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MESTRADO
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Fashion Future: uma Aplicação Web que Promove o Consumo Responsável de Moda

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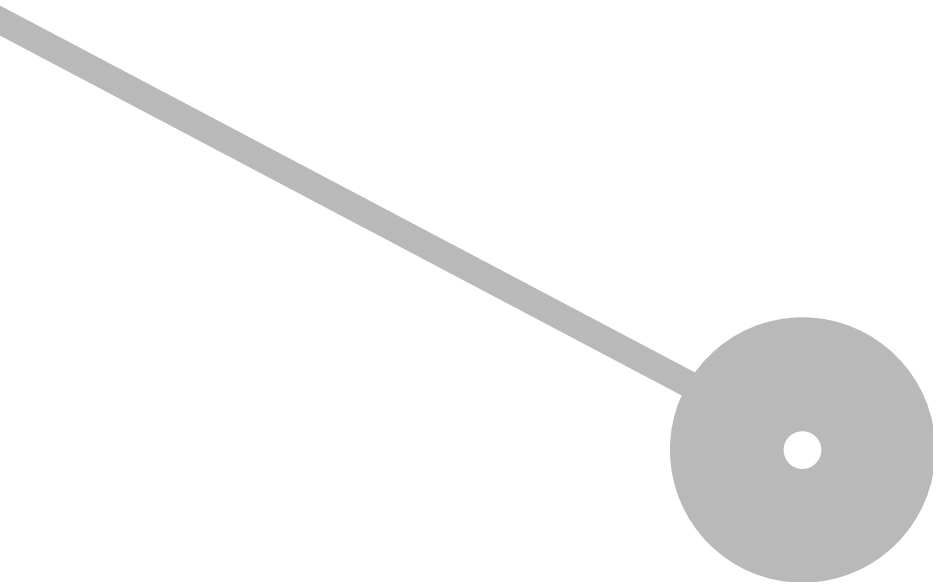

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Trabalho de Projeto de Mestrado
Mestrado em Media Digitais Interativos
Orientação: Prof. Manuel Jorge de Abreu Antunes Lima

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RESUMO ANALÍTICO

A evolução tecnológica tem proporcionado soluções inovadoras que facilitam a transição para práticas e comportamentos mais sustentáveis. No contexto atual, em que as consequências ambientais das práticas de consumo são cada vez mais evidentes, torna-se necessário disponibilizar aos consumidores ferramentas digitais que facilitam a realização de escolhas informadas e ambientalmente conscientes.

Este projeto visa desenvolver uma aplicação web interativa que permite aos utilizadores obter informações detalhadas sobre a sustentabilidade na moda, através de quizzes e desafios. Adicionalmente os utilizadores poderão criar um closet virtual de forma a poderem visualizar e obter informações sobre a roupa que possuem, a sua utilização, os cuidados que devem ter com a mesma, com o objetivo de incentivar um comportamento de consumo mais responsável. Através de uma solução digital interativa, o projeto pretende contribuir para a sensibilização dos consumidores, facilitando a adoção de práticas de moda mais sustentáveis.

Palavras-chave: Aplicações Web; Sustentabilidade; Moda; Gamificação; Comportamento de Consumidor.

ABSTRACT

Technological developments have provided innovative solutions that facilitate the transition to more sustainable practices and behaviours. In the current context, characterised by the growing visibility of the environmental consequences of consumption patterns, it becomes imperative to equip consumers with digital tools that empower them to make informed and conscientious decisions.

The aim of this project is the development of an interactive web application that will facilitate access to information regarding fashion sustainability through quizzes and challenges. Furthermore, users will have the capacity to create a virtual closet, thereby enabling them to visualise and access information regarding the items they possess, the manner in which they are utilised, and the methods by which they should be maintained. Through an interactive digital solution, the project aims to raise awareness among consumers and facilitate the adoption of more sustainable fashion practices.

Keywords: Web Applications; Sustainability; Fashion; Gamification; Consumer Behaviour

SUMMARY

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Glossary

App (or apps)

For the purposes of this work, the term ‘app’ (or ‘apps’), will be used to refer to mobile applications and web applications. The term ‘application’ will not be used in this context to avoid any confusion with its alternative meanings, such as ‘request’ – “an official request for something, usually in writing” - and ‘use’ – “a way in which something can be used for a particular purpose” (‘Application’, n.d.).

AI – Artificial Intelligence
API – Application Programming Interface
CRUD – Create/Read/Update/Delete
CSS – Cascading Style Sheets
CTA – Call to Action
DSRM – Design Science Research Methodology
EU – European Union
HTML – Hypertext Markup Language
HTTP – Hypertext Transfer Protocol
LCA – Life Cycle Assessment
NAM – Norm Activation Model
PI – Purchase Intention
SBAM – Sustainable Behaviour Applications for Mobile Devices
TPB – Theory of Planned Behaviour
TRA – Theory of Reasoned Action
UCD – User-Centered Design
UEQ – User Experience Questionnaire
VBN – Value-Belief-Norm
WTP – Willingness to Pay

1 INTRODUCTION

The fashion industry is notorious for its environmental impact, with the fast-fashion model driving overconsumption and waste. The fast-fashion model is characterised by the rapid production of new styles, at low prices, which has led to a surge in textile production and disposal. Textile production has increased from 58 million tonnes in 2000 to 109 million tonnes in 2020, and is projected to reach 145 million tonnes by 2030 (The Impact of Textile Production and Waste on the Environment, 2020). This growth has contributed to significant environmental problems, including water pollution, greenhouse gas emissions, and textile waste (The Impact of Textile Production and Waste on the Environment, 2020). Despite the growing awareness of sustainability issues, many consumers struggle to adopt habits that encourage responsible consumption. Wardrobes often exceed actual needs, with an average of 11 kilograms of textiles discarded per person annually in Europe (The Impact of Textile Production and Waste on the Environment, 2020). This excess often results in the neglect of items and impulse buying, thus perpetuating unsustainable consumption patterns.

This project aims to address these challenges by developing an interactive wardrobe management solution with gamification elements. This approach is intended to assist users in managing their clothing consumption in a more sustainable manner, by allowing them to log their clothing, track the frequency of their usage, and gain insight into the colours and categories most frequently worn. Additionally, the app will encourage the adoption of sustainable habits through fun challenges, sustainability quizzes, and gamification elements.

1.1 Motivation

A multitude of initiatives have been devised in an attempt to address sustainability in the fashion industry; this approach seeks to empower consumers by enabling them to make informed decisions. The motivation for this project stems from the necessity to address the disparity between awareness and action concerning fashion consumption, by providing actionable insights that actively engage and motivate individuals to rethink their relationship with fashion. The project aims to achieve this by

leveraging web apps to develop a tool that aims to inspire individuals to consider their habits and make more conscious decisions.

1.2 Objectives

The main objective of this project is to develop an interactive web app that fosters sustainability in the fashion industry. To this end, the following practical objectives will be considered:

1. investigate consumers' motivations for adopting responsible and/or sustainable consumption practices;
2. understand the influence of information on consumer behaviour and purchasing patterns;
3. evaluate the interest and suitability of the apps' content as a tool that encourages changes in consumer habits;
4. develop a digital solution that facilitates access to information, about fashion products and users' consumption habits, and encourages users to adopt more responsible practices;

Through increased awareness of fashion choices, this project seeks to foster responsible consumer behaviour and transform wardrobe management into an engaging and rewarding experience.

1.3 Document structure

The present document is structured into five main chapters. Chapter 1 provides an introduction to the project, outlining the motivation behind the work and its objectives, and an overview of the document's structure. Chapter 2 presents the literature review with particular reference to consumer behaviour, challenges and opportunities in sustainable consumption, and the use of fashion-related apps. It also explores the potential of mobile apps and gamification as tools for promoting responsible consumption. Chapter 3 describes the methodology adopted throughout the project, including questionnaire analysis and user personas. Chapter 4 details the development of the solution, covering an in-depth analysis of the interface and functionalities

developed, the technological stack utilised, and the results from user testing. Lastly, the conclusion provides a final reflection on the solution developed, discusses limitations, and suggests directions for future work.

2 LITERATURE REVIEW

The development of this project requires understanding fashion consumption, the challenges it presents, and the tools available to support sustainable practices. This literature review examines key areas, including consumer behaviour in fashion consumption, namely its influence, challenges, and opportunities, as well as the role of apps and gamification in fostering habit formation and sustainable practices. By analysing existing wardrobe management apps, and exploring the influence of sustainability apps, alongside the potential of gamification, this review establishes the context and basis for developing a novel approach to address fashion consumption.

2.1 Consumer influence

Consumers are recognised as key players in all consumer goods industries, pivotal to the success and failure of companies in the consumer goods sector. Recent trends, such as *shrinkflation*– the practice of maintaining the price of a product while reducing its size – have resulted in a heightened level of vigilance among consumers (Curtis et al., 2023). Additionally, consumers are highly sensitive to the notable decline in the quality of consumer service and the provision of satisfactory service experiences (Curtis et al., 2023).

