life situation is stressful. Allowing the user to self-monitor and set their own goals, perhaps with the help of the technology, allows for the user to work towards the behaviour change on their own accord (Thomson, Nash, and Maeder 2016). Self-monitoring is a PD principle that entails allowing the user to keep track of their own performance (Oinas-Kukkonen and Harjumaa 2009). Additionally, the system can give the user motivational reminders of their own achievements. While reminders is a PD principle itself, i.e., reminding the user of their target behaviour, a reminder can aim to motivate the user by giving them praise, which is another PD principle (Oinas-Kukkonen and Harjumaa 2009).

A few ways to tackle change are to enable the user to make sense of overconsumption of clothing in relation to their own life and life philosophy and to give the user confidence in their own resources when taking on SCPs (Rapp, Tirassa, and Tirabeni 2019). This is consistent with Shan, Neo, and Yang's (2021) findings that individuals do not upcycle because they feel they are not creative enough (confidence) and that it is a lot of effort as well as time consuming (life philosophy).

Adaji and Adisa's (2022) literature review findings suggest that employing mobile apps is effective in terms of persuasiveness due to high usage, thus increasing the likelihood of changing behaviour.

## 2.2.2. Gamification as a Motivational Tool

Rapp, Tirassa, and Tirabeni (2019) suggest that since change is ever-present throughout life, the technology aiming to change behaviour should be lifelong. Ludic design can help create an intrinsic experience of using a technology through playful interactions with the technology, which can prolong the life of the technology for change (Gaver et al. 2004; McPherson et al. 2016). On a similar note, Adaji and Adisa (2022) suggests using serious games as a persuasive technology for sustainability as they increase in popularity.

Gamification is defined as applying game design elements in non-game contexts (Deterding et al. 2011). Some mobile applications aiming to promote sustainable habits, such as Tise, apply gamification elements such as points and rewards, which Mekler et al. (2013) argue are effective ways to affect user behaviour. However, their findings suggest that maintaining long term engagement is more difficult as gamification elements do not increase the users' inherent motivation. According to (Deterding 2012), you need a deeper understanding of the users in order to develop meaningful and valuable attractors. Ouariachi, Li, and Elving (2020) analysed pro-environmental gamification platforms aiming to explore best practices, and found that applying attributes such as achievable, challenging, credible, feedback-oriented, and meaningful, is valuable in terms of engaging users.

List from Ouariachi, Li, and Elving (2020):
- Achievable: promoting possible actions within the reach of the individual.
- Challenging: a task that requires a certain degree of effort to perform.
- Credibility: trustworthy information and inspirations.
- Feedback-oriented: evaluation of current performance relative to a goal.
- Meaningful: evoking intense feelings.

If we want to use applications to guide individuals to be more sustainable, designers might have to look for ways to increase the users' intrinsic motivation. The findings of Deci, Koestner, and Ryan (1999) indicate that providing users with options and acknowledging

their emotions can increase their intrinsic motivation, suggesting how gamification elements can be successfully implemented. For instance, the element of competition in an application or service can increase a user's intrinsic motivation if it is perceived as informative; however, if the application or service emphasises the importance of beating other players, the user's intrinsic motivation will decrease (Deci, Koestner, and Ryan 1999). However, the authors conclude that gamification elements such as rewards undermine the intrinsic motivation of users.

Likewise, Rawsthorne and Elliot (1999) argue that gamification elements that simply aim to avoid negative outcomes will decrease the users' intrinsic motivation, while striving for a positive outcome will increase the users' intrinsic motivation. Michaelsen and Esch (2021) argues that a positive reframing is important as this determines the type of motivational process; rather than framing the goal as "I want to quit purchasing new clothing", the goal "I want to upcycle, tailor and mend clothing more frequently" can elicit appetitive salience. Appetitive salience, or approach motivation, is related to goals that are associated with positive processes that results in a reward in the form of a pleasurable feeling (Michalsen and Esch 2021).

Ouariachi, Li, and Elving (2020) analysed pro-environmental gamification platforms aiming to explore best practices, in which the authors suggest balancing extrinsic and intrinsic motivation, which suggests that employing some gamification elements that only pertain to extrinsic motivation can be done. Furthermore, Ouariachi, Li, and Elving (2020) state that gamification elements that engage extrinsic motivation and negative emotions can prompt users to act swiftly, whereas intrinsic core drives and positive emotions keep the user engaged with the platform for longer and with a positive attitude. Gamification methods such as social elements, notifications, and player data insights are often used in applications aiming to support behaviour and can help empower the user (Van Der Lubbe et al. 2021).

# Chapter 3: Methods

In this chapter the methods and research approaches taken will be presented and described, in addition to the qualitative methods utilised to gain insight and data. A goal for this thesis has been to co-create a prototype for a mobile application, this has influenced the choice of methods.

Firstly, the research philosophy that is the ground wall of the thesis will be presented, before methods and framework are detailed. Lastly, the specific data collection methods and analysis of the data will be further explained.

## 3.1. Research philosophy

In this chapter, the underlying philosophy that has impacted the choices for data gathering and research methods will be presented. The objective of this thesis is to explore how technology can support sustainable clothing practises, which not only requires a deep understanding of their thoughts and attitudes towards upcycling, but also their general life philosophy and what makes it desirable to act sustainably. Thus, an interpretive paradigm is a natural grounding stone for this research, as this paradigm views our knowledge of reality as socially constructed by humans and their consciousness and meanings (Walsham 2006).

Consequently, qualitative methods for gathering data are necessary in order to understand the users through their social and cultural contexts, and to understand why phenomena happen through the meaning that users put in them (Myers 1997).

## 3.2. Research Methodology: Double Diamond

As stated in the literature review, sustainable development aiming to promote SCPs can be described as a wicked issue. Design thinking as an approach means conducting a human-centred process, aiming to create a product by empathising with the user and involving stakeholders in the design process. Multiple sources argue that design thinking is an appropriate approach to wicked issues, as including stakeholders allows for multiple ideas that can address all users (Clune and Lockrey 2014; Shan, Neo, and Yang 2021; Pyykkö,

Suoheimo, and Walter 2021). Moreover, involving users in the design process increases the likelihood that a product will be successful (Robertson and Simonsen 2012).
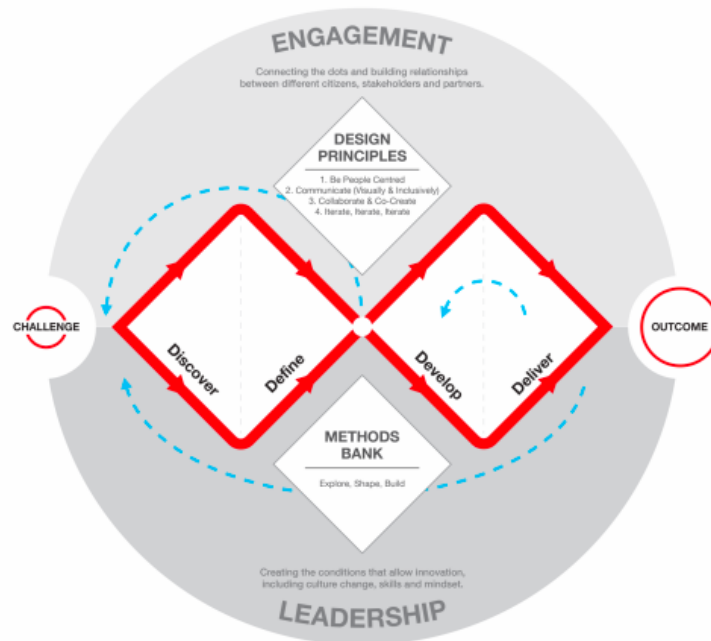


*Figure 2. Evolved Double Diamond Model from the British Design Council.*

The Double Diamond (DD) design process was chosen as a methodology as this design process allows for qualitative methods as well as an explorative approach both in the research phase and the design phase (figure 2). Moreover, the DD process is often applied when tackling wicked problems (Pyykkö, Suoheimo, and Walter 2021).

The first diamond begins with familiarising yourself with the research area and the state of the art, discovering practises, and empathising with the user. This gathering of knowledge constitutes the convergent phase of the diamond. In the diverging phase of the first diamond, analysing the data and narrowing the information are the priorities. In other words, the first diamond is essentially about *designing the right thing.* In the second diamond, the focus is on *designing the thing right.* The convergent phase of the second diamond entails creating prototypes that address the findings of the first diamond, testing them, and iterating. While the DD model includes a final delivery, the iterative nature of the model allows for continuous improvement throughout the process, which can provide a resolution that tames

the wicked problem. Consequently, the delivery is an outcome rather than a solution, as final solutions to wicked problems are not possible (Pyykkö, Suoheimo, and Walter 2021).

Key principles for the DD framework are to be people centred, to communicate inclusively and to collaborate and co-create, thus requiring the inclusion of users. In this thesis users were involved in all phases of the DD process. The process that has been applied in this thesis is shown in figure 3, in which the yellow post-its represent activities that involved users and the pink post-its represent activities that did not include users. In the first diamond, interviews were conducted with participants of the target group, aiming to reveal the state of the art. Subsequently, the interview data was thematically analysed in preparation for the defining workshop, which was held with a couple participants.
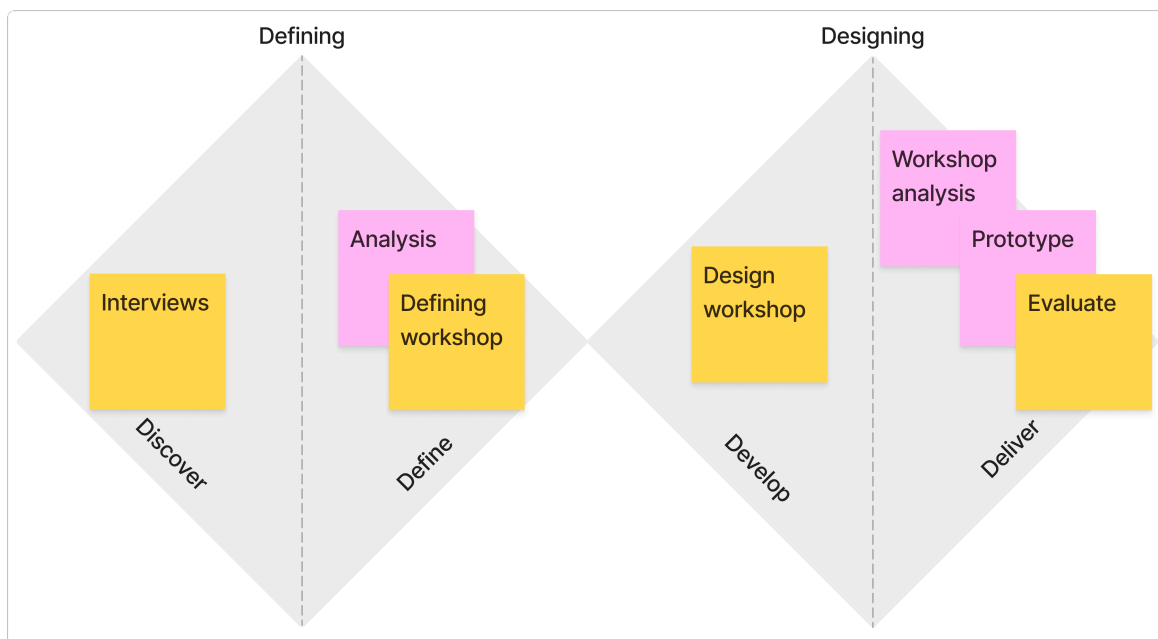


***Figure 3.*** *Double Diamond Activities.*

Users are not involved in every aspect of the design process for this research project, i.e., prototyping, but rather play co-designer roles in terms of creating and designing concepts and shaping the final outcome. Participants played a quite significant co-design role, especially in the defining and design workshops, where their ideas and thoughts were the main contributions to the conceptualisation of the prototype.

The goal of including users is to allow co-design to happen through *level four creating* creativity (table 1). In order to enable the participants to play a co-designer role, it was important to lead and guide the participants in the design process so that they were able to apply their means (Sanders and Stappers 2008). For this thesis, it was a goal to design an outcome with the participants through their creativity and engagement on a level four creativity type, rather than including users only for testing and approval of design.

Clune and Lockrey's (2014) case study adopted methods and principles from participatory design in their DD process, as they argued that "ideas are most powerful when developed from the 'inside out'". The authors, through the lens of participatory design, recognize users as co-creators, and argue that user participation is important within sustainable development literature. Clune and Lockrey (2014) included users through their participatory define- and design workshops, which allowed the users to partake in defining the problems and designing possible solutions. Likewise, this thesis includes a design workshop in which users will co-create solutions to problems uncovered in introductory interviews.

## 3.3. Research Methods

### 3.3.1. Interviews

In the beginning of planning the interview, the scope of this thesis was to explore how technology could support young adults in choosing upcycling of clothing. Thus, the aims interviews of the interviews was initially to gain qualitative and in-depth insight about the target groups attitudes and thoughts about SCPs, interviews were chosen as the first data collection method. The primary objective of the interviews was to gain insight into the perceptions and attitudes of the target group towards upcycling of clothing, as this would serve as the foundation for planning the defining and design workshops. Through the pilot interview, it was discovered that focusing solely on upcycling of clothing could be difficult as the participant might not be too familiar with the activity. Thus, the interview guide was improved and involved the following topics: clothing habits and attitudes, upcycling of clothing, tailoring, and mending. Consequently, the scope was widened to include SCPs rather than just upcycling of clothing.

The interviews were semi-formal, aiming to be held as an informal conversation. Standard questions for each topic were created regarding SCPs, however in most interviews the participant answered the questions without being asked, resulting in conversational interviews. The questions entailed asking about the general impression of incorporating sustainable practices to fashion, their current habits and desired habits. Since the interview revolved around the participant's habits and attitude towards SCPs, an important part of the interview was to lead with a non-condescending attitude and stating that the interviewer was just as interested in the participant's desired actions as well as their current actions revolving around sustainable fashion.

In total, interviews with 6 participants were held (participants 1-6), as 70% of themes are identified within the first six interviews (Guest, Bunce, and Johnson 2006). The participants were young adults with ages ranging from 23-28 from Norway, in which five of the participants receded in Oslo. The interviews were held in person, and notes were taken during the conversation.

### 3.3.2. Workshop

The decision to include workshops as research methods was, in addition to inspiration from Clune and Lockrey's (2014) design thinking case study, based on the notion that the social world is in a state of constant change and that the research methods included should reflect this (Tarr, Gonzalez-Polledo, and Cornish 2018). Since workshops provide the researcher with live data, this method is suitable for this view.

When including workshops as a research method, a degree of improvisation is inevitable. Tarr, Gonzalez-Polledo and Cornish (2018) introduces the term "imprography", which construes the balance of improvised and choreographed research. Most qualitative research can be described as either, however workshops introduce imprography through the researchers' lack of ability to change the direction of the workshop as the method starts.

In the likes of Lockrey and Clune's (2014) research which included participatory design principles, two workshops were held aiming to define problems and design solutions in this research. The workshops were planned in detail in terms of activities, meaning it was somewhat choreographed, however the participants were in charge of producing. The

activities were planned by reviewing personal experiences of being a participant in workshops, discussing workshop activities with fellow designers and reviewing Digital Society School's *Design Method Toolkit* ('Design Method Toolkit by the Digital Society School' n.d.).