Meeting consumer expectations is not merely a prudent practice it is a necessity in today's market. For instance, ineffective complain management could result in significant losses, estimated at US$887 billion in 2024, a notable increase from the US$494 billion lost in 2020 (Curtis et al., 2023).

2.2 Sustainable consumption and fashion

Consumer influence affects various industries; however, the fashion industry presents unique challenges to sustainability. The fashion industry has considerable influence on the global economy, but it also has a detrimental impact on the environment (Musova et al., 2021), particularly in relation to the production, distribution, and

consumption of fashion items, requiring a shift towards more innovative and sustainable fashion practices (Ikram, 2022).

Recent studies highlight the fundamental role of consumers in reducing environmental impacts (Schiaroli et al., 2024), and they are recognized as drivers in the shift towards a circular economy (Musova et al., 2021). Nonetheless, the literature points to a lack of consumer knowledge about fashion practices at the pre-purchase, use, and post-use levels, which hinders the adoption of sustainable solutions (Schiaroli et al., 2024).

Data shows that Europeans, in general, are particularly concerned about the impact of the environment on their well-being and daily lives (Attitudes of Europeans towards the Environment, 2024). However, despite the growing interest in sustainable options, fast fashion remains a dominant consumer trend among the European Union (EU) population (Attitudes of Europeans towards the Environment, 2024). A recent study revealed that 41.88% of individuals, from the EU, with Meta accounts engage with fast fashion through "content, pages, or events" related to it (Apetrei et al., 2024). This trend is more common among women, who also demonstrate a stronger preference for sustainable fashion compared to men (Apetrei et al., 2024).

2.2.1 Consumer behaviour

A number of theories have been employed in studies seeking to explain consumer behaviour. For example, Dangelico et al., (2022) utilised the Theory of Planned Behaviour (TPB), the Theory of Reasoned Action (TRA), and the Value-Belief-Norm (VBN), in order to ascertain behavioural intentions, taking into account a multitude of variables in order to determine purchase intentions (PI) and willingness to pay (WTP) a premium for sustainable fashion products. The TPB and the Norm Activation Model (NAM) have also been employed to explain consumer behaviour, particularly in the context of sustainable and ethical consumption, namely the intention to purchase second-hand clothing (Sepe et al., 2024).

Despite the advancement of research in this field, studies have revealed that consumers' positive attitudes do not translate into sustainable consumption or behaviour, a phenomenon known as the attitude-behaviour gap (Jacobs et al., 2018;

Taborecka et al., 2023). To address this gap, strategies are needed to bridge the gap between consumer attitudes and habits, promoting more sustainable and responsible consumption choices in the fashion industry. Understanding the barriers that hinder sustainable consumption, as well as the factors that motivate it, is crucial for designing effective interventions.

2.2.1.1 Challenges and opportunities

A multitude of factors have been identified as contributing to the adoption of more sustainable fashion practices among consumers. These include economic considerations as well as personal values and environmental concerns. Moreover, researchers have also grouped consumer needs into hedonic values and utilitarian values, as well as extrinsic and intrinsic motives (Doğan-Südaş et al., 2023; Halicki et al., 2024).

Second-hand market

A significant example of consumer focus on sustainable practices is the second-hand shopping market, which in 2023 constituted a market with an estimated value of US$197 billion (*Secondhand Apparel Market Value Worldwide from 2021 to 2028*, 2024). Research shows that second-hand clothing consumers are driven by economic considerations, fashion motivations and trends, and even a heightened awareness of environmental impact of clothing production and resource consumption (Sepe et al., 2024).

Additionally, findings from Halicki et al. (2024) reveal that, in some instances, second-hand shoppers prioritise “treasure hunting” over other motivations, namely economic and ethical. Furthermore, research indicates that “the positive influence of fashion motivation underscores a shift in consumer perception, highlighting how much buying second-hand clothing is now seen as fashionable” (Sepe et al., 2024). However, it is crucial to acknowledge the limitations of these findings. The survey was disseminated on social media groups dedicated to vintage fashion, a practice which may have resulted in a sample population with a greater interest in the given topic, and thus potentially skewed the results (Sepe et al., 2024).

Alternative materials and models

Beyond second-hand markets, the use of alternative materials and innovative business models is another critical area of sustainable fashion. For instance, studies revealed that consumers' strongest motivation for purchasing products made with waste or recycled materials were related to environmental concerns, specifically in an "effort to help solve perceived global environmental problems", and a desire to "support a business idea with good intentions" (Musova et al., 2021).

Similarly, Dangelico et al. (2022) found that consumers that are concerned with the environment have stronger purchase intentions and are more willing to pay a premium for sustainable clothing. Additionally, consumers who have previously purchased clothing made with sustainable materials, namely organic and recycled materials, are more willing to purchase and pay a premium for clothes with these materials (Dangelico et al., 2022). Conversely, no such inclination has been observed with alternative vegetable matter, a phenomenon attributed by the authors to the "very limited presence of these products in the market that reflects on a very low percentage of consumers having tried them" (Dangelico et al., 2022).

Furthermore, research shows that consumers from Slovakia are open to supporting new circular models, namely slow fashion, patchwork, swapping, and upcycling clothes (Musova et al., 2021). However, it is relevant to note that while respondents' show willingness to adopt the practices, their knowledge is lower than their willingness to support them (Musova et al., 2021).

Competing priorities in consumer decision making

An increase in environmental awareness has led to consumers seeking fashion, which is more aligned with their "personal values and convictions" (Apetrei et al., 2024), when purchasing new clothing, some consumers plan their shopping in advance and the clothing they buy matches their personal values (Gigauri, 2024).

However, as indicated by Fowler (2022), despite the participants' interest in sustainable consumption, sustainability does not emerge as the predominant factor influencing their purchasing decisions regarding fashion goods. In the study, one participant indicated that they would purchase a product if it were stylish and would consider its environmental impact only if it met their aesthetic standards. Additionally,

other participants in the study also stated that fashion was the primary consideration, with price, comfort, and functionality also being identified as key factors.

This trend is not limited to one region. A study by Rahman et al. (2021) involving participants from India and Canada, demonstrated that these consumers prioritise fit, comfort and style over sustainable aspects of the product. Similarly, consumers from Italy prioritise “comfort, followed by quality, price, type of fabric and resistance” while environmental impact has a ”medium level of importance” (Dangelico et al., 2022).

Research on consumers, from Cyprus, indicated that even consumers that “have general knowledge about sustainability and unethical business practices, are still not motivated enough to consume sustainably” (Papasolomou et al., 2023). Furthermore, there is a clear difference between generations when it comes to fast fashion, buying second hand-clothes, upcycled clothes, among others (Taborecka et al., 2023). Studies indicate that younger consumers, specifically Generation Z, exhibit higher environmental awareness and “their purchasing is influenced by principles of sustainability (Musova et al., 2021)”. However, a study conducted among women from Slovakia, reveals that, while Generation Z has higher levels of attitudes towards sustainable clothing, their actual buying behaviour does not translate into more sustainable purchases (Taborecka et al., 2023). Further conflicting evidence emerges from a study examining Generation Z consumers of the brand SHEIN, which suggests a lack of environmental knowledge concerning the fashion industry among this demographic (Zimand-Sheiner & Lissitsa, 2024). Additionally, when presented with negative information, there was no significant decrease in purchase intention, despite the personal responsibility participants felt for their actions (Zimand-Sheiner & Lissitsa, 2024).

A study conducted by Gigauri (2024) revealed that consumers in Georgia tend to refrain from wearing visually striking or ostentatious attire, instead favouring garments that are both comfortable and aligned with their professional and personal preferences. These consumers tend to be more modest with their fashion choices, yet they are still influenced by how fashion is advertised to them, moreover, the study indicates that marketing also has an influence on sustainability matters (Gigauri, 2024). Accordingly, as consumer perceptions are strongly influenced by marketing, it is imperative to adopt a consumer-centric approach when developing solutions and

addressing sustainability concerns. Moreover, when presenting sustainability information, it is of utmost importance to convey it accurately and clearly, ensuring that it is readily understood by most consumers (Rahman et al., 2021).

As indicated by Rahman et al. (2021) consumers, from Canada and India, attribute distinct levels of significance to product-related cues, encompassing both intrinsic and extrinsic cues, as well as those pertaining to sustainable production cues. The study defines intrinsic product cues as those related to the product itself, including, but not limited to, fit, comfort, style, quality, colour, durability, and fabric. Meanwhile, extrinsic product cues pertain to factors external to the product including brand name, price, and country of origin. Additionally, sustainable production cues are those pertaining to the environment, namely air quality, reduced water and energy usage, and absence of animal skin usage, as well as those pertaining to social and ethical matters, namely worker safety, no child labour, and provision of fair wages. When products possess sustainable attributes, consumer purchase intentions are higher, particularly with regard to fast fashion purchases (Taborecka et al., 2023). The communication of these sustainable attributes could be a strategic approach for stakeholders to consider.

Barriers to ethical purchasing

A small-scale study involving semi-structured interviews with 13 highly educated young participants from Germany, identified a number of factors that hindered ethical purchasing behaviour, including "price, lack of availability, transparency, image, lack of information, inertia and consumption habits" (Wiederhold & Martinez, 2018). These factors are found in subsequent studies.

For instance, according to research, some consumers are not willing to pay a premium for sustainable clothing (Rahman et al., 2021). However contrasting evidence from other studies reveals that price does not constitute a barrier. For instance, a study with women from Germany indicates that concerns about fashion and prices do not constitute as a barrier to the consumption of sustainable clothing (Jacobs et al., 2018). Furthermore, a study of Italian women indicates that environmentally conscious consumers are willing to pay a premium for sustainable clothing (Dangelico et al., 2022). Additionally, findings from a study with Slovak consumers revealed that price is not a barrier to purchasing sustainable alternatives (Musova et al., 2021). It is important to

acknowledge the volatility of price, which can function as a barrier in certain contexts but may be less significant in others.

Research indicates that despite concerns about the environment, consumers frequently lack the information necessary for sustainable consumption. They often have limited knowledge about "sustainable clothing and criteria" (Wiederhold & Martinez, 2018) as well as emerging trends, namely those pertaining to circular economy practices (Musova et al., 2021).

As suggested by Jeong & Ko (2021) sharing knowledge and information about sustainable fashion products is fundamental for consumers as it encourages them to change their behaviour. For example, as indicated by participants in a study of young Chinese consumers, despite their concerns about the environment, they lacked the appropriate information to engage in sustainable consumption (Fowler et al., 2022). The participants in the study also expressed that they seek information on Baidu, a Chinese search engine, and "they learn about sustainable fashion from reality shows, family, and friends" (Fowler et al., 2022).

Moreover, the information available to consumers is limited to product related details, such as material composition, and there is a notable lack of transparency concerning production related information, including details regarding working conditions, labour ethics, and manufacturing methods (Rahman et al., 2021). Consumers have expressed a desire for more information regarding this matter, as evidenced by a participant in a study who stated their wish to be more informed (Fowler et al., 2022).

A lack of information has been identified as a notable obstacle to purchasing sustainable products, with health safety concerns also emerging as a significant barrier (Musova et al., 2021). For example, findings from a study on Slovak women, indicate that 76% of respondents would purchase products made from waste materials, however 68% of respondents identified "distrust in health safety" as the primary barrier to the purchase of these products (Musova et al., 2021). Additionally, there is a perception among consumers that sustainable clothing is not durable, thereby impeding their inclination towards sustainable purchases, as suggested in the study durability aspects should be emphasised in order to facilitate the adoption of sustainable purchasing practices (Jacobs et al., 2018).

Furthermore, consumer choices are strongly influenced by the perception of value and trust in sustainable brands. Studies show that consumers are more likely to purchase a fashion product if they perceive that it has more value and benefits for them (Jeong & Ko, 2021). It is therefore imperative that consumers are provided with the requisite tools and resources to enable them to make well-informed decisions. This view is supported by Papasolomou (2023), who asserted that "Retailers claiming to engage in sustainability must develop products that are correctly labelled and give adequate information about their products that is not only comprehensible but also credible and useful." Transparency and trust are essential in this context, as consumers rely on accurate and trustworthy information to evaluate sustainability claims.

Over the years, fast fashion brands like H&M, TopShop, and Zara, have responded to consumer demands by launching sustainability-focused programs, namely by introducing collections focused on this matter (Rahman et al., 2021). However, such initiatives are met with consumer scepticism. For instance, in a study conducted by Fowler (2022), a participant indicated that they are not easily mislead by brand claims. When a brand develops a product line with an emphasis on sustainability, they tend to inquire about the brand's overall commitment to sustainability and whether the introduction of this line is merely a marketing strategy. As evidenced by the findings in Fowler's (2022) study, there is a prevailing perception among participants that brands lack credibility in the context of sustainable fashion. This perception is accompanied by a demand for greater transparency and regulatory oversight in this domain (Fowler et al., 2022). According to Wiederhold & Martinez (2018), a similar sentiment regarding brand claims was expressed by a participant, who stated "I cannot take these claims seriously. Such a big retailer [H&M] does that for a particular reason and for me it is highly questionable whether these actions are verifiable sustainable.".

In addition to general concerns about credibility, there is a perception that sustainable clothing retailers do not have a significant presence in retail spaces (Jacobs et al., 2018). Their presence is primarily observed online and in catalogues. Consequently, a significant proportion of consumers, who prefer to shop in store, is not being catered to, thus the perceived availability of sustainable clothing is low (Jacobs et al., 2018).

The obstacles identified in the consumption of sustainable fashion are significant, but by no means beyond the capacity of consumers to overcome them.

Furthermore, it is imperative to develop and provide solutions that align with the evolving consumer needs and demands of the modern era, ensuring transparency and access to information to bridge the gap between attitudes and behaviour.

2.2.2 The use and post-use stages of consumption

A substantial body of research has been dedicated to the examination of consumer behaviour at the point of (pre-)purchase (Schiaroli et al., 2024). However, there has been comparatively less attention dedicated to the subsequent stages of the product lifecycle, particularly with regard to use stage, and disposal or post-use stage (McNeill et al., 2020; Schiaroli et al., 2024). This lack of attention may be a contributing factor in the lack of consumer knowledge regarding the appropriate care of garments.

A literature review by Schiaroli et al (2024) suggests that the use stage can be divided into personal use and collaborative use. The main practices for personal use identified in this stage include “1) Continuing wearing garments, (2) Laundry practices, (3) Repair activities, and (4) Support services”. While collaborative use refers to "(1) Renting, (2) Leasing, and (3) Pooling". These findings highlight the varied ways in which consumers engage with their clothing, which in turn has an impact on sustainability outcomes.

Building on the aforementioned findings, a study of young South Korean consumers revealed interesting nuances in personal use. Specifically, fashion-sensitive consumers are more likely to consume and make excessive purchases of clothing. However these consumers may also be more inclined to repair clothing if they have an emotional connection to the garments, regardless of whether the item is a fast fashion piece or not (McNeill et al., 2020). This finding underscores the notion that consumers’ emotional attachment to garments transcends conventional price and quality considerations, thereby influencing behaviours such as repair rather than disposal (McNeill et al., 2020).

Nonetheless, research also shows that consumers are more likely to dispose of clothing for fashion reasons rather than product failure (McNeill et al., 2020). Some consumers dispose of garments in the trash (McNeill et al., 2020), whilst others donate and sell items (Cooper & Claxton, 2022). A study conducted in the United Kingdom

revealed that the majority of items discarded due to product failure are so due to pilling, colour fading, fabric breakdown, and accidental damage (Cooper & Claxton, 2022). The researchers proposed several solutions grouped by "textile technology and manufacturing, quality assurance and testing, and consumer behaviour". Regarding the latter group, the study indicated that consumers may contribute to product failure if they lack the requisite knowledge to take better care of garments, thereby extending their lifespan or ensuring that garments at least meet their expected lifespan (Cooper & Claxton, 2022). This knowledge gap emphasises the necessity for innovative solutions to empower consumers with the tools and information required to make more sustainable choices.

2.3 Technology as a means for sustainability and responsible consumption

Technology offers immense benefits, including enhanced access to information, communication, entertainment and art (Curtis et al., 2023). Furthermore, it has emerged as an essential tool for sustainability in various contexts. From the promotion of recycling practices to the development of smart solutions, namely smart lighting, smart air quality monitoring, and smart water monitoring (Maksimovic, 2018), technology is playing an increasingly pivotal role. Additionally, academic contributions in this area are advancing, particularly in exploring how technology might contribute to sustainable consumption (Ertz & Elgaaied-Gambier, 2023).

Nevertheless, there is a growing sentiment amongst the public that the rapid advancement of technology is overwhelming. This is evidenced by the findings of a survey which found that 47% of respondents shared this view (Curtis et al., 2023). In order to respond to this emerging concern, it is essential that technology is deployed in a thoughtful and effective manner, ensuring that it has a beneficial influence on people's lives without exacerbating the issues that give rise to this unease. Additionally, the demand for regulatory oversight in the technological domain is increasing, paralleling the demand observed in the context of fashion brands (Curtis et al., 2023; Fowler et al., 2022).

2.3.1 Apps and digital solutions

The use of web apps to encourage sustainable consumption is becoming increasingly prevalent, with these digital tools offering more accessible and engaging information. These apps employ strategies such as providing information in an accessible and engaging format and integrating real-time data, sustainability information, personalised recommendations, and/or gamified models. The aim is to encourage the adoption of more sustainable behaviours, as evidenced by the examples of the Buycott App, JouleBug and Good on You (D'Arco & Marino, 2022). Researchers have explored the use of apps to foster sustainable behaviour in various domains, namely mobility (Goetz et al., 2024).