Workshops as a research method supports an immersive and collaborative environment for both the facilitators and the participants, which can lead to limitations if the participants are uncomfortable and passive in the workshop (Ørngreen and Levinsen 2017). Ørngreen and Levinsen (2017) adopt Darsø's (2001) distinction between the "clinician", who focuses on the participant, and the "ethnographer", who focuses on the research. When facilitating a workshop which requires presence and activity from the participant, it is important to balance the clinician and ethnographer role in order to avoid limitations caused by passive participants. Therefore, both workshops included food and snacks catering to physical needs and introductory conversations, icebreakers, and frequent breaks to address the participants' social comfort.

### 3.3.2.1. Defining workshop

Clune and Lockrey's (2014) workshops aimed to define existing unsustainable practices, as they argue this is essential to create solutions that promote sustainability. For this thesis, however, the unsustainable practices are quite clear; we buy and throw away too much clothing. Thus, it was decided to have a defining workshop aiming to construct "how-might-we" questions (HMWs) that could help us design the right thing in the forthcoming design workshop.

HMWs are created in order to reframe the problem and are popular within design thinking to create more innovative solutions while keeping the team focused on solving the right problem (Rosala 2021). The HMWs should be specific to user insight and broad as this enables the generation of multiple ideas that addresses real issues. Moreover, HMWs should be phrased positively, as positive verbs such as "enhance" rather than negative verbs such as "reduce" can generate more ideas and encourage creativity (Rosala 2021).

The goal of the workshop was to use the predefined problems discovered in the analysis of the interviews and reframe them to HMW's that were to be used in the design workshop. The

agenda for the defining workshop was to review and gain a mutual understanding of the problems, and to form relevant HMW's for the forthcoming design workshop.

As such, the defining workshop consisted of four activities conducted for each problem (table 2); discussing the problem and gaining a mutual understanding of what it entails, individual brainstorming for five minutes, collaborative brainstorming for 10 minutes and dot voting the HMW's.

| Time | Activity |
| --- | --- |
| 10 minutes | Discussion |
| 5 minutes | Individual brainstorming |
| 10 minutes | Collaborative brainstorming |
| 2 minutes | Dot voting |
| 5 minutes | Break |

*Table 2.* Agenda of the Defining Workshop.

This workshop and defining the HMW's was important in terms of defining the specific "scenarios" the participants of the design workshop was going to work with. As this project relies heavily on co-design principles, the author deemed it important that real users were a part of determining the problems and how to brainstorm possible solutions.

### 3.3.2.2. Design workshop

The purpose of the participatory design workshop was to use the HMW's created in the defining workshop to generate design ideas. The objective was to have the two groups formulate one idea per HMW, addressing the challenges with sustainable clothing practices and possible solutions.

The design workshop included seven participants who were divided in two groups. The workshop started with a short introduction to the topic, explaining central terms within sustainable clothing practising to establish a common "language". Additionally, the objective of the workshop and the activities planned for the workshop was explained.

The workshop was split in three parts, each part focusing on one HMW. The parts consisted of the same three activities, crazy eight, brainwriting and working with an idea canvas and lasted for 32 minutes (table 3). When planning the workshop activities, the dilemma of having the participants develop one idea over a longer period of time versus working on many ideas in shorter spans was reflected upon. Many of the participants had never been part of a design workshop before, and reported they were nervous they were not creative enough and could not contribute with good ideas. Aiming to reduce the chance of overthinking and running out of ideas, the decision to have the participants work in shorter and intense intervals was made.

| Time | Activity |
| --- | --- |
| 8 min | Crazy Eight |
| 12 min | Brainwriting |
| 12 min | Idea Canvas |
| 10 min | Break |

*Table 3.* Agenda of the Design Workshop.

**Crazy Eight**

Crazy eight and brainwriting are two brainstorming activities included in order to "loosen" the participants up. Crazy eight entails having eight minutes to draw and/or explain eight different ideas which addresses the HMW question. As previously stated, some of the participants were nervous about their ability to come up with good ideas. Therefore, the crazy eight activity was great, not only to get the participants' imagination started, but also to break the ice.

**Brainwriting**

Aiming to refine the ideas from the crazy eight exercise, brainwriting was the next activity on the agenda. The participants chose their three favourite ideas from the crazy eight activities and explained them on a paper before passing the paper to the participant next to them. The participant then had three minutes to draw upon or further develop the ideas. This was repeated a total of two times. In addition to allowing for the participants to play off each other's creativity, the brainwriting allowed the participants to get familiar with the existing ideas before the interval's last brainstorming activity.

21

***Figure 4***. *Brainwriting during the design workshop.*

**Idea Canvas**

For the last brainstorming activity, each of the groups collaborated on formulating more refined ideas addressing the HMW questions. For this activity the groups were encouraged to use the ideas from the previous brainstorming activities to either draw upon or merge together to come up with innovative ideas. In order to help the participants to formulate ideas, an Idea Canvas was included. The idea canvas consists of three text boxes where the user can 1) explain their idea, 2) which challenges they are addressing and 3) the primary benefits of the idea. The objective of including the idea canvas was to make the participants more aware of how their idea addresses the HMW question by "forcing" them to reflect on the challenges and benefits the idea addresses and provides. Alternatively, having a tangible canvas to work on could be easier to manage rather than conveying their idea on a blank piece of paper.

***Figure 5.*** *Using the idea canvas during the design workshop.*



**How might we:**

Sketch and/or explain your idea:

What challenges are you addressing:

Primary benefits

***Figure 6.*** *The idea canvas used during the design workshop.*

The workshop ended with the groups presenting their ideas to each other, allowing for commentary, questions, and praise from each other. Additionally, the participants could comment on the workshop.

### 3.3.3. Recruiting participants

The target group of this research are young adults (20-30 years old) who desire sustainable fashion practices, making the researcher a part of the target group. This has some benefits such as the researcher sharing similar experiences in terms of economy, current trends, and the state of society around us. However, this also meant that the researcher had to be cautious not to undermine the design thinking methodology by letting their own opinions being too leading in meeting with the participants.

The participants that are included in this study do know the researcher personally, given that the researcher sampled participants based on whether they thought the participant could provide relevant information. While this provided quality information and participants that was available throughout the research project, it means that the sampling of this research might not be representative for all young adults in Norway.

The participants were first introduced to the research project through oral or written conversation. Throughout the participant's involvement in this research project, they have been informed that their consent of partaking in activities providing information or ideas can be retracted. A full overview over all participants and can be seen in table 4.

| Activity | Participants |
|---|---|
| Participant 1 | Sewing skills: Beginner |
| | Attention to clothing: high |
| | Awareness of sustainability: medium |
| | Openness to SCPs: medium |
| Participant 2 | Sewing skills: High |
| | Attention to clothing: high |
| | Awareness of sustainability: High |
| | Openness to SCPs: High |
| Participant 3 | Sewing skills: High |
| | Attention to clothing: high |
| | Awareness of sustainability: medium |
| | Openness to SCPs: High |
| Participant 4 | Sewing skills: Intermediate/advanced |
| | Attention to clothing: high |
| | Awareness of sustainability: high |
| | Openness to SCPs: high |
| Participant 5 | Sewing skills: Intermediate |
| | Attention to clothing: low/medium |
| | Awareness of sustainability: high |
| | Openness to SCPs: medium |
| Participant 6 | Sewing skills: Beginner |
| | Attention to clothing: high |
| | Awareness of sustainability: high |
| | Openness to SCPs: high |
| Participant 7 | Sewing skills: Beginner |
| | Attention to clothing: high |
| | Awareness of sustainability: high |
| | Openness to SCPs: high |
| Participant 8 | Sewing skills: Beginner, has never sewn. |
| | Attention to clothing: high |
| | Awareness of sustainability: low |
| | Openness to SCPs: medium, is intrigued |

| Participant 9 | Sewing skills: Beginner, has never sewn. |
|---|---|
| | Attention to clothing: high |
| | Awareness of sustainability: high |
| | Openness to SCPs: high |
| Participant 10 | Sewing skills: Beginner, has never sewn. |
| | Attention to clothing: medium |
| | Awareness of sustainability: medium |
| | Openness to SCPs: medium, but is intrigued |
| Participant 11 | Sewing skills: Beginner, has never sewn. |
| | Attention to clothing: high |
| | Awareness of sustainability: low |
| | Openness to SCPs: low, but is intrigued |

*Table 4. Overview over participants.*

## 3.3.4. Analysis

Throughout the research, thematic analysis has been used as a method to analyse the data from the interviews and the design workshop. As the interviews resulted in more data to analyse, the analysis included both affinity mapping and thematic analysis. When analysing the data from the design workshop, a thematic analysis was conducted.

When analysing the data from the interviews, the first step was to code the data in an affinity map according to their theme. Since the interview guide was split in three parts - upcycling, mending and tailoring - this provided a natural thematic split. Furthermore, reviewing the data uncovered sub-themes such as "as-is", "challenges" and "possibilities".

*Figure 7.* Initial Affinity Mapping

From the affinity map, a thematic analysis was started. In accordance with Braun and Clarke's (2006) six phases of thematic analysis, the affinity map acted as the first step of familiarising myself with the data before generating the introductory codes and reviewing whether the themes work in regards to the coding. An inductive approach to the analysis was taken, meaning that the themes of interest were made as the data was analysed (Braun and Clarke 2006). The main learning outcome of this process was to uncover barriers for upcycling practises common to all participants aiming to address these barriers in a design workshop.

As previously mentioned, the data from the design workshop was not as extensive as the interview data. Thus, a thematic analysis was conducted without any supplementary analysis methods. The data from the design workshop was the ideas presented in the idea canvas'. The first step of the analysis was to read through all the ideas, before reviewing the HMW's separately. The goal of this was to identify similar or repeating themes of the respective HMW.

# Chapter 4: Findings

In this chapter, the findings from the interviews, the defining workshop, and the design workshop will be presented and elaborated on. The findings describe the participants' beliefs and attitudes toward sustainable clothing practises (SCPs), such as upcycling, tailoring, and mending. Findings that only pertain to particular SCPs will make this clear.

## 4.1. Interview findings

Analysing the interviews uncovered some recurring themes. Regarding SCPs such as upcycling, mending, and tailoring, a majority of the participants reported that they did not feel that their skills were good enough. Additionally, a majority of the participants reported that especially upcycling required them to be creative and that this was challenging. Moreover, all participants agreed that choosing to enforce sustainable clothing practices can be challenging as it has to be prioritised.
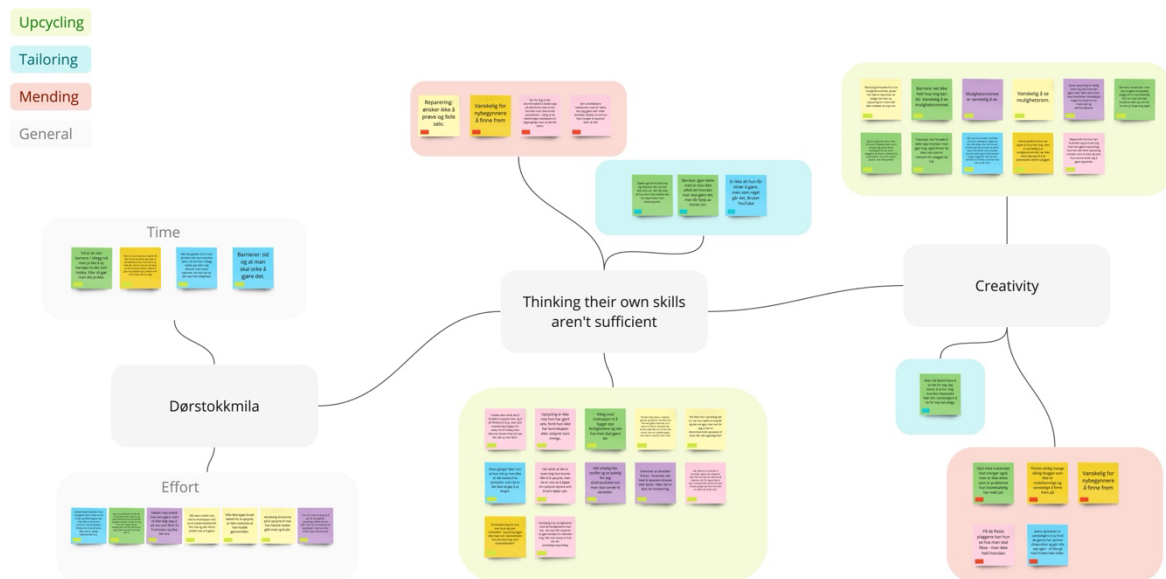


*Figure 8.* Thematic analysis of interview data.

### 4.1.2. Thinking their skills are not sufficient

Regarding SCPs, all participants either stated or acknowledged that sewing is difficult. Some participants noted that, given their sewing level, they would avoid SCP projects because they thought they were too advanced. Participant 1 said that "I don't know how difficult it is, I've

only sewn one thing before, and that was fun, but I imagine it to be demotivating and a waste of time". Participant 6 stated that they had not done any clothing upcycling projects, as they felt they did not have the knowledge or equipment needed. This participant wanted to upcycle more in addition to continuing with tailoring and repairing, but the challenge of seeing possibilities with the skills they have hindered the participant from actually doing so.

Moreover, participants who did not have a lot of sewing equipment were hesitant to buy the required equipment for fear of it being wasteful if they did not end up sewing more. Some participants said that they did not wish to try and fail and that, as a beginner, it can be difficult to determine a project's difficulty level. Participants 1, 5, and 6, who classified themselves as beginners, brought up that it is difficult to know how to start a sewing project at all, both in terms of the practical skill of sewing and the technicality of how they should carry out a project, e.g., how they should repair a tear in their shirt. Even interview participants (participants 2, 3, and 4) who classified themselves as experienced hobby sewers noted that they often face barriers, such as not daring to attempt new projects. However, these participants stated that their experience enabled them to overcome this obstacle, as they would often find solutions through friends or the internet.

### 4.1.3. Creativity

Regarding creativity, every participant reported that SCPs, especially upcycling, required them to be creative. A common sentence among all participants was that it is difficult to see upcycling possibilities in a garment, e.g., to decide to upcycle a t-shirt into scrunchie hair ties. Moreover, participant 1 elaborated that there is often a limit to what they could imagine as desirable upcycling products in the sense that they would want to use the upcycled product. This is an important aspect, as promoting upcycling is only sustainable if the upcycling product is used. Participant 3, who was more experienced with sewing, added that the challenge of seeing upcycling opportunities can often stem from the garment's limited fabric, which in turn limits possible upcycling products.

Moreover, many interview objects detailed how it can be difficult to determine how they could tailor or mend clothing. As participant 2 said, "If you have done it before, it might be obvious how to do it, but for beginners, it's hard to understand". Likewise, participant 6 stated that when they received repaired garments from a tailor, they immediately thought that

this was something they easily could have done themselves, however, it did not occur to them how they could have done it before.