In the fashion domain, several apps can be identified namely Good on You and ThredUp. Good on You evaluates fashion and beauty brands on an ethical level, and provides general information on the sustainability measures of these brands, in the dimensions of *Planet*, *People*, and *Animals* (*FAQs*, n.d.). Additionally, in the fashion domain, another platform is ThredUp. ThredUp is a marketplace for second-hand clothing. In addition to offering a marketplace for second-hand clothing, ThredUp provides information regarding the environmental impact of purchasing used items. This information is provided in the form of an estimate, based on a Life Cycle Assessment (LCA) conducted by Green Story Inc, in 2022 (*The Methodology Behind Our Eco Stats*, 2022).

Furthermore, virtual wardrobes, such as *Cladwell*, *Stylebook*, *Acloset*, *Whering: Your Digital Wardrobe*, and *Save Your Wardrobe*, are tools used to facilitate the management of users' existing clothing inventory. The apps available on Google Play Store for Android devices were downloaded to facilitate their review. The following sections provide a more detailed exploration of their features and functionalities.

Cladwell

Cladwell is an app that enables users to scan their clothing items and subsequently organise them in a *capsule wardrobe* format for different weather conditions, or occasions. The objective is to reduce the quantity of clothing purchased by each individual and create outfits from the existing wardrobe, as Cladwell asserts, "We

know that great style is made with more creativity, not more consumption" (*Digital Closet*, n.d.). The app offers style guidance with the assistance of artificial intelligence, assisting users in combining their outfits in a more efficient and practical manner.

Subsequent to the completion of the download and creation of an account, it was possible to verify the features that had been highlighted on the website. It was ascertained that the application possessed these features; however, it was found that they were severely limited in the free version of the app. As shown in Figure 1, while it was possible to make outfit combinations, the number of combinations was restricted, and no statistical data on clothing was available in this version. The premium version of the app could not be assessed.

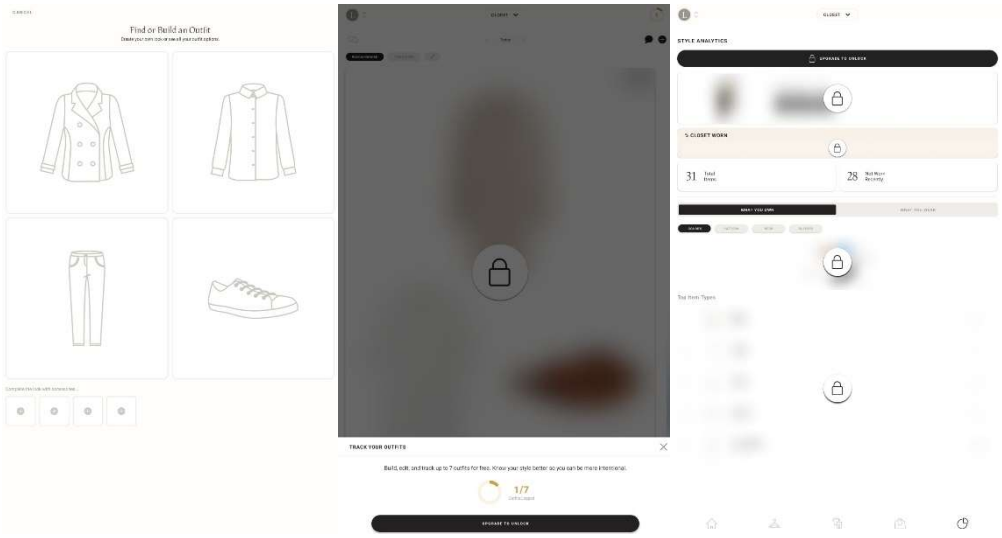

Figure 1 – Cladwell app screenshots

Stylebook

In the case of the Stylebook app, users are afforded a more comprehensive range of features, including the capacity to incorporate custom clothing items and devise ensembles. Furthermore, users are able to view the outfits they have worn throughout the month and obtain information such as the frequency of garment usage, the colours most frequently worn, and other pertinent data. Additionally, users can search for inspiration for new outfits directly on the app (*Features*, n.d.). However, an independent verification process of the Stylebook app was unsuccessful due to the app's exclusivity to iOS, which rendered the assessment of its features unfeasible.

Acloset

The Acloset app enables users to scan their garments and categorise them according to the seasons, style of clothing, rating, colour, among other characteristics. In addition to these features, the app also provides information on the brands on which the user has spent the most money, as well as the cost per use of each item, and the total by product category. Furthermore, the app allows users to plan outfits and share them on social media (*How It Works*, n.d.-a). A review of the app revealed that its features align with those previously shared on the website, moreover the app also offers artificial intelligence (AI) styling and the option to share outfits on the app's feed, thereby serving as a source of inspiration for other users. Additionally, the app's navigation is intuitive, even for novice users, which further enhances its appeal and ease of adoption. The main drawback of this app is that the free tier is limited to 100 pieces of clothing. Figure 2 illustrates some of these features and highlights the apps minimalistic interface.

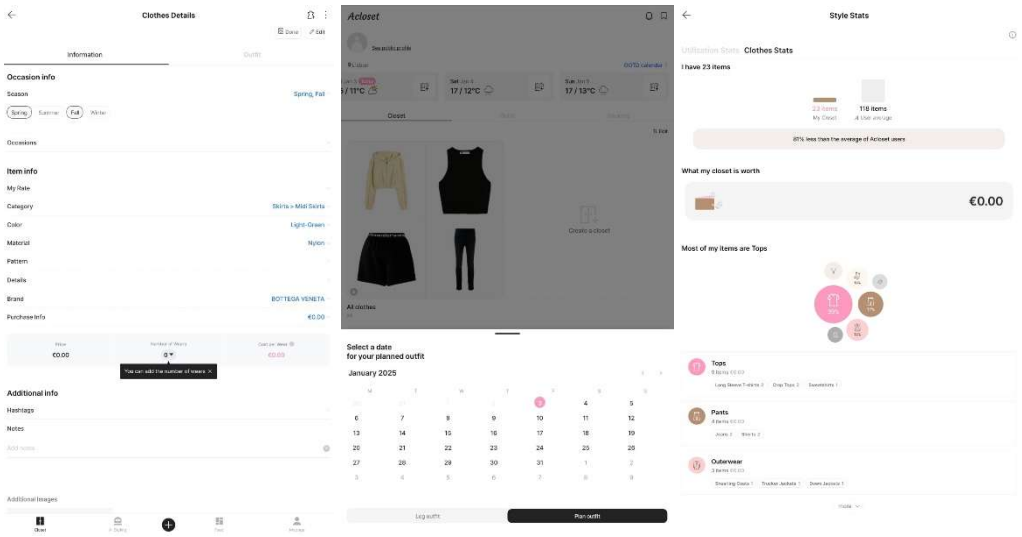

Figure 2 – Acloset app screenshots

Whering: Your Digital Wardrobe

Whering: Your Digital Wardrobe, enables users to digitise their clothing and create sets of garments. It also facilitates the sharing of these sets with friends and the planning of outfits. Furthermore, it provides information on the value of the wardrobe and a percentage of the garments that have been worn (*How It Works*, n.d.-b). The platform also disseminates information on clothing repair and alteration services (*Services*, n.d.), and allows second-hand items to be sold on its marketplace. Upon

analysis of the app, it was determined that the navigation process is notably straightforward, and the product details and statistical information were found to be comprehensive and informative, as illustrated in Figure 3.