Additionally, some participants (participants 2, 3, and 4) reported that they would do online research for videos targeting specific garments, e.g. "upcycled jeans", but the search results are not always relevant or something desirable for the participant. The difficulty of envisioning the finished garment also applies to mending and tailoring projects, while they would research online to see other people's projects, it is not easy to find relevant projects. This was especially relevant for some of the participants in regards to mending, participant 4 stated that "there are a lot of granny blogs that are not mobile friendly and difficult to navigate".

### 4.1.4. Time and motivation

On a higher level, all participants spoke of sustainable clothing practices as desirable, moreover, many of the participants said that they did not want to support environmentally and socially unsustainable fashion businesses. However, accessibility, prices and the desire for trends did win sometimes.

Additionally, all participants commented that time is a big obstacle as it is challenging prioritise SCPs in a busy schedule. Participant 4 said "It is something you must set aside time for and prioritise. It is easier to go out and shop for new clothing", and participant 2 said that "Regarding time, you are so tired when you come home, then you also have to clean up after sewing".

Thus, time and accessibility can be a big factor as to why people choose to buy new clothes instead of enforcing sustainable clothing habits. Reviewing the interview data, I hypothesised that addressing the user's lack of confidence and creativity could motivate the user to spend time and effort enforcing sustainable clothing habits.

## 4.2.1. Defining workshop findings

The defining workshop aimed to establish three HMWs related to issues related to sustainable clothing habits. After discussion, brainstorming and dot voting the final HMWs to present in the defining workshop were as follows:

*1) How might we boost the users' creativity in terms of sustainable clothing practices?*

*2) How might we empower the user to feel that they are able to redesign, tailor and mend?*

*3) How might we motivate the user to achieve more sustainable clothing practices?*

HMW 1) addresses the challenges of seeing possibilities with sustainable clothing practices. The HMW is left quite open and allows for brainstorming in terms of invoking internal and external creativity.

HMW 2) is directed to the interview object's statements regarding their skills and, perhaps the most relevant, their feeling of whether they are able to complete a sewing project, as this hinders the interview objects to give SCPs a try.

Lastly, HMW 3) relates to the interview objects' sentiments about being able to prioritise sustainable clothing practices. As established earlier, fast fashion is likely to be chosen over sustainable clothing practices as it is faster and more accessible, despite the interview objects stating that they desire more sustainable clothing habits. This HMW aims to explore how we can motivate the user to make more sustainable clothing choices and make it worth the time and effort to enforce sustainable clothing practices.

## 4.2.2. Design workshop findings

The ideas for each HMW will be presented before discussing similarities discovered after thematically analysing the ideas.

### 4.2.2.1. How Might We boost the user's creativity in terms of redesign and mending?

**Group 1**

The first group chose to address the lack of inspiration by creating "starter packs", which provide the user with step-by-step instructions and the alternative of purchasing the required equipment at home with a courier similar to courier services such as Foodora or Wolt. The user can search for specific starter packs if they already have an idea of what type of sewing project they want to do, or they can browse trending starter packs that are popular with other

users. A significant benefit of this service is that the user can check off sewing equipment they already possess, so that they do not need to purchase more than they need.

Additionally, other users' creations from a starter pack can be presented to spark the users' interest. If this is not sufficient to inspire the user, the user can order a mystery starter pack, providing the user with a "bold" upcycling project, i.e. an upcycling that produces a statement piece.

**Group 2**

Group 2 came up with an idea to present users with upcycling and repair patterns in an online store format. They described the concept as explorative, in which the user can explore different styles or categories based on their preference. Likewise, to group 1's idea, this concept provides a "popular" page, where the most shown/liked patterns appear. Additionally, group 2's concept also includes a user society, where the user can see what other users have created, and users can post patterns and/or videos.

The idea behind this concept is to make it simpler for the user to navigate the sea of various SCP opportunities by collecting patterns and tutorials in one location, saving the user from having to browse online on various platforms, etc.

## 4.2.2.2. How Might We empower the user to feel that they are able to redesign and mend?

**Group 1**

Group 1 had two different ideas and chose to split the group in two to work on the respective ideas.

The first idea involves an app or web page that lists the typical challenges you encounter when sewing. The challenges are categorised so that it is easier for the user to navigate the page. In addition to textual instructions, each challenge has video instructions showing how to solve the problem. Moreover, if the instructions are unclear or if the user is not able to find the correct solution, this idea provides the user with a 24-hour chat and video consulting on booking.

The second idea entails collaboration with a local senior centre where a mutual trade is made between young adults and seniors. The premise is to pair young adults aiming to learn to sew or improve their skills with experienced seniors. This idea allows for smaller and bigger projects and is adaptable to the user's skill.

**Group 2**

The second group came up with the idea of a sewing game, "Sew a seam", a game that teaches the user to sew through challenges that entail upcycling, repairing and mending of clothing. The challenges consists of step-by-step tutorials that can be spread over several days, making the sewing project more manageable. To upkeep motivation, the game gives motivational notifications and streaks when the challenge is worked on every day. Additionally, the challenges and streaks can provide the user with points that can be used on hobby shops, for example, Selfmade in Norway.

## 4.2.2.3. How Might We empower the user to feel that they are able to redesign and mend?

**Group 1**

Aiming to motivate the user to achieve more sustainable clothing habits, group 1 presented a digital wardrobe that gives the user suggestions for improvements. The idea requires that the user registers clothing and other textiles they are willing to change (upcycle, repair, tailor), if the registered articles are not changed within a set period of time, the wardrobe will suggest selling the item. To motivate the user to change said article, other users may come up with suggestions on how to modify it. Alternatively, the money it is sold for can be given to charity as an incentive to do something good.

**Group 2**

The group presented a function that shows the accounting of clothing items by presenting cost per wear. Additionally you could register a clothing item to see how much it cost the planet to produce. Thus, the function becomes a personal climate accounting for your clothes. To motivate the user to upcycle and repair what they already have, rather than guilt the user, this function can include motivational notifications when you choose to upcycle or repair a garment.

The group reported that, while they try to not buy new clothing, some garments such as plain t-shirts can be difficult to buy secondhand or sew themselves. Their function addresses this by providing a ranking of different clothing brands so that if you have to buy something new, you can do so with a clearer conscience.

This function could contribute to a better understanding of sustainability and pollution regarding clothes on a consumer level; while we know that the clothing industry is bad for the environment, it is difficult for the consumer to understand what an individual garment "costs". Additionally, it could give the user a better overview of their consumption.

## 4.2.2.4. Design workshop analysis

Aiming to uncover trends and themes in the ideas produced in the design workshop, the ideas were thematically analysed (figure 9). The ideas were analysed by summarising the ideas of each HMW question and identifying similar ideas or motivations of the ideas.



*Figure 9.* Analysis of the design workshop.

The ideas formed from *"How might we boost the user's creativity in terms of sustainable clothing practices?"* were quite similar, both groups brainstormed an application in which the user is presented with tutorials. Drawing on community creativity, both groups aimed to evoke creativity by showing the user tutorials that are popular with other users. Group 2 further enhanced the external inspiration by suggesting that users can post tutorials.

Additionally, both groups involved step-by-step tutorials so that the user can choose projects according to their skill level, creating a low threshold offer to the user. The ideas both serve as a "hub" for sustainable clothing practices in which the user can browse for inspiration while knowing that they will get help to complete projects.

The main difference between the two groups is that group 2 chose to draw inspiration from social media apps such as Instagram and Pinterest, e.g. by allowing the user to post tutorials themselves and explore a variety of tutorials. Group 1 had a slightly more practical approach, aiming to provide the user with the tangible equipment they would need for the project.

To "*empower the user to feel that they are able to redesign, tailor and mend",* both groups came up with ideas that enabled the user to learn how to sew according to their level of skill. The means to do so, however, were quite different. While Group 2's game aimed to motivate the user to learn a new skill through gamification, group 1 aimed to do so by enforcing positive social emotions with the senior centre idea and through providing information. Group 1's game addresses the user's hesitation to start a sewing project and aspires to maintain this motivation by manifesting the user's performance through notifications and points.

Lastly, the ideas that were presented with "*how might we motivate the user to achieve more sustainable clothing habits"* both involved raising the user's awareness of their clothing usage and consumption. While Group 1 aimed to do so by motivating the user to take action with their existing garments, Group 2 proposed a personal climate accounting in which the user is made aware of the planetary cost of clothing items.

## 4.2.2.5. Thoughts on workshops

Multiple participants in the design workshop were anxious and unsure of whether or not they possessed the necessary skills to participate as they did not feel sufficiently creative. One participant reasoned this with "I can't draw", a few others "warned" the author that since they

had not been a part of a workshop before, they could not promise "good contributions". As stated by Ørgreen and Levinsen (2017), uncomfortable participants can lead to a passive workshop, so when arranging the design workshop, the author had to carefully consider this factor.

In order to avoid limitations related to passive participants, the author had to carefully reflect on how to take on the "clinician" role, who focuses on the participant's wellbeing (Darsø 2001). This was done in several ways, foremost, the design workshop was started of by introducing the participants to each other and have small talk over some food. This was an effective way to naturally breaking the ice and making sure that the participants were socially comfortable. Furthermore, the workshop was planned in a manner in which the participants had to work with the HMWs in short and intense intervals, so that they did not have too much time to second-guess their ideas and contributions. Furthermore, this highlighted the fact that they did not need to come up with a brilliant proposal on their own. This was received well by the participants; in the post-workshop reflection, multiple participants said that it was nice to be able to focus on one HMW question and try and be as productive in the assigned 32 minutes, and then "just be done with it without further ado".

For further co-design projects, the author reflects on whether the design workshop should be named differently to lower the threshold for participating. Perhaps if it was called e.g., "brainstorming workshop", the participants would not be so anxious of their drawing skills and their ability to come up with complete concepts.

# Chapter 5: Design

In this chapter, the prototype design is presented. The prototype was designed by applying Jakob Nielsen's (1994) usability heuristics and PD principles (Oinas-Kukkonen and Harjumaa 2009). Nielsen's (1994) heuristics are a set of design principles for interaction design, designed as a "rule of thumb" rather than specific design guidelines. Some heuristics, such as *consistency and standards*, were applied in the first prototypes in terms of the UI layout, while other heuristics were applied in the more detailed high-fidelity prototype. Throughout the next sections the author will detail how the heuristics and PD principles were applied to the design. In chapter 5.3 an overview of how the different heuristics are applied is presented in table 9, and an overview of how the PD principles were applied is presented in table 8.

## 5.1. Conceptualising

As previously stated, the ideas from the design workshop resulted in some mutual themes, being:

- Community creativity; showing other users' creations, showing popular tutorials.
- Empowering users through learning; step-by-step tutorials, adaptable to the users' skills
- Giving the user awareness about their own clothing consumption and its impact.

By identifying these mutual themes, it became clear that teaching how to sew and tutorials would have to be a central part of the application as both groups incorporated this to some degree in four of their ideas. Additionally, group 2 had one idea about presenting tutorials and applying gamification elements such as points to motivate the user. In addition to being compatible with tutorials, group 2's idea about the sewing game is very much compatible with the community creativity aspect and gives the user awareness of their own consumption.

The first draft of how the game prototype could be set up is presented in table 5. The sewing game can combine user empowerment through learning how to sew by completing challenges with community creativity by allowing the user to explore challenges, see what challenges are popular with other users and see what other users have created. Additionally, the game

could bring awareness to clothing consumption by visualising the kg of CO2 the user saves by completing challenges.

| User issue | Design workshop findings | Implemented solution | Gamification |
|---|---|---|---|
| Thinking their skills are not sufficient | Empowering users through learning | Step-by-step tutorials, adaptable to the user's skills, positive reinforcement by seeing the number of completed challenges. | Tutorials are presented as challenges which provides points. |
| Lack of creativity | Community creativity | Showing other users' creations, showing popular tutorials, discover-feed, suggested challenges | Social comparison |
| Motivation | Giving the user awareness about their own clothing consumption. | The tutorials show how many kg of CO2 the user saves by not throwing the clothing item. | Kg CO2 saved is incorporated into the points system, by which the user is rewarded. |

*Table 5. Overview of the prototype concept.*

The concept of the prototype is a mobile application presenting upcycling, tailoring and repair tutorials in the form of challenges. A challenge is a step-by-step tutorial giving detailed instructions, each step is a sub-task, and while there is no time limit for completing the challenge, completing a sub-task every day will provide points (table 6). The challenges present the amount of CO2 that is saved by modifying the garment rather than throwing it away, in addition to giving points relative to the challenge's difficulty. The goal of using

points as a gamification method is to give the user a reward for improving their sewing skills and for making an effort to consume sustainable fashion.

| Term | What is it |
|------|-----------|
| Challenge | Step-by-step tutorial. Challenges have three levels: beginner, intermediate and advanced. The level decides how many points the user receives. Each challenge has an amount of kg of CO2. |
| Stats | The user is presented with stats: streak, points, kg CO2 saved and the number of completed challenges. The objective of the stats is to motivate the user to continue with sustainable clothing practices. |
| Streak | The user gets a streak by completing one sub-task each day. |

*Table 6. Explanation of terms used in the prototype.*

Rather than using levels that are achieved through points, the number of challenges completed is presented to solidify the user's achievements. Moreover, this emphasises what the user has completed, instead of what they have to complete. Completed challenges, streaks, points, and kg of CO2 saved are stats presented to the user with the aim to motivate them by showcasing their effort and accomplishments. In this way, we can empower the user to feel that they are able to sew and complete projects.

## 5.1.1. Thoughts on motivation and Gamification

When incorporating gamification elements aiming to motivate the user to take on sewing challenges, it is important to keep the sustainability mission in mind. That is, it would not be sustainable to encourage the user to buy new clothing items to complete challenges. Therefore, certain gamification elements were not included. One such was levels, for example, that users can level up based on how many points they have. As the most sustainable clothing practice of them all is to use the clothing you already have, the prototype should not motivate the user to take on challenges that they do not see a clear use case.

The goal with the application is to inspire and train the user, and while gamification elements are used to encourage the user to complete the challenges, their progress has no impact on their usage of the application. For example, in Duolingo, your progress determines what exercises you can complete and when you can complete them. Since the aim of the

application is to support more sustainable clothing habits through creativity and empowerment, the application does not restrict the user. Rather, the user will be given recommendations based on their completed challenges and inspiration through seeing what other users have created.