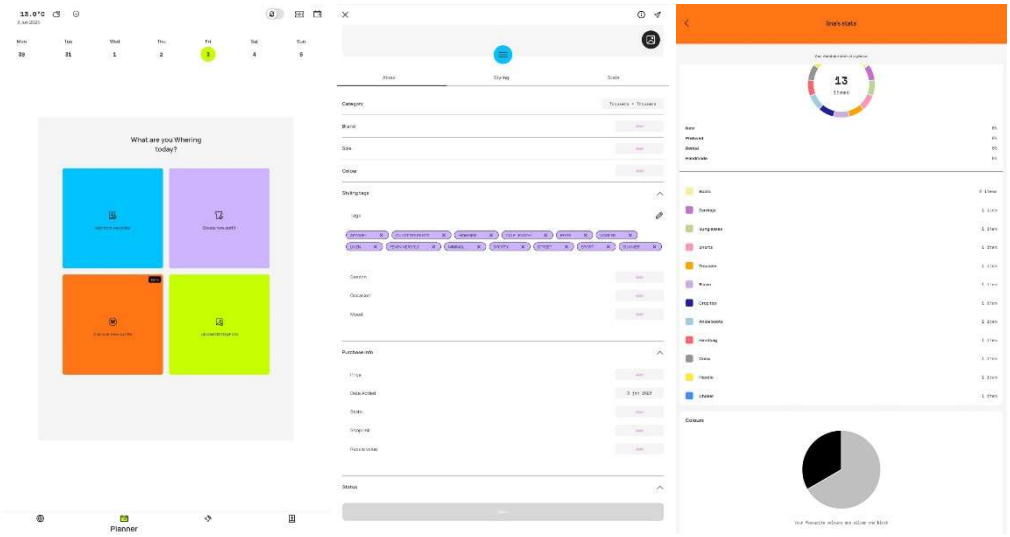

Figure 3 – Whering: Your Digital Wardrobe app screenshots

Save Your Wardrobe

Lastly, Save Your Wardrobe is an app that also facilitates the creation of a virtual wardrobe. While the website provides information on the company's history and the concept behind the application, as well as various calls to action, such as "So follow us, download the app, and let's make fashion circular." (*For Consumers*, n.d.), it does not offer detailed information regarding the specific functionalities of the app. Upon downloading the app to verify its features, it was found that no clothing items could be logged using any of the available methods. Attempts to take photos and upload existing images both resulted in the same error message. Furthermore, attempts to add clothing items from a website also resulted in an error. Both of these errors are shown in Figure 4.

It is worth noting that the last app update for Android users was on the 15th of October of 2024, and as of this analysis on the 2nd of January of 2025, the app was still not functioning properly. As it was not possible to complete this step, it was not possible to determine most of the app's features. However, it was possible to ascertain that the app provides information on sustainability and fashion through a blog feature, as well as a news and wardrobe tips feature. Furthermore, the app incorporates a services function,

(e.g., for repairs and cleaning), however this feature is only available for users located in the United Kingdom. While Save Your Wardrobe attempts to promote sustainable practices, the app is not functioning as intended, rendering it unusable and its claims unverifiable.

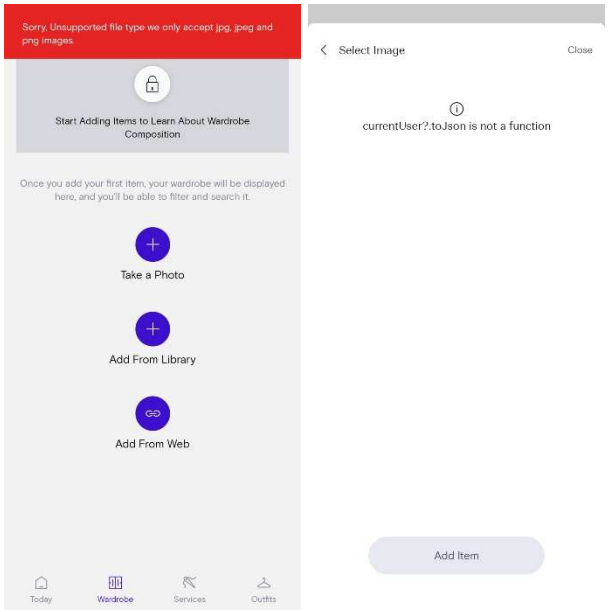

Figure 4 – Save Your Wardrobe app screenshots

Summary

The apps presented provide the possibility of managing the clothes that each user has, offering various tools for organisation, planning and creativity in the use of clothes. Some of these platforms, such as Cladwell incorporate principles aligned with sustainability, such as the *capsule wardrobe* concept, which aims to optimise the use of existing garments and reduce unnecessary purchases. However, the initiatives are limited in their active promotion of sustainable practices and responsible use of clothes.

2.3.2 Sustainability apps

Building on the broader theme of apps and digital solutions, sustainability focused apps have emerged as an important subset of tools designed to address environmental and social challenges. According to Guillen & Hamari (2024) “sustainable consumption apps are mobile applications that enable users to intentionally make choices related to acquisition, use, and disposal – including exchanging, recycling, and

other activities to prevent the use of landfills - of goods and services that consider socio-environmental impacts today and in the future".

Furthermore, as D'Arco & Marino (2022) highlight, sustainability apps can serve as a motivating tool for those who are interested in adopting a more sustainable lifestyle but may require additional encouragement or support to facilitate the transition. This perspective is reinforced by the findings of Sun et al. (2022) who suggest that gamification apps may serve a means for people to "subtly accept the concept of sustainable consumption and apply it to life practice". Similarly, Doğan-Südaş et al. (2023) posit that gamified mobile apps may have, from a marketing point of view, "a positive influence on consumers' sustainability behaviour (consumption or participation)". Nonetheless, it is of utmost importance to acknowledge that while this study suggests such an influence as a potential outcome, no sustainability apps were directly involved in the study. Instead, the findings were extrapolated and applied to these apps, highlighting an expectation rather than a confirmed effect.

An experimental study by Jäger et al. (2020) on a potential sustainability app and purchase intentions, revealed that consumers could change some of their purchase intentions upon receiving sustainability information, as long as it is presented in a concise and clear manner (i.e. eco score). Few participants in the study sought more detailed information despite it being provided on the app (Jäger et al., 2020). The preceding study was also constrained by the fact that the products available were limited to a small number of food items, and not apparel. However, it is important to note the influence of the changes made by the app on purchase intentions.

A study conducted with participants living in the United States of America, revealed that participants who use sustainability apps can be positively affected by the apps. The findings indicated that the users of these apps tend to align their personal norms with their actions both in private and public environments (D'Arco & Marino, 2022). The validation of hypothesis also revealed that the correlation between (1) awareness of consequences and ascription of responsibility and (2) ascription of responsibility and personal norms, is stronger in individuals who use sustainability apps. Furthermore, this study found that while employing the NAM, the theory was "consistent in explaining or predicting environmental citizenship behaviour" (D'Arco & Marino, 2022). Furthermore, Cudok et al. (2022), investigate the involvement of communities and

the circular economy through a platform that connects consumers interested in extending the life cycle of their goods, promoting the sharing of ideas and sustainability tips. With features that encourage the sharing and selling of products between community members, this solution demonstrates the potential of digital solutions to influence consumer habits.

The studies presented underscore the potential of apps to drive meaningful behavioural change. While these studies did not employ the SBAM (Sustainable Behavior Applications for Mobile Devices) Guidelines, the development of these guidelines provides a new approach to evaluating apps designed to encourage sustainable behaviours, laying the groundwork for future research in this area (Tancredi et al., 2024).

2.4 Gamification

Gamification, as defined by Deterding et al. (2011), refers to "the use of game design elements in non-game contexts", a definition widely accepted and cited in subsequent literature (Sun et al., 2022; Tancredi et al., 2024; Werbach, 2014). Werbach (2014) proposed an alternative definition, describing gamification as "the process of making activities more game-like". Nevertheless, the field of gamification is relatively new and while "there is no uniform definition of gamification in academic circles" (Sun et al., 2022) the field continues to evolve as scholars and practitioners deepen their understanding of its application and impact.

A systematic literature review by Guillen et al. (2021) identified the most common gamification elements employed across various contexts in the literature. These elements, listed by order of frequency, include (1) goals, challenges, missions; (2) leaderboards and rankings; (3) points; (4) achievements, badges, and medals; (5) feedback; (6) cooperation, teams, communities; and (7) social media features, among other elements (Guillen et al., 2021).

Researchers have investigated the potential of games and apps focused on gamification in various areas, including sustainability education, energy reduction, transportation and air quality, and waste management and water conservation (Douglas & Brauer, 2021). Several apps demonstrate the ability of gamification to drive behavioural change. For example, *Forest: Focus for Productivity* (Cudok et al., 2022), and *WaterDo:*

To Do List & Schedule (Seekrtech, n.d.), employ gamified elements to foster productivity habits and personal organisation. Other apps, such as *SleepTown*, facilitate the establishment of healthy sleep routines and habits (Seekrtech, n.d.). These apps, along with others, illustrate the potential of gamification to instigate positive behavioural modifications in domains such as productivity and personal well-being. As Tancredi et al. (2024) note "gamification involves designing interactions, environments, and game dynamics that encourage users to persistently engage in certain behaviors over others".

2.4.1 Challenges and ethical considerations

Notwithstanding its apparent benefits, gamification also presents challenges and ethical concerns. For instance, Spanellis (2023) has identified instances where gamification – and the practice that predates the concept – has been employed to increase consumption, in order to "retain the customers and encourage them to spend more on the products or services a particular company is offering", as noted by the author this approach has been subjected to significant criticism by scholars. Furthermore, Guillen & Hamari (2024) emphasize that the incorporation of gamified elements must be employed with clear and defined objectives, rather than merely for aesthetic purposes as it was the case for several apps analysed by the authors.