## 5.2. First prototypes

The first lo-fidelity prototypes consisted of hand-drawn sketches presenting the main page's overviews and their contents. The prototype would include three main pages: 1) a home page, 2) challenges and 3) a personal page. For the home page, two different versions were made where v1 was focused on browsing through categories and challenges and v2 was more personalised by presenting challenges recommended to the user in addition to showcasing what other users have sewn (figure 9).
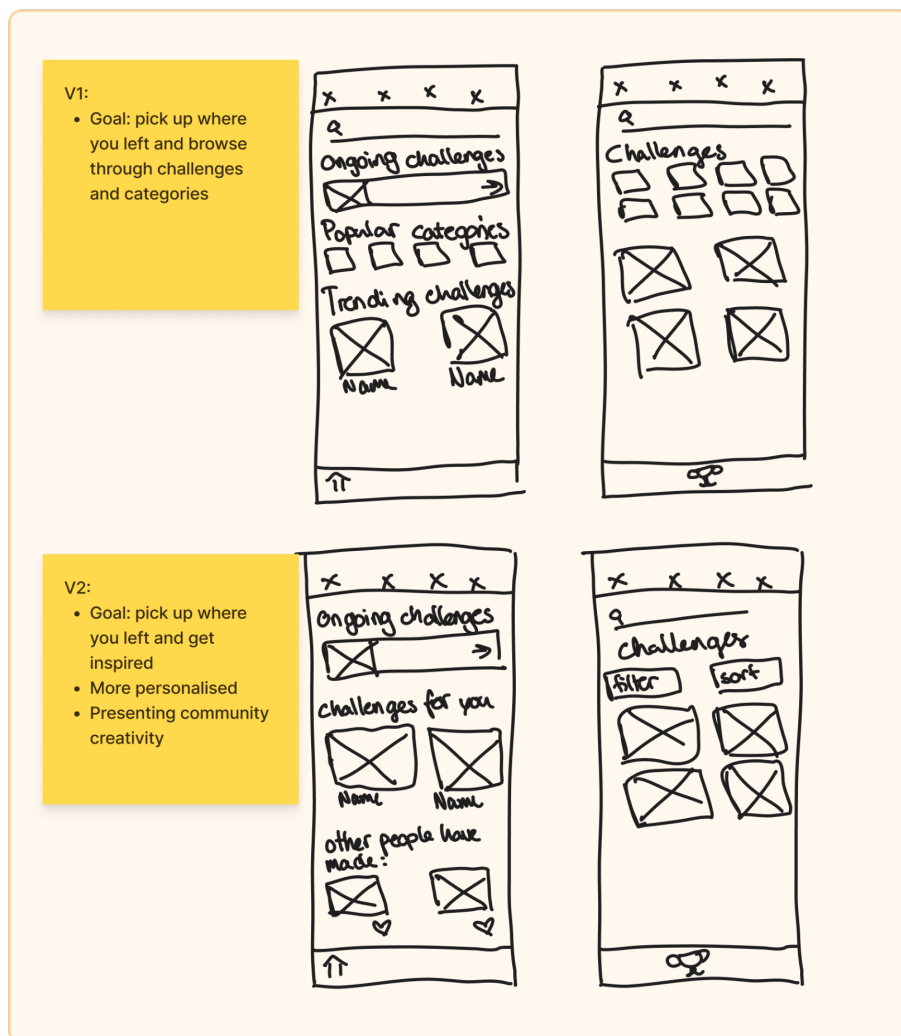


*Figure 10. First prototypes of the home page and challenges page.*

After revising the overall pages of the prototype, it became clear that the v1 homepage's focus on challenges and categories were redundant as the challenges page would present this. Rather, the aim of the home page should be to allow the user to pick up where they left of and get inspiration through personalised recommendations and the rest of the community, as the V2 home page. The V2 home page is heavily inspired by Spotify's home page, in which the user is presented with recently played songs and introduced to new music (figure 11). By providing the user with familiar interfaces, the principle of *consistency* is applied (Nielsen 1994). In order to organise and structure the application, an overview of the pages and their corresponding user goals were created (see table 7). Based on the overview of the prototype (table 7) new wireframes for the main pages were made, shown in figure 10. Common to all pages is the stats in the top of the UI, influenced by Duolingo's mobile application (figure 11).
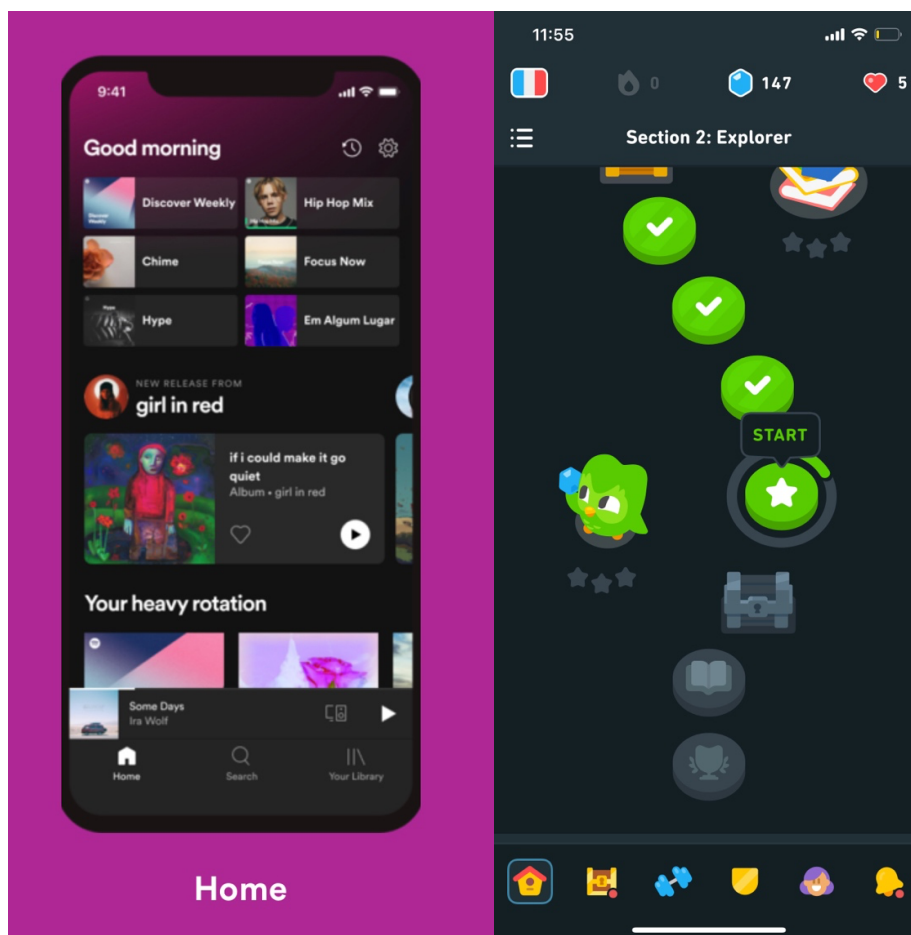


*Figure 11. Left: screenshot from Spotify's home page (Spotify 2023). Right: Screenshot from Duolingo's home page (Duolingo 2023).*

| Page | The user can… | Addresses |
|---|---|---|
| Home | …pick up where the user left of and get inspiration through personalised recommendations and the rest of the community. | Lack of creativity, motivation. |
| Challenges | …browse challenges by sorting and filtering categories. | Lack of creativity, empowerment. |
| Personal page | …get an overview of their achievements (kg CO2 saved, completed challenges), and see their liked posts. | Lack of creativity, empowerment, motivation. |
| Challenge task site | | Empowerment. |

*Table 7. Overview of the page's user goals.*
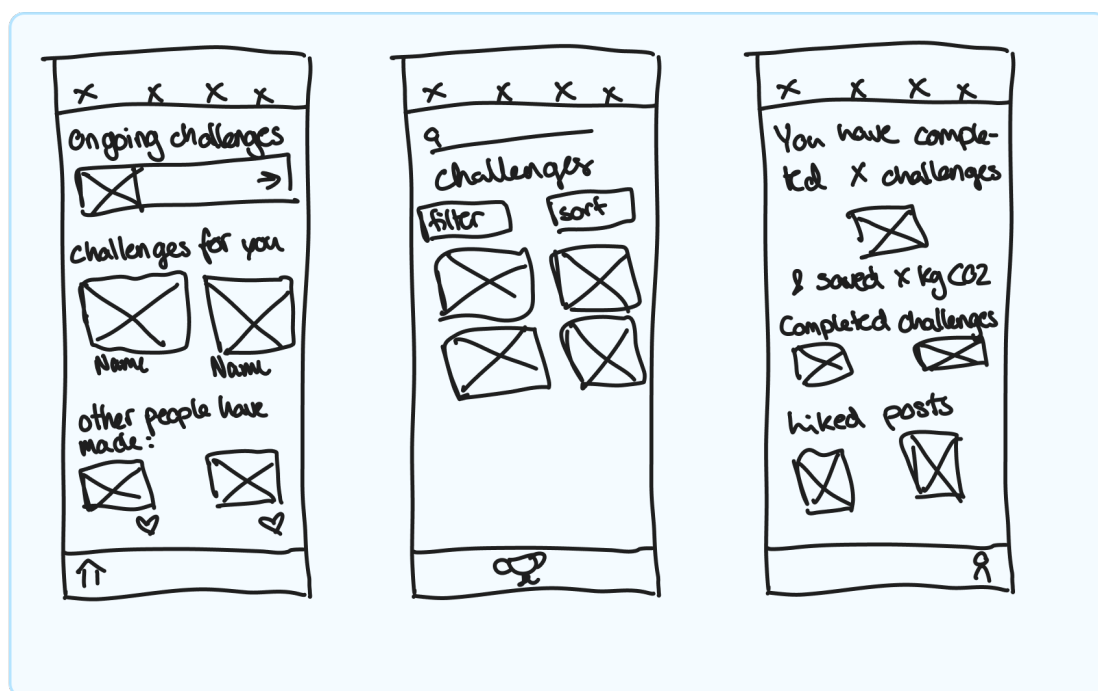


*Figure 12. Wireframes of the main pages: home, challenges, and personal page.*

When the design of the main pages had been established, the sketching of the challenges began. A careful consideration was how gamified the challenges should be without compromising the sustainability goal discussed in chapter *5.1.1. Thoughts on Gamification*. In figure 11 the premise of the challenge is that once you complete a challenge, you will be presented with challenges with increased difficulty level. This may fit the associations with

the word challenge better and empower and motivate the user by nudging them to challenge themselves. Moreover, it was considered to incorporate a ranking system to further reinforce the community feeling. However, as stated in *5.1.1. Thoughts on motivation and gamification*, it was important not to encourage the user to complete challenges solely for gaining points or level up. The user should only complete challenges that produce clothing articles that they desire to use. As such, the alternative became to congratulate the user when they complete a challenge and encourage them to share a photo of what they made, because showcasing their creations to other people can be motivational too (figure 12).
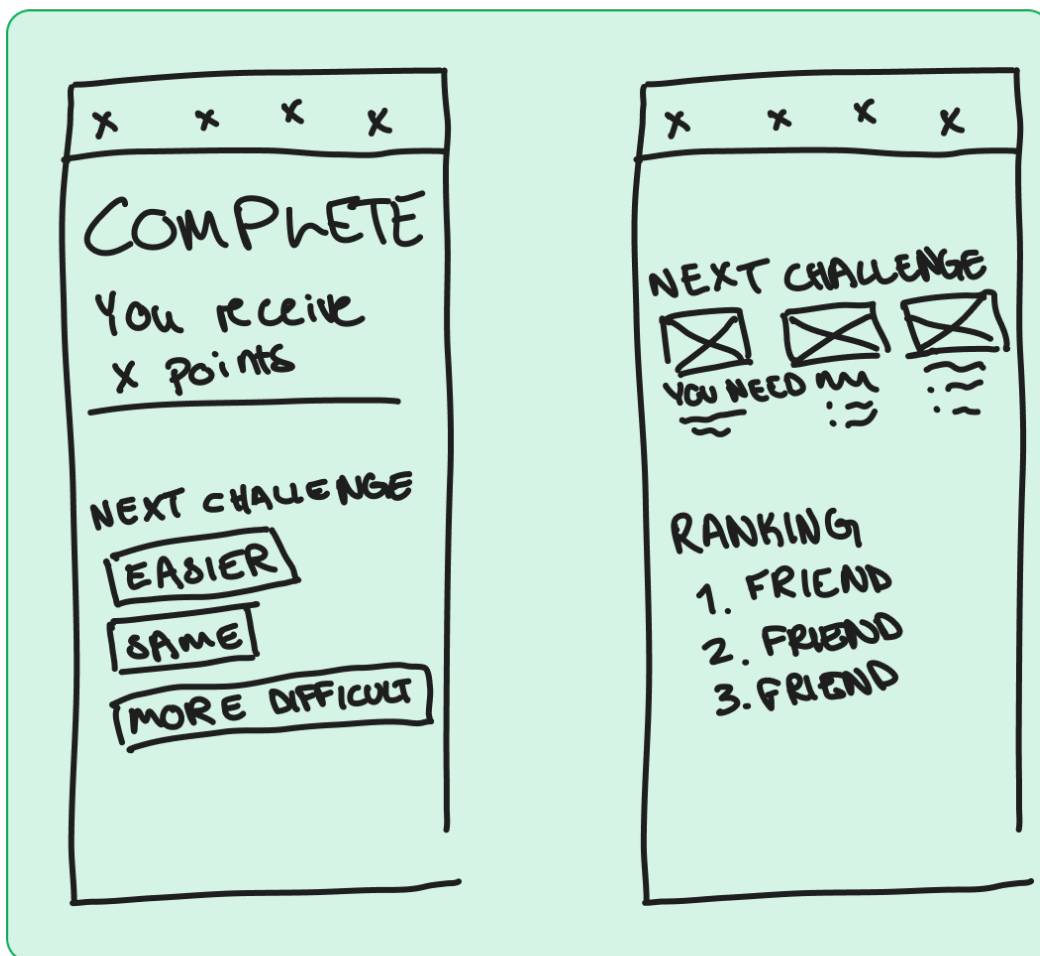


*Figure 13. Alternative wireframes for completed challenges with increasing difficulty.*

When the user browses challenges, they can navigate to the specific challenge page to see details such as a summary of the steps, kg CO2 saved, difficulty level, what they need and pictures of other users' completed challenges (figure 12). When completing the challenge, the user will be presented with expandable explanations for sewing terms, e.g., "seam

allowance". Having these term explained is an important feature, as both groups in the design workshops incorporated this teaching aspect in their respective ideas.
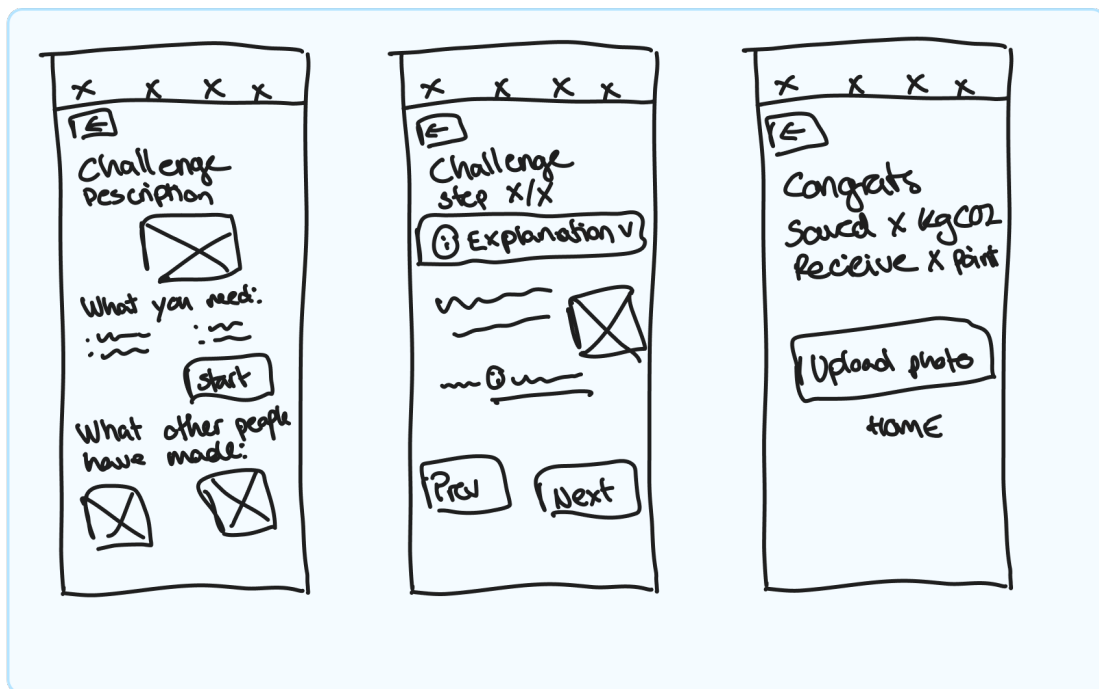


*Figure 14. Wireframes of challenges.*

# 5.3. High-Fidelity prototype

The low-fidelity sketches were transferred to interactive prototypes in Figma so that the prototype could emulate a mobile app for the following evaluation. This prototype includes real photos with fitting descriptions to create an immersive prototype, and allows you to freely explore throughout the application, and to complete a challenge. It consists of three main pages: the home page, challenges page, and personal page (figure 13).

## 5.3.1. Main pages

As the UI of the application uses a lot of pictures, the colours are muted both in order to prevent visually straining the user and to have an aesthetically appealing UI. Additionally, the aim of the design of the main pages is to keep the UI as minimalist possible without compromising the usability of the application (Nielsen 1994). Aiming to apply the principle *recognize rather than recall*, the UI has a simple UI aiming to reduce what the user have to remember (Nielsen 1994). This is achieved by introducing the user to few design elements; in the main pages, the user is mainly presented with challenge cards and other users' posts.

44

A key principle of designing elements that are shown in the main pages, mainly cards presenting challenges, was to prioritise information that supports the main goal of persuading the user to choose SCPs. Figure 17 is an illustration of this; initially, the challenge card displays only a photo, category, and the challenge's name, however, when the challenge is clicked, additional information is displayed. This design feature is influenced by Pinterest's mobile application UI, in which the user is presented with a picture they can click on to receive more information (figure 15) and applies to the principle of *consistency and standards* (Nielsen 1994). With regards to the principle of consistency and standards, there is an internal consistency with buttons and fonts in the prototype as well (Nielsen 1994).
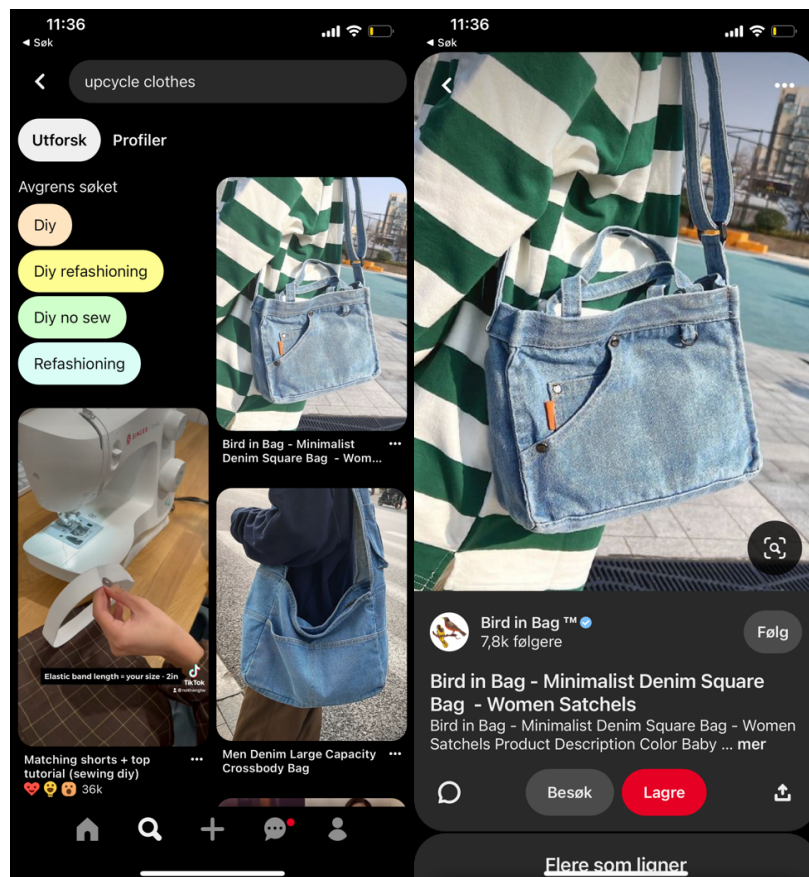


**Figure 15.** *Screenshot from Pinterest's search page.*

On the home page (figure 13) the user is presented with their ongoing challenge(s) and can continue their process, recommended challenges based off their user data (completed challenges, preferred difficulty level etc.), and other users' posts from completed challenges. In this page, the PD principle *personalisation* is applied, as the prototype suggests challenges

for the user based on their previous interaction with the application (Oinas-Kukkonen and Harjumaa 2009). As previously stated, the aim of the home page is to let the user pick up where they left the application and present inspiration both in specific recommendations (challenges) and by browsing what other users have made.

The personal page (figure 13) is a hub for the users' achievements and saved posts. The overview of completed challenges and kg's CO2 saved is paired with an illustration of a tree that grows larger as the user completes more challenges, which enables the user to self-monitor their achievements (Oinas-Kukkonen and Harjumaa 2009).
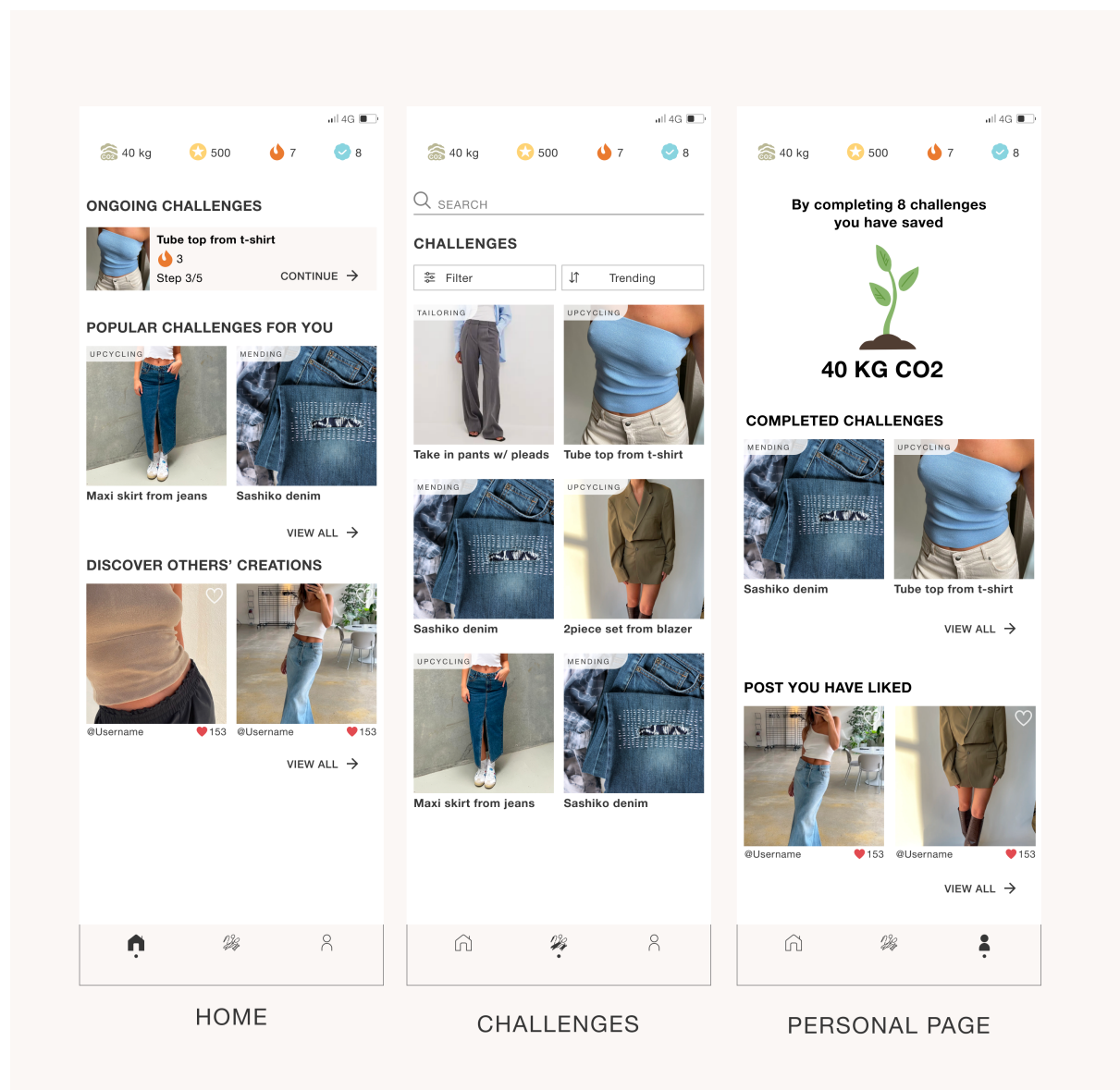


***Figure 16.*** *Overview of the main pages of the prototype.*

The challenge page (figure 14) has one primary goal which is to present the user with different challenges in a manner which makes it easy for them to navigate to a desirable challenge, with the standard sorting being trending challenges. This is addressed by including filtering and sorting options that can enable the user to filter based on garment or difficulty level, and sort by trending or difficulty. When the user has filtered the desired feed, they can pre-view specifications of the challenge, i.e., what type of challenge it is, its difficulty level and stats gained from completing it. While there is no right and wrong when navigating to a desired feed, the applications does provide some *error prevention* by allowing the user to input their desired difficulty level of challenges which automatically hides these challenges from the user, thus prohibiting them from taking on challenges that might lead to headache (Nielsen 1994). Moreover, this is an application of *tailoring*, by filtering out irrelevant challenges for the user (Oinas-Kukkonen and Harjumaa 2009).



*Figure 17. Detailed overview of the challenge page.*

## 5.3.2. Completing a challenge

When the user has navigated to a desirable challenge (either through the home page or the challenge page), they are presented with a preview page (figure 18) where they can see what materials and equipment they need, preview all of the steps and see other users' posts from completing the challenge.
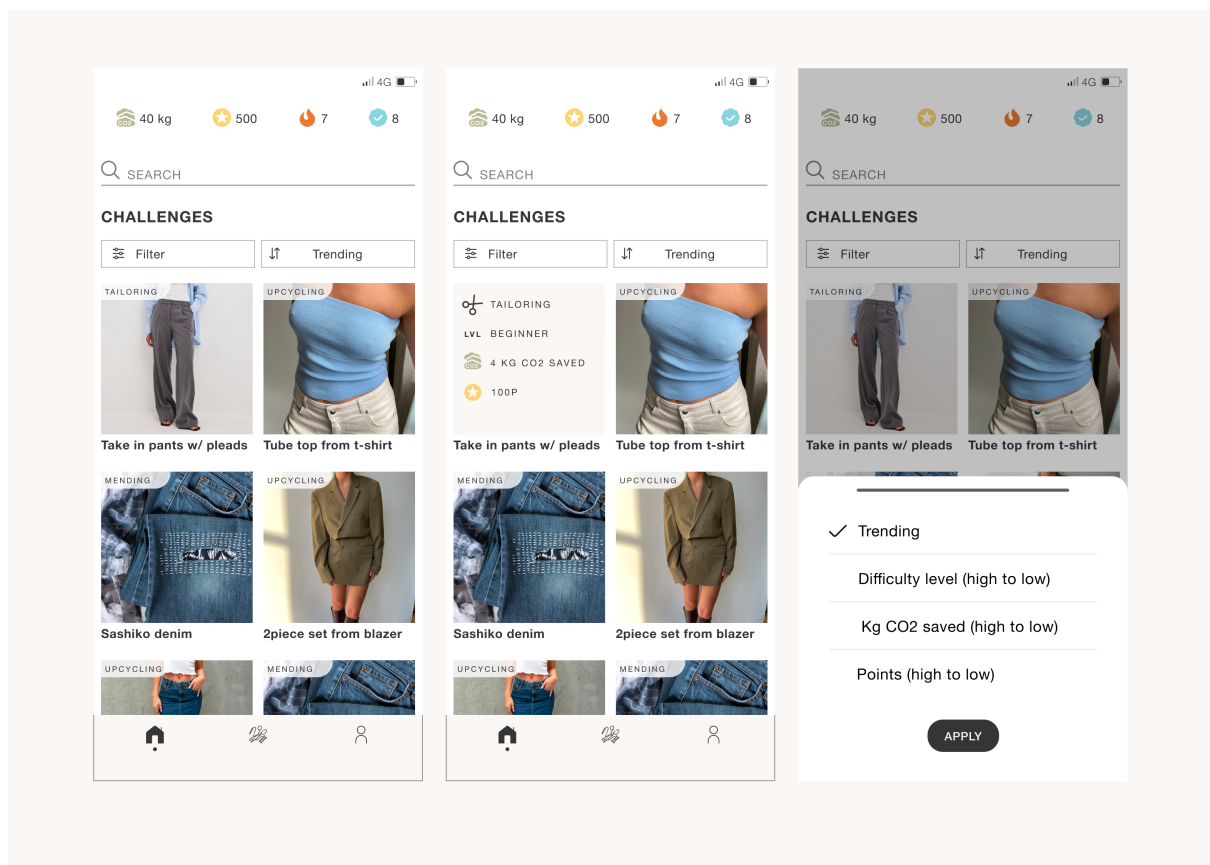
The challenge itself is designed as a step-by-step instruction with textual and visual directions. The user is able to exit the challenge in every step by maintaining placement of the home button, thereby applying the principle *user control and freedom* (Nielsen 1994). While the prototype only displays one challenge, an important guideline for the challenge UI is to avoid too much text per step. Participant 4 of the interview reinforces this, by stating that too much text could be quite overwhelming. Another important consideration is the language of the challenge and maintaining a *match between the system and real world* (Nielsen 1994). In the challenge that was implemented in the prototype, this was done by aiming to keep the language simple and natural for the target group, and by providing visual and textual explanations for sewing terms that might not be familiar to the user (figure 17).