Moreover, researchers who rely on established theories to develop effective implementations of gamification elements are presented with challenges, due to the difficulty to assess the "impact of different elements of a complex design" (Spanellis, 2023). While gamification demonstrates considerable success in promoting behavioural change within certain contexts, its failure to do so in others remains uncertain (Douglas & Brauer, 2021). Furthermore, when developing a gamified app, it is of utmost importance to consider ethical implications in order to prevent the creation of a manipulative system that lacks transparency regarding the objectives and aims of the app (Spanellis, 2023). As Sun et al. (2022) points out, a group of "experts, academics, designers, and developers", place a great importance on the trust system, which includes "personal privacy", "credibility of the content and statement within the app", "trust in app's operation and motivation", and "real feedback". By prioritising transparency,

developers and other stakeholders can create apps that not only engage users but also uphold ethical standards and build user trust.

2.4.2 The potential of gamification

Gamification has been explored in several domains, however the application of gamification in driving sustainable consumption remains relatively under-researched (Spanellis, 2023; Sun et al., 2022).

Emerging research, such as the work of Sun et al. (2022) offers valuable guidance. Sun et al. (2022) characterized gamification apps for sustainable consumption as "multiple behavioral scene settings, online and offline and the virtuality and reality combination, multiparty participation and cooperation". Sun et al. (2022) further address gamification design for sustainable consumption apps, by developing an index system, which is focused on overall principles and objectives, interactive experience of the game, system support, and trust systems. These first-grade index dimensions are further detailed in the second-grade index.

Gamification can be a promising method for modifying behaviour, promoting sustainability, and fostering healthier practices. Moreover, research shows that apps with gamification elements will have a positive influence on perceived utilitarian and hedonic values, which, in turn, have a positive influence on consumers satisfaction (Doğan-Südaş et al., 2023). Although these findings were found in a marketing context, it remains noteworthy to consider the potential influence of gamification on consumers.

Furthermore, the potential of gamification and persuasive design has been investigated with the aim of reducing energy consumption and encouraging the formation of long-lasting habits in a work environment (Oppong-Tawiah et al., 2020). The system developed provides employees with feedback on their energy consumption, which is presented in the form of a virtual garden that blooms or wilts based on each employee's consumption. The app has been developed to encourage this behavioural shift without the use of external rewards. This approach supports the change in habits based on personal motivations and is not contingent on external rewards, which, when withdrawn, may result in the abandonment of the habits developed (Oppong-Tawiah et al., 2020). Moreover, if the incentives provided are deemed to be of no value or benefit to

the user, they may cease to utilise sustainable consumption apps (Guillen & Hamari, 2024). Although the use of external incentives has been employed in the context of sustainable lifestyle apps, this strategy may not be effective, as "in matters of sustainability, consumers require moral sense and capacity to act morally" (Spanellis, 2023).

Other specific elements of gamification have also been studied in the context of pro-environmental behaviour. With regard to feedback, a study conducted by Wolf (2020) has explored the effects of visual feedback and numerical feedback, as well as a combination of both types, on vividness and information quality. According to the study, both perceived vividness and information quality "should encourage pro-environmental behavior" (Wolf, 2020). The results of the study demonstrate that the aforementioned elements do have a positive effect on pro-environmental intention, which in turn has a positive effect on actual behaviour (Wolf, 2020).

Overall, gamification has been positively received by users, with some suggesting greater emphasis on challenges (Cudok et al., 2022). This proposition aligns with the prevailing themes in research concerning gamification (Guillen et al., 2021). A key factor in ensuring the success and longevity of gamified sustainable consumption apps is understanding the mechanisms that contribute to their continued use. While the number of gamified sustainable consumption apps that have endured for more than two years remains limited, several characteristics that may contribute to their longevity have been identified (Guillen & Hamari, 2024). These findings are promising for future endeavours, suggesting a strong foundation for the development of more enduring and impactful gamified solutions.

2.5 Summary

The literature reveals that consumers have diverse habits and positions towards sustainable fashion, and fashion in general. Whilst some studies indicate a reluctance amongst consumers to adopt sustainable shopping practices, others highlight a willingness to recognise alternatives as a feasible option, specifically by adopting circular economy practices (Dangelico et al., 2022; Fowler et al., 2022; Gigauri, 2024; Halicki et al., 2024; Musova et al., 2021; Rahman et al., 2021; Sepe et al., 2024). Further studies have

also revealed that consumers are sensitive to how brands position and present themselves, how they perceive product value, and availability of options (Fowler et al., 2022; Jacobs et al., 2018; Rahman et al., 2021; Taborecka et al., 2023; Wiederhold & Martinez, 2018). The research findings indicate that consumers may lack the appropriate knowledge or awareness to care for their garments in a manner that ensures they are long-lasting and retain their integrity (Cooper & Claxton, 2022; McNeill et al., 2020; Schiaroli et al., 2024). Despite the barriers that may hinder the adoption of responsible and sustainable practices, the findings also reveal promising consumer attitudes, which could be nurtured to adopt new habits with the appropriate encouragement (Papasolomou et al., 2023). In this context, mobile apps have the potential to play a significant role, as the utilisation of apps to promote sustainable practices has been posited as a viable tactic to encourage the adoption of such practices (D'Arco & Marino, 2022; Ertz & Elgaaied-Gambier, 2023; Jäger et al., 2020). Furthermore, in order to enhance the experience and develop a more interactive and engaging app, the incorporation of gamification elements has been posited as a viable strategy to engage and motivate users to maintain the habits they have developed (Oppong-Tawiah et al., 2020; Sun et al., 2022; Tancredi et al., 2024; Wolf, 2020).

3 METHODOLOGY

This project is aligned with the Design Science Research Methodology (DSRM) and is complemented by User-Centered Design (UCD) to ensure that the developed artefact effectively addresses user needs (Abras et al., 2004). DSRM is particularly suited to this research as it emphasises the creation of an artefact to address a real problem (Vom Brocke et al., 2020). Furthermore, it has been applied in studies that focus on mobile apps for sustainability and/or gamification (Cudok et al., 2022; Oppong-Tawiah et al., 2020). The integration of UCD principles serves to enhance the user experience and ensure the app aligns with its intended audience. The six steps of DSRM, identified by Vom Brocke et al. (2020), will be employed with UCD techniques (Abras et al., 2004) in the following manner:

1. Problem identification and motivation

   This step was described in the introduction, which explains the problem of unsustainable fashion consumption and the motivation for the project.

2. Definition of the objectives for a solution

   The objectives of the solution were defined as follows: enable users to track clothing usage and identify neglected items, promote sustainable wardrobe management practices, and engage users through gamification and challenges.

3. Design and development

   The design and development will follow a user-centred approach, informed by insights from a survey and the creation of personas. These insights will guide the functionality and design features. The design process will focus on making the app intuitive and engaging. Due to time constrains, the process will not be iterative, but the initial user feedback will provide valuable insights for design decisions.

4. Demonstration

   After development, a round of user testing is conducted. This step is integral to the process as it provides feedback on the usability of the app, identifies any navigation difficulties, and uncovers areas of confusion or obstacles that could potentially affect the user experience. The feedback collected from the users

is then used to make refinements to the user interaction and overall user experience.

5. Evaluation

   Due to time constraints, long-term evaluation and multiple feedback cycles are not feasible. Therefore, the evaluation will primarily concentrate on findings from the user testing phase. The feedback collected will be analysed through the lens of UCD, thereby ensuring the functionality of the app meets the needs of its target users.

6. Communication

   The findings and results of the project, along with the development of the app, will be communicated through the thesis report. This report will provide an overview of the design process, apps features, and the rationale behind the design decisions made during development.

3.1 Project planning and timeline

An initial project plan, outlining key steps and timeline, was developed as part of the project proposal. The undertaking of this project entails the steps described below:

1. Literature Review

   The project begins with a literature review, involving an analysis of extant studies pertaining to consumer behaviour, sustainability, and the role of apps in promoting sustainable practices.

2. Online Questionnaires

   The aim of this stage is to understand consumer habits, sustainability awareness, and interest in an informative and gamified solution. The data collected will inform content and strategy development tailored to user needs.

3. Definition of functionalities and contents

   Based on the literature review and survey data, the main functionalities and contents are defined.

4. Data and content collection

This step focuses on obtaining information on sustainable practices, garment care, among other information. While the literature review provides a baseline, this step ensures the inclusion of any additional information not previously considered .

5. Interface and User Experience Design

   A mobile first approach is employed to create an intuitive and visually appealing solution optimised for mobile devices. This step aims to deliver a seamless user experience that encourages sustainable consumer behaviour.

6. Web App Development

   This stage involves the development of the app and the implementation of pre-defined functionalities.

7. Usability Tests

   Usability testing is conducted to evaluate the application.

8. Final Adjustments

   Final adjustments are made based on the observations and feedback of the previous step.

9. Conclusion and Delivery

The project timeline was revised due to unforeseen circumstances. In Figure 5, the planned timeline is depicted in a lighter colour, whereas the actual progress is illustrated using a darker colour to provide a clear comparison. Specifically, a delayed start to step 6 resulted in subsequent delays in most of the following stages.