The PD principle tunnelling means to means to guide users through a process in which it is possible to persuade the user along the way (Oinas-Kukkonen and Harjumaa 2009). While the prototype is created with the aim of allowing the user to browse freely, tunnelling is implemented through the concept of the challenges themselves. The main idea of the application is to complete challenges, which creates a clear "tunnel" for use, moreover, the step-by-step nature of the challenges holds the users' hand while they manually complete the SCP.
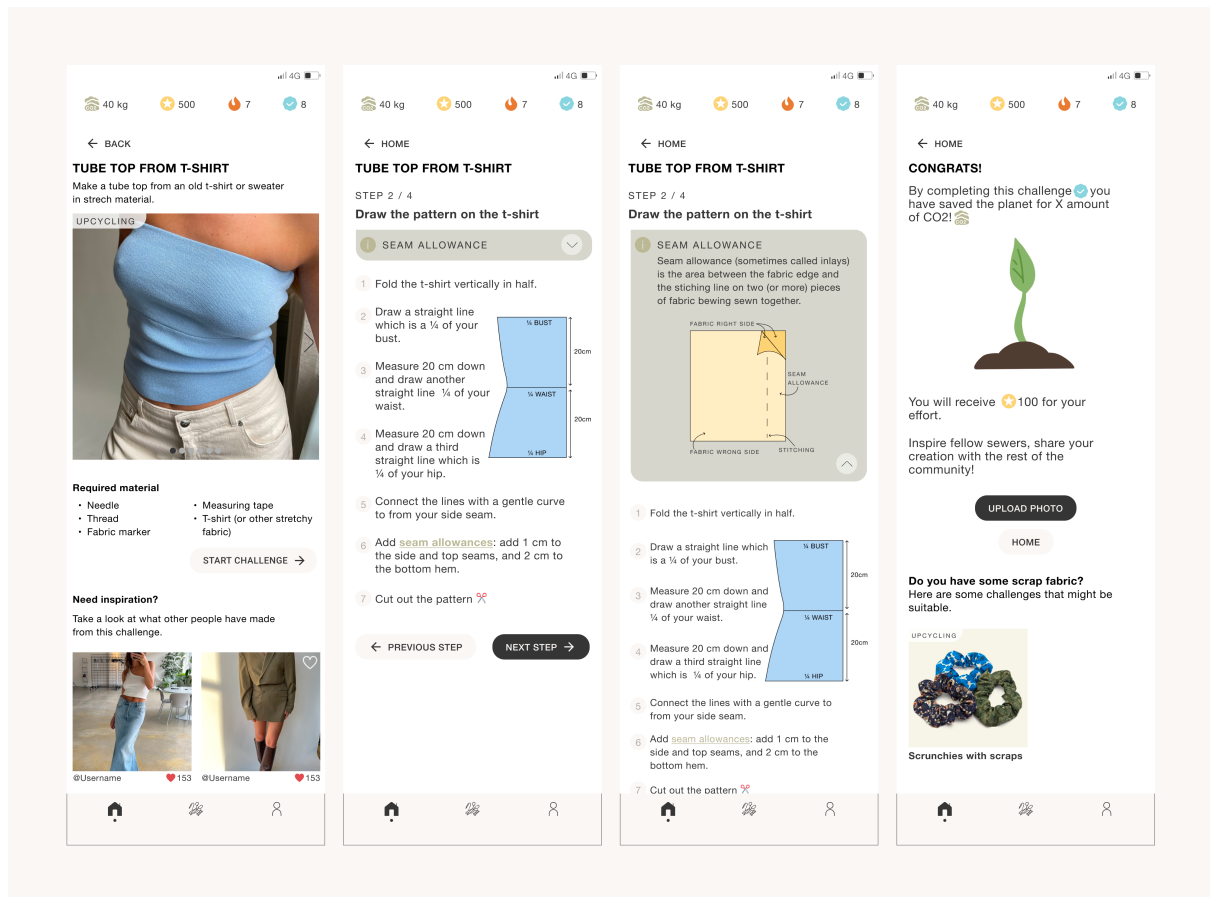
***Figure 18.*** *Steps for completing a challenge.*

When the user has completed a challenge, an animation of a tree appears (figure 15). This is a tree that grows as the user completes challenges. While the animation does not represent a true cause-and-effect relationship, it is a symbol of how their selection of SCPs has a positive environmental impact, and can therefore be described as an application of *simulation* (Oinas-Kukkonen and Harjumaa 2009). Moreover, the PD principle praise is applied because the user receives a congratulatory text, which also provides information of how their stats have changed (Oinas-Kukkonen and Harjumaa 2009).

Moreover, the user is prompted to upload a photo of the results to share with the rest of the community. The persuasive principle recognition describes that a system is more persuasive if it allows for the user to receive public recognition when they achieve the target behaviour (Oinas-Kukkonen and Harjumaa 2009). This principle is applied in the application by encouraging the users to post photos of their completed SCP challenge, on which they can receive likes from other users. Lastly, the user is presented with other relevant challenges that can utilize scrap fabric that is difficult to utilise, in turn minimizing waste.

### 5.3.3. Stats

When the user completes challenges, their stats increases, which is an application of *rewards* stats (Oinas-Kukkonen and Harjumaa 2009). These are always available for the user in the header of the application (figure 19) and allows them to self-monitor their achievements (Oinas-Kukkonen and Harjumaa 2009). The aim of the stats is to motivate and engage the user by showing them data of their environmental impact, difficulty level, engagement, and user history:

- Kgs CO2 saved: each challenge saves an amount of CO2.
- Points: points are given according to the challenges difficulty level.
- Streak: the streak is maintained by completing at least one sub-task per day during a challenge.
- Completed challenges: shows how many challenges the user has completed.
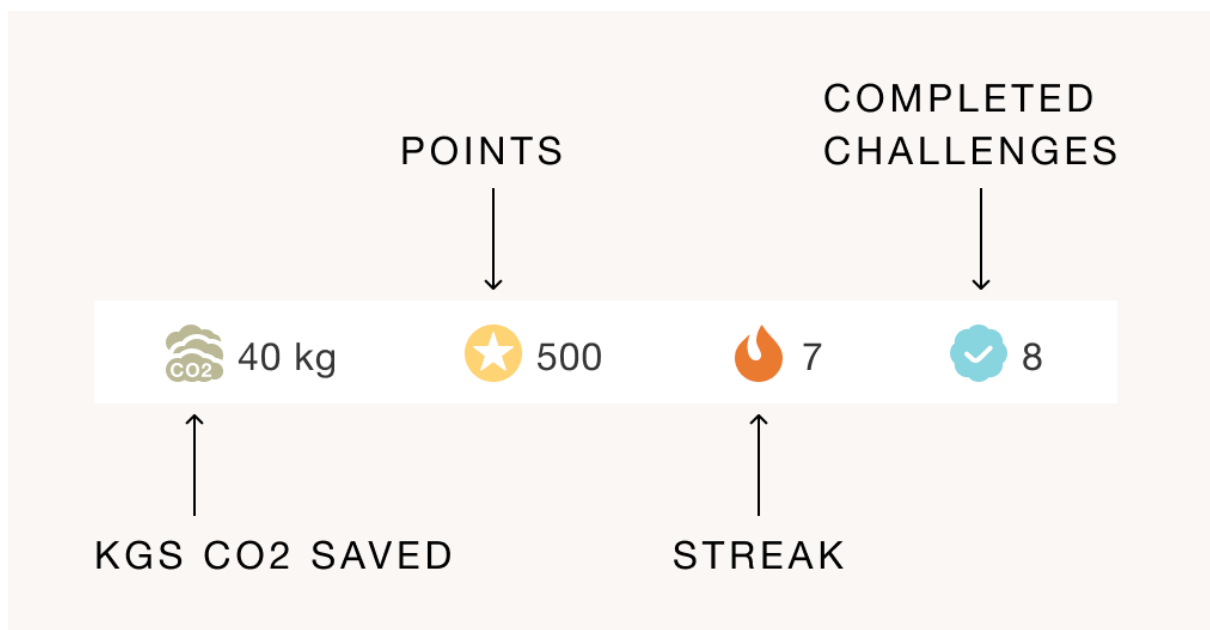


*Figure 19. Overview of stats.*

### 5.3.4. Notifications

As stated in the literature review, notifications are frequently used to support behaviour and empower the user by reminding the user of the applications' existence and/or updating the user on their performance or achievements (Van der Lubbe et al. 2021) Consequently, three types of notifications were made aiming to empower the user and support them in choosing SCPs.
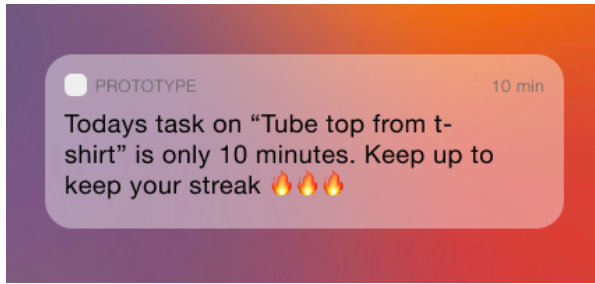
*Figure 20. Notification 1.*

Notification 1 (figure 14) aims to encourage the user to continue challenges they have started by reminding them to keep their streak.
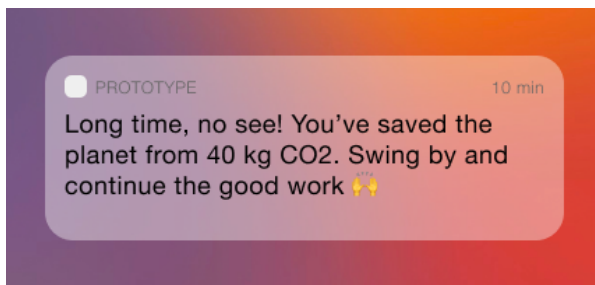


*Figure 21. Notification 2.*

Notification 2 (figure 15) is presented to the user if they have not visited the application recently and encourages them to open the application. This is done by praising the results of their SCP related actions, and is personalised to their achievements.
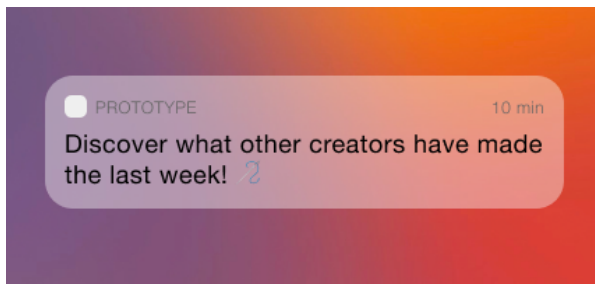


*Figure 22. Notification 3.*

Notification 3 aims to remind the user that the application exists when it is not being used, similar to notification 2. Notification 3, however, does so by tempting the user with inspiration from other users.

To summarise the design chapter, table 8 lists up how PD principles are applied in the prototype and table 9 lists up how usability heuristics are applied to the prototype.

| Persuasive Principle (Oinas-Kukkonen and Harjumaa 2009) | Implementation |
|---|---|
| Tunnelling | • Step by step |
| Tailoring | • Difficulty levels |
| Personalisation | • Recommended challenges<br>• Ability to change feed<br>• Notification 2 |
| Self-monitoring | • View completed challenges<br>• Stats (tracking performance) |
| Simulation | • Tree growing from completing challenges and saving more CO2 |
| Praise | • Congratulating user when completed challenges<br>• Notification that praises previous behaviour |
| Rewards | • Stats |
| Reminders | • Notification that reminds user to complete challenge<br>• Notification that reminds them of previous achievements and encourages to continue behaviour |
| Suggestion | • Recommended challenges |
| Social learning | • Viewing other users' posts |
| Social comparison | • Viewing other users' posts |
| Normative influence | • Viewing other users' posts |
| Recognition | • Posting their own completed challenges and receiving likes |

***Table 8.*** *Implementation of Persuasive Design Principles (Oinas-Kukkinen and Harjumaa 2009)*

| Usability Heuristic (Nielsen 1994) | Design element |
|---|---|
| Visibility of system status | Instant feedback: when users click the "like" button it changes appearance to confirm the interaction, when users complete a challenge, stats are immediately changed and the user is informed about this. All navigation buttons has an informative name which gives the user knowledge about the effect of clicking the button. |
| Match between system and real world | Using the target group's language, providing pro-tips when sewing language is used. |
| User control and freedom | The user is able to exit from wherever. |
| Consistency and standards | Internal consistency with design elements such as buttons and fonts. External consistency by using industry conventions, UI inspiration from other popular applications. |
| Error prevention | The user can adapt their preferred difficulty level, preventing that they take on challenges that are too difficult. |
| Recognition rather than recall | The UI of the application has little hidden features, thus allowing them to recognise features. Assistance is given in context, for example during a challenge. |
| Flexibility and efficiency of use | The design tailors content by providing the user suggested challenges based on previous use of the app. Moreover, the application design provides some customisation in the sense that the user can choose which difficulty levels they want to have. |
| Aesthetic and minimalist design | Prioritising the content that supports the primary goal to motivate choosing SCPs. Keeping the UI as simple as possible, preventing overwhelming users by avoiding too much information at once. Minimalist colour scheme as the UI is picture based. |

*Table 9. Implementation of usability heuristics (Nielsen 1994).*

## 5.3.5. Prototype Limitations

As the aim of the prototype is no explore how PD principles and gamification elements can persuade users to choose SCPs, there are certain aspects it does not take into consideration. One being privacy concerns, which is an important consideration when introducing applications with user profiles. Moreover, the application does not include detailed

functionality such as enabling the user to control notification settings and change their preferred difficulty level.

# 5.4. Evaluation

In this chapter the evaluation of the prototype and the results will be presented. The objective of evaluating with users was to evaluate the concept of the prototype; can the prototype help young adults choose sustainable clothing practices? Firstly, the evaluation design and the participants of the evaluation will be presented, before results will be presented. The results are parted in 1) motivation, 2) inspiration, and 3) empowerment.

## 5.4.1. Evaluation design

The evaluation was set to be approximately one hour long. The evaluation session started with an introduction, stating what is to be evaluated and what is not; the evaluation was not to be a usability test, evaluating the interface. Instead, the aim was to evaluate whether the concept could be motivating and engaging. The participants were told about the premise of the prototype, and its objective to motivate, empower and inspire users. Five participants were included in the evaluation, of which some of them had previously participated in the design workshop (table 10). Participant 11 had not participated in any previous design activities, while participant 3 had only participated in an interview.

| Participant | Participated in design workshop |
|---|---|
| Participant 2 | Yes |
| Participant 3 | No |
| Participant 4 | Yes |
| Participant 6 | Yes |
| Participant 11 | No |

*Table 10.* Overview of Participants of the Evaluation

To make sure that the participants got a full overview of the prototype, they were given a set of tasks to perform. After the participants had performed the tasks, a semi-formal interview was held. The aim was to converse with the participant, where the researcher and participant could address remarks made during the browsing and reflect together. The following questions were standardised and asked each participant:

- Would this motivate you to begin sustainable clothing practices?
- Would this inspire you to begin sustainable clothing practice projects?
- Would this empower you to feel that you are able to conduct sustainable practices?
- Would this make you more likely to choose sustainable clothing practices?

## 5.4.2. Motivation

All participants answered that they would be motivated to choose SCPs with this concept prototype. Participant 4 expressed that, as a hobby sewer knows from experience that it can be difficult to get started with a sewing project and believes that this concept could help motivate getting past this threshold, which will have a self-reinforcing effect. Moreover, participant 2 described the format of the challenges as motivating, as the ability to preview the challenges enables them to determine whether they have necessary prerequisites, both in terms of equipment, skills, and time.

Social features were repeated as a motivating factor among participants 2, 3, and 11. The section "discover other peoples' creations" (figure 13) was especially highlighted as motivational; seeing that other people are completing SCP challenges might motivate oneself to do so as well. Additionally, being able to view what other people have made from a challenge you want to complete and the option to upload photos of your own creation was described as motivational. Participant 3 stated that sharing photos of your own creations would be motivating as they often would like to present others with what they have made themselves, however they do not have a platform they would be comfortable doing this on as of today. Likewise, participant 2 said that uploading photos would be motivational, both because they would receive recognition in the form of likes from other users and because it could contribute to motivating other users.