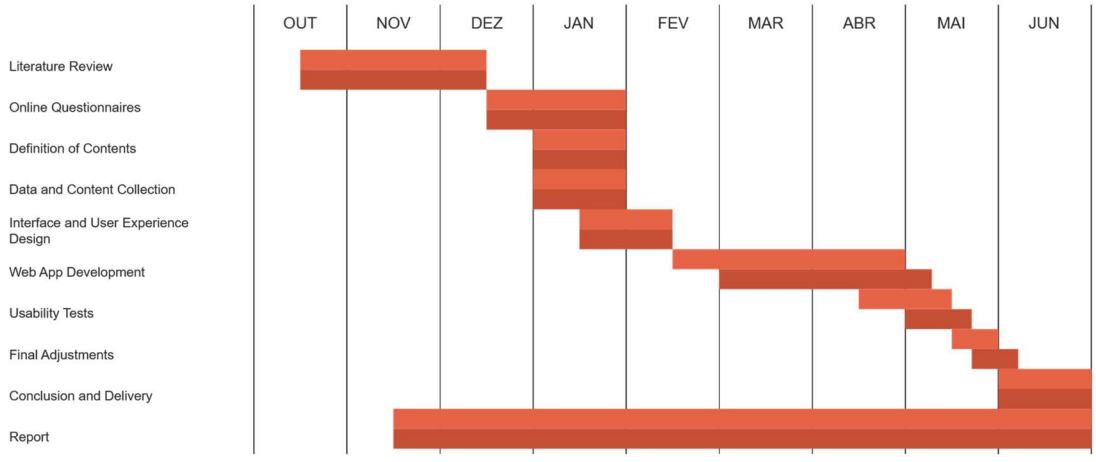

Figure 5 – Project timeline

3.2 Questionnaire design and analysis

The questionnaire was designed to collect valuable data on participants' demographic information, fashion choices and attitudes, and tracking apps. The questionnaire was disseminated through a variety of channels, including an email communication distributed by ESMAD, as well as on Discord groups dedicated to fashion, moreover it was shared on other social media platforms, specifically TikTok. The questionnaire was distributed on the 8th of January 2025 and was available until the 31st of January 2025. A total of 113 respondents completed the questionnaire.

The demographic data, as shown in Table 1, provides an overview of the participants in the survey.

Table 1 – Participants' demographic data

	Absolute Frequency	Relative Frequency
What is your age group?		
Under 18	6	5%
18-24	55	49%
25-34	38	34%
35-44	4	4%
45-54	6	5%
55-64	3	3%
65 or older	1	1%
How do you identify?		
Genderfluid	1	1%
Man	24	29%
Non-binary	4	4%
Woman	84	67%
What is the highest level of education you have completed?		
Bachelor's Degree	38	34%

Doctorate	6	5%
High School Diploma or Equivalent	19	17%
Master's degree	20	18%
Some College	16	14%
Some High School	14	12%

The participants were primarily young adults, with most falling within the 18-24 (n=55, 49%) and 25-34 (n=38, 34%) age groups. The majority of respondents identified as women (n=84, 67%) and were highly educated. Additionally, the majority of participants resided in Portugal (n=89, 79%).

As shown in Figure 6, the participants reported a moderate interest level in fashion (M = 3.51). Additionally, nearly all participants (n=104, 92%) had heard of the term *sustainable fashion*, whereas familiarity with the *circular economy* in a fashion context was lower, with only 36% (n=72) reporting awareness. When asked about the importance of sustainability when shopping for clothes, the participants reported a moderate level of concern (M = 3.08), on a Likert scale ranging from 1 = not important to 5 = extremely important.

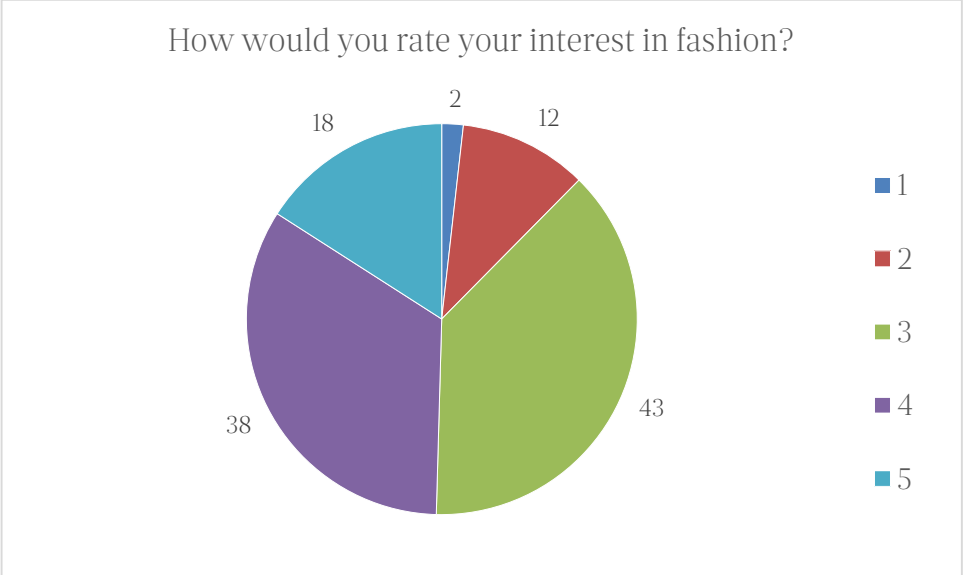

Figure 6 – Participants' interest in fashion

Participants exhibited similar clothing consumption habits, as detailed in Table 2. The most common purchasing frequency was *every 3 months* (n=40, 35%), followed by *every 6 months* (n=31, 27%). Outfit repetition was frequent, with a considerable share repeating outfits *once a week* (n=78, 39%) or *once to twice a month* (n=33, 29%). Very few participants reported repeating outfits less frequently. Regarding clothing retention, the participants indicated they retained their clothing for *more than 5 years* (n=52, 46%) or *3-5 years* (n=42, 37%).

Table 2 – Participants' clothing purchasing and consumption habits

	Absolute Frequency	Relative Frequency
How often do you purchase new clothing?		
Once a week	0	0%
Once a month	23	20%
Every 3 months	40	35%
Every 6 months	31	27%
Once a year	16	14%
Other	3	3%
How often do you repeat outfits?		
Once a week	78	39%
Once to twice a month	33	29%
Every 3-6 months	1	1%
Once a year	0	0%
Never	1	1%
How long do you usually keep clothing before disposing of it?		
Less than 6 months	0	0%
6 months to a year	3	3%
1-2 years	16	14%
3-5 years	42	37%

More than 5 years	52	46%

Additionally, participants were asked about their main reasons for disposing of clothing. Since multiple options could be selected, a total of 233 reasons were recorded. The most prevalent reason was that the clothing was *damaged or worn out* (n=97, 42%) followed by *does not fit anymore* (n=87, 37%), as shown in Figure 7.

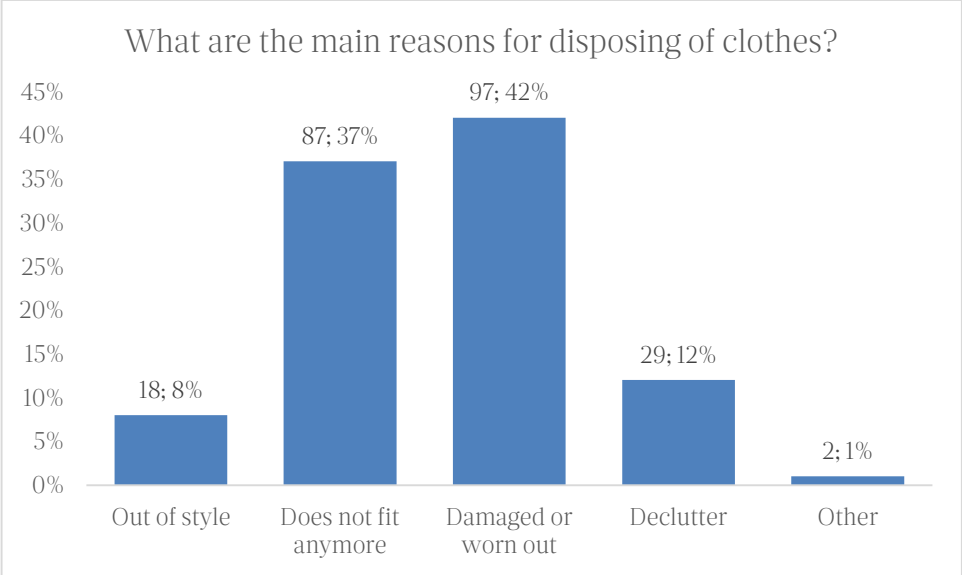

Figure 7 – Participants' reasons for disposing of clothing

Further data was collected on how various factors influence purchasing decisions, with detailed results presented in Table 6 in Appendix A. The results indicate that price, quality, style and comfort are major factors, as at least 65% of respondents rated these factors as *very influential* or *extremely influential*. In contrast, brand, eco-label, country of origin, recommendations from friends and family, trends, and social media were reported to have lower levels of influence. Additional data was collected on the frequency of various sustainable practices. The results presented in Table 7 in Appendix A., indicate that while repair and donation are well integrated into consumer habits, other sustainable practices such as upcycling, patchwork, rent, swap, and sell, were less prevalent.