Additionally, the stats had a positive impact on potential motivation. Foremost, the stats represent and solidifies the users' achievements, and in participant 4's words are "a fun way to motivate oneself". Participant 11 also commented that the stats provide them with numbers they can brag about to friends. Kg's $CO_2$ saved was the most motivating stat for participants 2, 3, 6, and 11, as this stat would help them understand the impact of their actions and thereby motivate them to continue choosing SCPs. Number of completed challenges was also mentioned as a motivating stat, participant 6 reflected that this stat would give them a sense

of credibility and thus motivate them to continue choosing SCPs. Likewise, participant 3 attributes the feeling of credibility to the points stat and states that this would motivating to choose SCPs *again*. Regarding motivation to continue a challenge, participant 3 reflected that streaks could be motivational and help them complete challenges because they would nudge them to continue where they left off.

Regarding notifications, there was less of a consensus among the participants. Participants 2 and 3 thought notification 1 (figure 13) would be motivating to receive during an ongoing challenge, as this might motivate them to continue and complete the challenge. Participant 11 felt that the biggest motivational factor for them was inspiration from other users and thought that notification 2 (figure 14) would motivate them to enter the application and seek for new challenges, likewise, participant 6 liked notification 2 as it gave them praise for previous achievements. Participants 3, 6, and 11 though notification 3 (figure 15) could motivate them to enter the application and browse for new challenges, as this notification drew upon their accomplishments.

### 5.4.3. Inspiration

Regarding inspiring creativity within the user, participants 2, 4, and 11 highlighted viewing other users' creations as the most inspirational factor of the concept. While participant 11 noted that seeing what other people have done with their garments could help them to think of possibilities within their own wardrobe, participant 4 stated that, in addition to being motivational, other peoples' creations might have adjustments they would not come up with themselves. Participant 2 reflected that seeing what other people make is always inspirational, and that it could reflect the current trends, which would make the application feel more alive. Moreover, the ability to like post and thereby save them for a time it is appropriate to begin a challenge is a nice way to "save" the inspiration.

Additionally, the concept itself received high marks from all participants in terms of inspiring creativity because the application's premise exposes users to SCP possibilities that they might not have thought of or come up with on their own. In addition to sparking creativity related to a specific challenge, participants 3 and 6 stated that the concept might start some creative processes and open the users mind for SCP opportunities outside the application as well. Participant 4 also thought that being presented with suggestions for challenges, such as what

you can do with scrap fabric or suggestions based on completed or liked challenges, can inspire creativity in the moment and enlighten the user so that they can be creative later in another setting; "it plants seeds of ideas to the next time you want to sew".

### 5.4.4. Empowerment

All participant highlighted the step-by-step format of the challenges as highly empowering as it made them feel as if the SCP project was more manageable, participant 6 stated that the ability to go back and forth between steps and not receiving too much information at once would make them more comfortable with starting a project. Moreover, the educational feature of including explanation of sewing terms was emphasised as empowering by participants 3 and 4, as this could educate beginners or refresh the memory of more advanced sewers. The option to choose preferred difficulty level was also discussed as empowering, both in the sense that it makes it easier for the user to find challenges that they can complete and in the sense that increasing difficulty can give the user confidence.

Participant 4 also believed that viewing other users' accomplishments would be empowering; "if other people have completed this, then so can I". There was little feedback on being able to view their own completed challenges.

Completed challenges and points were taken up as empowering stats in the sense that they would make them confident in their prerequisites to complete challenges. Seeing how many challenges they have previously completed creates a sense of achievement, according to participants 3, 6 and 11. Points are also an indicator of progression and the users' sewing experience, and therefore solidifies their skills participants 3, 4, and 6. Participant 2 stated that all stats are essentially a presentation of their achievements and can therefore be empowering.

Notification 3 (figure 15) was the only notification that was viewed as empowering; participants 3 and 6 commented that it communicated previous achievements which implies that you are able to continue with SCP challenges.

## 5.4.5. Notes for further iterations

Overall, the participants found that the application would motivate them to choose SCPs, and unanimously stated that they would be more likely to choose SCPs with the application. While some design features, such as seeing other users' creation, addressed multiple needs (motivation and creativity), other design features addressed one need specifically. An overview on how the design choices addresses user needs is presented in table 11.

| Aim | Features |
|---|---|
| Motivation | <ul><li>Seeing other users' creations</li><li>Posting their own creations</li><li>Stats (especially kg CO2 saved and points)</li><li>Notifications (especially notification 1 & 2)</li></ul> |
| Creativity | <ul><li>Seeing other users' creations</li><li>Recommended challenges</li><li>Presentation of challenges/being presented with challenges</li></ul> |
| Empowerment | <ul><li>Step-by-step format</li><li>Seeing that other users have completed the challenge</li><li>Explanations for sewing terms.</li><li>Choosing difficulty level</li><li>Stats (completed challenges, points)</li><li>Notification 3</li></ul> |

*Table 11. Overview over how features affected the participants.*

While the aim of the evaluation was not to test usability, the participants gave design critiques on how they would modify or add features to increase the application's persuasiveness or ability to support the choice of SCPs. The design critiques are presented in table 12 and provides a natural starting point for further research.

Positive feedback was received regarding the notifications1 motivational impact, however, the notifications had varying effects on the participants and should be improved and tested to a greater extent. The participants provided several suggestions for how the wording and framing of the notification could be altered to engage them more, suggesting that the notifications need further work on being personalised. This would require a higher level of personalisation over the application as a whole.

| Design element | Design critique |
|---|---|
| Points | Some participants commented that, while points gives "bragging rights", they might have been more impactful if they provided something tangible, either a prize or if the increasing points unlocked features for them. |
| Challenges | • Participants 2 and 6 said that they would like it if users were able to post challenges themselves, so that more of the applications' content is user generated.<br>• Participant 6 suggested that the prototype should nudge the user to increase difficulty level as they progresss.<br>• Participant 2 also suggested giving the user a time estimate for the challenge.<br>• Moreover, participant 2 suggested giving the user an opportunity to rate challenges. |
| Social aspects | • Many of the participants expressed a desire for social networking in the application. They would like for it to be possible to follow other users, so that it would be more personal.<br>• Moreover, participant 2 expressed a desire to be able to visit other users' profile to see more of their completed challenges. |
| Personalisation | Participant 6 suggested that the application should uncover the users' goal with using it (increasing sewing skills, increasing motivation, receive inspiration). By doing so, the application might be more persuasive for the user. |
| Liked posts | A better system for liked posts. Participant 4 suggested taking inspiration from Instagram's archive system, in which the user can create folders. |
| Pro-tips | Participant 2 enjoyed the tips given during the challenge but suggested that tips could be adjusted to the user's level. An example of this could be that advanced sewers could get mini challenges that gave them more points. |

*Table 12. Design Critiques from the Participants.*

# Chapter 6: Discussion

For the discussion, the findings will be discussed in order to answer the research questions. As specified in 1.1. Research Question, the main research question is 1) *how can mobile applications support young adults in choosing sustainable clothing practices?* An additional research questions is: 1.1) *How can applying design-thinking methods support creating the right thing?*

Thus, this chapter will be divided in two parts; the first part will discuss *how* the mobile application presented in 5. Design can support young adults in choosing SCPs, and the second part will discuss *why* it can support young adults in choosing SCPs.

## 6.1. How does the mobile app support the choice of SCPs?

In this section, the design choices will be discussed. The findings from the interviews presented three overarching themes that prohibited the users from taking on SCPs: 1) lack of creativity, 2) feeling that their skills are not sufficient, and 3) lack of motivation. The design workshop generated specific ideas to meet the user issues, resulting in a prototype presented in chapter 5. This chapter will discuss whether the application of PD principles and gamification can successfully persuade users to choose SCPs to answer RQ 1.

### 6.1.1. Persuasive Design

While the underlying motive of the application is to encourage people to choose SCPs, their motivation to do so can differ. Therefore, if their motivation changes over time, for example from coming from an environmental concern to simply wanting to sew more, the application can support all these motivations. By acknowledging that the desire to change behaviour is multiple, and accounting for the user's uniqueness, the application can be more motivating for the user and the persuasiveness of the application is increased (Rapp, Tirassa, and Tirabeni 2019; Thomson, Nash, and Maeder 2016). This also encourages a long-term use of the application, while this has not been evaluated.

Personalisation is a PD principle that can be applied to address the notion that change is multiple, and that users' motivation can change over time, as personalisation of the technology and its information takes into account the users' uniqueness (Rapp, Tirassa, and

Tirabeni 2019; Thomson, Nash, and Maeder 2016; Oinas-Kukkonen and Harjumaa 2009). The prototype allows for personalisation as it suggests challenges for the user based on their previous interaction with the application, which, findings from the evaluation suggests that this works as persuasive because it helps boost the users' creativity. Furthermore, the argument that personalisation can encourage long-term use of the application is supported by participant 4's assertion that being presented with suggested challenges generates ideas for what to sew the next time it is appropriate (Thomson, Nash, and Maeder 2016). The suggested challenges initiates creative processes that would not otherwise occur.

While the primary goal with the notifications was to remind the user of the applications' existence and persuade the user to use it again, the participant's comments from the evaluation suggests that notification 2 also follows the persuasive principle of praise. As mentioned in chapter 5, notifications 1 and 2 had a motivational effect, while notification 3 was persuasive because of its empowering effect. Notification 2 (figure 21) offers praise through personalised feedback that highlights the users' personal achievements and will naturally change correspondingly to the users' activity in the application. The evaluation showed that, while the participants did not have a very strong reaction to notification 2, it had persuasive potential because of its personalised praise. Participants commented that being presented with their previous achievements could be both motivating (participant 11) and empowering (participant 6).

Praise is also applied to the application when the user has completed a challenge and is presented with a congratulatory text praising their effort and impact (figure 18). As mentioned in the design chapter, this page also applies the PD principle simulation because of the animation. While the participants of the evaluation commented that it was a "cute" touch, and a fun way of disclosing progress, only participant 6 remarked that this would be motivating, indicating that the animation is not particularly persuasive. However, the prototype was only evaluated by testing it once with simulated use; if the evaluation had lasted longer and included actual use, the illustration of the expanding tree could perhaps be more persuasive.

The principle tailoring is applied to the prototype trough the users' ability to choose difficulty level for challenges, which automatically filters out challenges that are above the users' preferred difficulty level. This can arguably be linked to the need to address the users' growth

and enables them to gradually complete harder challenges in their own pace. Thomson, Nash, and Maeder (2016) argue that for a technology to support long-term use and consequently increase its persuasive potential, it is important to address the fact that the user's needs change over time. Therefore, the technology for change must be able to encompass changing user needs. This is consistent with the findings from the evaluation, in which the participants commented that it would be motivating and empowering to increase the difficulty level over time as this would manifest their progress and make it easier for them to find appropriate challenges. Participant 6 of the evaluation also suggested the application could recommend that the user increase the difficulty level as they progress, as this would be motivating. This would fall under the principle suggestion; offering appropriate suggestions can have greater persuasive success (Oinas-Kukkonen and Harjumaa 2009).

The principle self-monitoring is applied by implementing stats and by presenting the user with their completed challenges. Participants of the evaluation described that the stats were both motivating and empowering. The stats solidify the users' achievements, and participant 3 commented that it was fun to watch them grow, which *can* suggest that employing stats could give the user incentive to visit the application more often. This concurs with Thomson, Nash, and Maeder's (2016) findings that shows that self-monitoring can increase the usage of the application and positively affect realised target behaviour. The most impactful stat in terms of motivation was kg $CO_2$ saved, as the participants reflected that seeing the impact choosing SCPs has would motivate them to continue. Nonetheless, points and completed challenges were also described as motivational. Moreover, many participants commented that these stats would give them confidence in their skills, suggesting that they are persuasive because they are empowering the user. Consequently, the author argues that applying self-monitoring through stats were successfully persuasive because the stats were able to motivate and empower the user. As stated in chapter 5.4.3., there was little feedback on being able to view their completed challenges on their personal page. While the participants commented that it was a handy feature, they were unsure if it would be empowering. The author reflects on whether this could be because the participants were presented with fake images, and if the results might have been different if the evaluation consistent of long-term use and the participants had their own data in the application.

In addition to serving a self-monitoring role, the stats are also an application of the PD principle rewards. Thomson, Nash, and Maeder (2016) found that rewards typically have a

positive effect on behavioural change, but they emphasise that the rewards must be presented as meaningful in order to live up to its persuasive potential. The participants the stats described as both motivating and empowering, which suggest that implementing rewards in this form is successful in terms of persuasiveness. Some participants even noted that the stats are nice because it gives them something to brag about to other users, which introduces the possibility that stats could fall under the praise principle in some cases.

The PD principle tunnelling is applied to the concept of the application which is to complete challenges through step-by-step instructions. The aim of this instruction format is to hold the users' hand while they conduct the target behaviour (SCPs) and being able to persuade them to continue along the way (Oinas-Kukkonen and Harjumaa 2009). As stated in the previous chapter, the step-by-step format made the participants feel confident that they would be able to complete the challenge because it made the instruction easier to follow and that pictures and explanatory text would make completing the challenge simpler. Thus, the tunnelling applied in the application is able to persuade the user to conduct the desired behaviour by empowering them to feel that they are able to do so.

PD principles related to social support are also applied in various aspects of the application, as social support structures can be persuasive for engaging and immersing users, as well as motivating and supporting behavioural change (Thomson, Nash, and Maeder 2016). One of which is viewing other users' posts and liking them, which arguably can be an application of both social comparison and normative influence. Firstly, the principle social comparison is applied by allowing the users to see other user's creations, this allows them to compare what other people do with their own actions. Multiple participants of the evaluation commented that seeing what other users have made would inspire them as they might adjust the SCP product or come up with ideas that the participant themselves would not have thought of themselves. This reflection implies that viewing other users' posts would also fall under the principle social learning, meaning that the application enables the user to learn from other users that are performing SCPs (Thomson, Nash, and Maeder 2016).

Moreover, seeing other users' posts can be described as an application of *normative influence* because the participants reflected that seeing that other people have managed to complete challenges might empower them to do so as well (Oinas-Kukkonen and Harjumaa 2009). This means that other users' posts can persuade the user to take on SCPs by empowering

them to do so. Thomson, Nash, and Maeder (2016) argues that social sharing can have a positive effect on the users' motivation and behaviour, which these findings support. With social sharing, the user is also able to share photos of their own creation, thus including the principle recognition. This was well received from the participants in the evaluation and was described as highly motivating, participant 2 stated that posting your own creation would be motivating because they would receive recognition through likes. Consequently, the author argues that the way of which social support principles are applied to the application is successfully persuasive.

## 6.1.2. Gamification

As stated in chapter 2.2.2., gamification is a PD method that consists of applying game design elements in non-game contexts (Deterding et al. 2011). While gamification can be effective means to affect user behaviour, an important aspect of the application design was that it should not motivate to the degree of overconsumption (Deterding et al. 2011; Mekler et al. 2013). In other words, the application aims to encourage a "model behaviour" (choose SCPs), however only when needed as purchasing more clothes than one needs is still overconsumption.

When implementing gamification elements in the application, Ouariachi, Li and Elving (2020) suggests applying the attributes achievable, challenging, credibility, feedback-oriented, and meaningful to engage users, which were considered when designing the mobile application. The attribute achievable, meaning that the application promotes actions that are doable for the user, is implemented through allowing the user to select difficulty level and filter challenges based on this (Ouariachi, Li and Elving 2020). This enables the user to take on challenges that are appropriate for their skills and/or desired difficulty for the specific project. As previously stated, the participants of the evaluation had a positive response in terms of choosing the desired difficulty level, as this would empower them to feel that they possess the skills necessary to complete the challenge. The challenges present how many steps are involved, thus giving the user an indication for how much effort is required from them, and by extension making it easier for them to decide whether the challenge is achievable for them in the moment. This was evaluated as motivating for the participants. Therefore, the findings of the evaluation concur with Ouariachi, Li and Elving's (2020)

argument of applying the attribute achievable and suggests that the prototype has successfully implemented this attribute.

Moreover, the ability to set a preferred difficulty level enables the users to be challenged *if* they desire to be challenged. As stated in chapter 5.1.1., certain gamification elements such as levels were not incorporated in the design, as the application did not want to push the user to complete more challenges than necessary. However, participants of the evaluation stated that they would be motivated and feel empowered by completing challenges with an increasing difficulty level, as this would indicate that their skills would have improved. Thus, the attribute challenging was unintentionally applied to the application design, because of the meaning that the participants put in it. Moreover, levels and offering the user challenges (objectives) are frequently applied in behaviour-supporting applications (Van Der Lubbe et al. 2021).

In terms of credibility, several participants of the evaluation stated that their use of the application would be pendant on that the challenge instructions would be good and easy to follow, if they cannot trust that the challenge is as easy as stated they would not use it. A limitation of the prototype is that is includes a dummy stat, kg $CO_2$ saved, which indicates that the participants did not have to consider whether the application was trustworthy with the information it gives. In a real application, a transparent and honest disclosure of how this stat is calculated would have to be conveyed to the user. Nevertheless, the application would provide the user with credible information when the user views other user's creations. However, further evaluation with real data would have to be conducted to draw conclusions on whether credibility has successfully been applied.

Lastly, Ouariachi, Li and Elving (2020) highlight the attribute meaningful as important for building strong physical and mental connections with the user to affect behaviour, especially because this attribute addresses cognitive, emotional and behavioural engagement with the user. The application addresses cognitive engagement by allowing the user to freely choose which challenges they want to complete; this does not affect any progress or further journey in the application. Thus, the user can make their own meaningful choices in terms of *how* they choose to be sustainable. Nonetheless, the application addresses the users desire to be sustainable and highlights how their actions have positive environmental impact through stats, thus sparking emotional engagement with the user by showing how their actions can

contribute to their desire to change the world. Multiple participants of the evaluation credited the stat "kg CO2 saved" as the most impactful in terms of motivation, which suggests that this stat can support an emotional engagement for the user. Lastly, the user is behavioural engaged by the fact that the application has a real-life appeal, as the sustainable action provides a tangible product they can see. By reviewing evaluation data, the author argues that the application holds the attribute meaningful because the participants state that learning of their actions impact, learning from other users, improving their skills, and increasing their confidence would significantly increase their motivation to take on SCPs.

In the application, rewards have been incorporated in the form of stats. Researchers disagree as to whether rewards are an effective tool for motivating the user; while Deci, Koestner, and Ryan (1999) argue that rewards undermine the users' intrinsic motivation, Van der Lubbe et al.'s (2021) literature review of empowering users with gamification argues that rewards are an important component in behaviour-supporting applications. Since the stats represent skill development and environmental impact, a number of evaluation participants stated that they found rewards to be a fun method to motivate themselves. This implies that the statistics are useful and support the user in selecting SCPs. Nonetheless, some participants stated that they believed the stats would be more influential if they were accompanied by tangible rewards, which is consistent with the argument that rewards undermine intrinsic motivation. However, according to Ouariachi, Li, and Elving (2020), appealing to the user with extrinsic motivation is not a problem if it is proportionate to promoting intrinsic motivation, and given that the stats themselves represent values that promotes their environmental impact (kg CO2 saved) and increasing sewing skills (completed challenges and points) the extrinsic and intrinsic motivation can potentially balance each other out.

Consequently, the mobile application can support young adults in choosing SCPs. The interviews uncovered three overarching themes hindering the participants from taking on SCPs, being: 1) lack of creativity, 2) feeling their skills are not sufficient, and 3) not being motivated. The evaluation results suggests that PD principles and gamification has successfully been applied to the design, as the application is persuasive because it addresses the identified user needs and can persuade the user by inspiring, empowering, and motivating the user to choose SCPs.

### 6.1.3. Limitations

The prototype has not been evaluated over a long period of time. While the participants expressed initial excitement for the prototype during the evaluation and stated that they would be motivated to choose SCPs, there is a possibility that this effect could diminish over time. A long-term evaluation of the application would be preferable, as it would collect data on whether or not the application supports young adults in selecting SCPs over time.

## 6.2. Why does the mobile app support the choice of SCPs?

The most important reason for the application's ability to support young adults in choosing SCPs is the methodology that was chosen for this thesis. Incorporating methods that not only considers but includes users in a manner that allows them to take on a co-designer role has enabled a design process in which the outcome resonates with the target group.

### 6.2.1. A Double Diamond process to enforce Design Thinking

The Evolved Double Diamond process from the UK Design Council has four principles to be people-centred, communicate (visually and verbally), collaborate and co-create, and iterate. As mentioned in chapter 3.1. Research Philosophy, a cornerstone for this thesis is the interpretive research paradigm, i.e., viewing our knowledge of reality as socially constructed by humans and their consciousness and meanings (Walsham 2006). An interpretive research paradigm is compatible with the design thinking principle of empathising with and understanding the user's requirements, strengths, and desires. For this thesis, this has been accomplished through the use of qualitative methods that enable the researcher to comprehend the user by examining their social and cultural context and to comprehend their actions through the meaning that the users ascribe to them (Myers 1997). The preliminary interview ensured an in-depth understanding of the participant's attitudes and current practices in terms of SCP and was important introductory work to establish what context the further design process had to work with, while the workshops presented the participant's priorities.

Brown and Wyatt (2010) highlights empathising with the end-users in order to address their needs, which is important to design the right thing. Changes have been made to the design process and the development of the project's scope in response to the participants' focuses

and priorities. The "us-with-them" mentality was prevalent, for instance, when preliminary interviews altered the scope of SCPs (Brown and Katz 2011). Moreover, the design process has been obviously influenced by the participants' contributions to the workshops. Shan, Neo, and Yang (2021) argues that a strength of including users in the design process is that the user insight can create requirements to the design. Throughout the design process, the participants' needs and objectives have always determined the design's requirements, thereby enhancing the designs' ability to address a wicked problem (Shan, Neo, and Yang 2021; Robertson and Simonsen 2012).

In addition, the divergent and convergent thinking phases of the DD model have enabled the author the freely explore user needs and improvise changes during the process based on the participants' input. In other words, the process has been substantially dictated by the emerging findings. Thus, the design process can be described as a continuous reflection-in-action process, in which the participants have learned from partaking in design activities and the author has learned from the participants by letting them steer the projects' direction (Schön 1991). The design process has been significantly influenced by imprography, with the author only able to plan in a limited capacity due to the contributions of the participants (Tarr, Gonzales-Polledo, and Comish 2018). The author argues that is has been crucial to have a design process that allows for this in order to conduct a genuinely human-centred design process. The DD model and a design thinking approach has allowed for a continuous reflection-in-action process, in which the participant's contributions has decided how the further design activities had to be planned.

The methods involved in this design process has also been an important factor as to why we were able to create a prototype that can promote choosing SCPs. Cross (1989) describes the designers' ability to generate many ideas in a quick manner, in this design process, however, it is participants who have generated the ideas through partaking in workshops. The author argues that it is the participant's ability to generate many ideas fast *in addition* to their respective perspectives that supports Clune and Lockrey's (2014) argument that design thinking is an appropriate approach to tackle wicked problems.

Choosing methods that heavily involves users, i.e., semi-formal interviews and workshops allows the participants to choose what they think is important to focus on and prioritise themselves. Consequently, the design process is influenced by imprography, where the author

has been able to choreograph in regard to interview guides and planning workshop activities (Tarr, Gonzales-Polledo, and Comish 2018). However, the inevitable improvisation that emerged during design activities steered by participants caused a continuous reflection-in-action process, in which the author had to treat challenges on the way as possibilities to change the process (Schön 1991). A clear example of this was the change of scope during the pilot interview, however, each design activity had a change of direction caused by participants. This allowed for a quite agile design process, where the author could change direction and explore emerging design possibilities as they came.

## 6.2.2. Co-designing

As mentioned in the literature review, Sanders and Stappers (2008) differs between *co-creation* and *co-design*, of which co-creation is a principle of the DD model. While co-creation is defined as any act of collective creativity, co-design is described as the application of collective creativity throughout the design process (Sanders and Stappers 2008). Throughout the design process, the participants have been invited and engaging in all design activities. The author argues that the participants have been able participate with a level four creativity in the workshops, thereby assuming a co-designer role. By partaking in interviews and the define- and design workshop, the participants have individually and collectively contributed with concepts and feedback. During the design workshop, one could argue that they effectively assumed the designer role, while the author served only as a facilitator. The authors' job was to analyse the workshop results to combine these ideas into a feasible concept.

An important reason as to why the participants were able to partake in design activities with a level four creativity is the considerations taken for the participants' comfort during the activities. As mentioned in *chapter 5*, consideration in terms of social comfort and the means by which they could express their ideas, had to be taken in order for the participants to be able to partake with level four creativity and take on the co-designer role (Sanders and Stappers 2008). For the groups of participants that took part in the workshops of this project, the activities laid out enabled them to freely express their ideas, be it visually, vocally, or textually. Moreover, the planned activities had to consider the participants level of comfort beforehand. As mentioned in chapter 4.2.2.5, some participants stated that they were nervous and unsure if they were creative enough to partake in a workshop. This resulted in a

workshop in which the participants worked in shorter intervals where the participants could focus on one HMW question at the time, without too much time to overthink their contributions.

A cornerstone for the methodology in this thesis has been Brown and Wyatt's (2010) sentiment that the relation between the designer and the consumer should be "us-with-them", which is a natural invitation to including participatory design methods. The methods included in this thesis has aligned with the design thinking principles of *collaborate and co-create* and *communicate*. Employing a define workshop and a design workshop was influenced by Clune and Lockrey's (2014) research and includes participatory design and co-creation principles. While the separate workshops would mean that co-creation happened during the design process, the decision to have both workshops and thus include the users in defining the problem and conceptualising solutions lead to a co-design process in which the participants were able to take on a co-design role.

The methodology and design activities combined with the fact that users were able to take on a co-designer role resulted in many ideas. These ideas have been powerful individually, because they come from the target group, end users. However, the strength in the prototype is that it is a coalition of multiple ideas from participants with their own perspective, experiences, and attitudes. The author argues that a strength of this thesis' methodology is the creation of multiple ideas to meet the complex issues regarding sustainable clothing habits and forming these into a feasible concept that can support young adults in choosing SCPs (Clune and Lockrey 2014; Cross 1989). Thus, the findings of this thesis support the Clune and Lockrey's (2014) argument that design thinking is appropriate for meeting wicked problems.

By collaborating and co-creating, the author and the participants have been able to design together and share creativity. The author argues that the users have been able to take on a co-designer role in which we have conceptualised a mobile application that is able to support young adults in choosing SCPs. The design process in this thesis – from the interviews to the evaluation – has been influenced by an explorative approach in which the author has constantly reflected on how participants can be included in the design of the process. Although the evaluation uncovered design critiques, the results suggests that the prototype can motivate, empower, and inspire young adults, therefore supporting the notion that ideas

are more powerful made from the inside and that involving real users increases the prototypes flexibility for real use (Clune and Lockrey 2014; Robertson and Simonsen 2012).

Moreover, the co-design process has enabled the participants and the author to explore *how* the users' want to be persuaded to choose SCPs, thus enabling successful appliance of PD principles and gamification. Thomson, Nash, and Maeder (2016) argues that simply applying PD principles is not enough for successful persuasion, and the author argues that inviting participants to be co-designers can increase the technology's persuasiveness by coming up with ideas for persuasion from the "inside-out".

### 6.2.3. Limitations

Despite the absence of an iterative process, this thesis concludes with a natural continuation point for further iteration. As stated in Chapter 3.2., the mobile application design demonstrated in this thesis, is not a final product, but rather a result that requires further development. Furthermore, the evaluation results present several design critiques from the participants that should be considered in future iterations.

Furthermore, the participatory nature of the methodology makes it difficult to determine the generalizability of the findings, despite the author's contention that it is appropriate for designing interventions that promote sustainable actions. Even if the same participants were recruited using the same methods as in this study, the outcomes could differ from the design presented.

# Chapter 7: Conclusion

This thesis explores how mobile applications can support young adults in choosing SCPs through a DD co-design process, aiming to answer the RQ 1 "How can mobile applications support young adults in choosing sustainable clothing practices?". An additional RQ relevant to explore RQ1 was RQ 1.1. "How can applying design thinking methods support creating the right thing?". The contributions of this thesis can be relevant for researchers and practitioners that are interested in how one can design persuasive mobile applications with a design thinking methodology.

Literature pertaining PD suggests that simply applying PD principles to the technology is not sufficient to persuade the user, rather, the designer has to consider the users of the technology when applying principles in order to increase the persuasive potential (Thomson, Nash, and Maeder 2016). In this thesis, this was done by inviting participants as co-designers and enabling them to define the user needs and frustrations, and brainstorm possible solutions. This resulted in the making of a prototype of a mobile application in which the applied PD principles and gamification elements were influenced by the co-designers' opinions and ideas.

While the evaluation results are positive, it is difficult to say if the prototype would support *all* young adults in choosing SCPs. Further testing and iteration with a larger participation pool should be done. Moreover, it would be methodologically wrong to assume that the prototype presented in this thesis is a final solution; rather, it is an outcome that should be iterated further upon. Participants of the study expressed design critiques that constitutes a base for further work on the prototype.

The author argues that the reason mobile application is able to support young adults in choosing SCPs is twofold, and directly answers the research questions. Firstly, the application can successfully support young adults in choosing SCPs because PD principles and gamification elements were successfully applied, and increases the application persuasiveness by motivating, empowering and inspiring the user. Second, the methodology chosen for this thesis included real users who co-designed the persuasive design elements to meet user needs. By co-designing the application with real users, the author and the co-

designers have been able to design the right thing by generating multiple ideas to meet the complex issues regarding sustainable clothing habits and forming these into a feasible concept that can support young adults in choosing SCPs (Clune and Lockrey 2014; Cross 1989). The findings imply that design thinking and co-design processes can, in addition to being appropriate to tackle sustainability issues, be appropriate when aiming to design persuasive mobile applications.

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