The final section of the questionnaire examined respondents' use of tracking apps. Only 21% of respondents (n=24) indicated using tracking apps, with *fitness apps*

(n=17, 35%) and *sleep trackers* (n=10, 20%) being the most commonly selected categories. Other selected tracking apps included *mobility apps* (n=8, 16%), *personal finances* (n=8, 16%), *productivity tracker* (n=5, 10%). Additionally, one participant selected *other* (n=1, 2%) and specified a *reading app* under this category. When asked if they have considered using a fashion app, 66% of participants selected *no*, while only 34% selected *yes*. Moreover, data was collected on respondents' interest in various features of a fashion app, as detailed in Table 8 in Appendix A. Using a scale where Not Interested equated to 1 and Extremely Interested to 5, an average score was determined for each feature to ascertain the overall level of interest. The results indicate that the categories received, on average, a moderate level of interest, specifically *planning outfits* (M=3.35), *garment care (washing and repair)* (M=3.34), *organising and categorising clothes* (M=3.28), *receive tips on garment care* (M=3.27), and *personalised recommendations* (M=3.14). In contrast, features such as *educational content* (M=2.95), *tracking item usage* (M=2.54), *gamification (rewards and challenges)* (M=2.38), and *community engagement (share on social media)* (M=2.08) exhibited lower levels of interest.

Finally, the participants were asked to express their feelings on the idea of monitoring their wardrobe. Once more they were permitted to select multiple options and provide their own response. A total of 190 feelings were recorded. The results indicated positive response, with the option that garnered the most interest being *curious about my stats (which clothes I wear most often, colours)* (n=65, 34%), followed by *motivated to see how often I wear certain types of clothes* (n=42, 22%). Nonetheless, the participants also expressed concern and uncertainty, as the options *concerned it might be overwhelming or too time consuming* (n=40, 21%) and *uncertain about its usefulness* (n=27, 14%) also gathered a considerable share of selections. A small percentage of respondents selected *indifferent* (n=13, 7%) and a few also added their own opinion by selecting the option *other* (n=3, 2%).

3.3 Personas

Following the collection and analysis of questionnaire data, two user personas were developed to guide the design and functionality of the application. The questionnaire contained the following question: *Have you ever considered using a*

fashion app? – which served as the foundation for segmenting the respondents. Subsequently a total of 20 participants were selected at random, for each response. The groups were then analysed to extract meaningful insights regarding their preferences, behaviours and, most importantly, interest in certain features for a fashion app. These personas were crafted based on the insights gained. The subsequent tables (Table 3 and Table 4) provide the description for each persona.

Table 3 – Persona 1

Persona 1: Jordan	
 Figure 8 – Persona 1 illustration. Retrieved from Freepik[1].	30 years old Lives in an urban area Fast paced lifestyle, practical, and minimal interest in fashion apps.
Jordan is a practical individual who views clothing as functional necessity, rather than a means of self-expression. They maintain a functional wardrobe that suits their daily activities, prioritising comfort, and price over style, and they are not influenced by trends or social media. Sustainability is moderately important, but they rarely engage in circular economy practices such as upcycling, renting or swapping clothing. Jordan finds fashion apps as overly complicated for their needs.	
Interest in fashion app features (1-5)	
Educational Content	3
Planning outfits	3.1

[1] https://www.freepik.com/free-vector/man-standing-drinking-coffee-character_88416282.htm#fromView=search&page=1&position=0&uuid=08faa44e-cdfd-4c4f-b4b2-84a4dffcf0a6&query=man+illustration

Personalised Recommendations	3.05
Garment Care (washing and repair)	3.45
Community Engagement (share on social media)	1.8
Tracking item usage	2.5
Gamification (rewards and challenges)	1.95
Receive tips on garment care	3.25
Organising and categorising clothes	3.3

Pain points	Motivation
Struggles with keeping their closet organised and ensuring garment care without too much effort. Easily loses interest in complex app features.	Simplicity and efficiency. Jordan prefers clear, practical tools that help them maintain their wardrobe without requiring significant time or effort.

Table 4 – Persona 2

Persona 2: Taylor

25 years old
Lives in an urban area
Fast paced, creative and fashion conscious.

Figure 9 – Persona 2 illustration. Retrieved from Freepik[2].

Taylor is an active fashion enthusiast who is open to using fashion apps for wardrobe management. They are conscious of sustainability but prioritise style and comfort

[2] https://www.freepik.com/free-vector/woman-drinking-coffee-reusable-pot-character_88416366.htm#fromView=search&page=1&position=2&uuid=57eb6bf6-91d4-40d4-b8cd-55c77389d3e6&query=woman-drinking-coffee-reusable-pot-character

when making purchases. Taylor enjoys exploring outfit ideas and prefers having an organised wardrobe. They occasionally engage in circular economy practices, especially donating, repairing, and selling clothes.

Interest in fashion app features (1-5)	
Educational Content	3
Planning outfits	4.2
Personalised Recommendations	4.05
Garment Care (washing and repair)	3.85
Community Engagement (share on social media)	2.35
Tracking item usage	3.2
Gamification (rewards and challenges)	3
Receive tips on garment care	3.95
Organising and categorising clothes	4.05

Pain points	Motivation
Wants to make the most of their wardrobe and ensure that their style remain fresh without buying excessive clothing.	Creative exploration and wardrobe optimisation. Taylor is drawn to features that help them experiment with outfits and maintain their clothing effectively.

While there are some similarities between the personas in terms of their fast-paced urban lifestyles, and moderate interest in sustainability, ultimately, they have distinct goals and objectives. Persona 1, Jordan, seeks simplicity and practicality, valuing a streamlined experience with minimal effort. In contrast, persona 2, Taylor, is motivated by creativity and wardrobe optimisation, preferring features that allow for exploration and style experimentation.

3.4 Summary

The methodology for this project consists of incorporating the six steps of DSRM with UCD tactics, specifically through the use of surveys, in this case a questionnaire, and the development of user personas. The project plan includes a structured timeline, which outlines the main stages of development, from the literature review and consumer insight gathering, to defining app functionality, design, development, and testing.

4 PROJECT DEVELOPMENT

The present section provides a comprehensive overview of the process through which the solution was designed and implemented. The section is organised into five subsections: gamification implementation, page-level interaction analysis of the solution, an overview of the technological stack used in the development, insights from user testing, and a concluding summary.

4.1 Gamification implementation

This subsection describes how gamification elements were implemented within the web app, with the objective of encouraging sustained user engagement and fostering sustainable habits. These elements were informed by a comprehensive literature review.

In accordance with the review conducted by Guillen et al. (2021) of prevalent gamification elements, the project incorporates several key elements, including challenges and missions, a points system, and feedback.

Goals, challenges and missions were implemented in the form of daily challenges, which users must unlock through active interaction with the app. The process of unlocking the challenges, and other locked features, are framed as missions (i.e., complete task X to unlock feature Y), with the objective of encouraging ongoing participation.

The points system was implemented along with the feedback mechanism in the following manner: users receive immediate feedback via a disappearing modal that informs them of the type of points earned after performing an action. Additionally, users have access to a feature that displays the number of points accumulated during the present month, thereby supporting self-monitoring and reinforcing positive behaviour. The points are further connected to a personality which describes the user and how they interact with the solution devised, a feature which was inspired by the gamified solution devised by Oppong-Tawiah et al. (2020) for energy conservation.

Feedback, as highlighted by Wolf (2020) is a mechanism which has an effect on pro-environmental intention and behaviour and is implemented in multiple forms. In addition to the points feedback, users receive contextual warnings when they attempt to

perform an action deemed incompatible with a given event (e.g., in care events, as described in the following subsection). Similarly, users receive a warning when they attempt to exit a challenge before completing it. In both instances, user autonomy is maintained: users are informed of the potential implications of their actions but retain the freedom to proceed as they intend. Furthermore, feedback is also provided in the quiz component, in which users received immediate responses to correct and incorrect answers.

Lastly, ethical considerations were central to the design of gamification elements and other content. Particularly, the content of the tips and quizzes was carefully crafted to avoid the promotion of excessive consumption. This design decision was influenced by Spanellis (2023), who highlighted how gamification has been co-opted by companies to encourage unsustainable consumer behaviour. In contrast, this project aimed to leverage gamification to promote mindful and sustainable actions.

4.2 Page-level interaction analysis

This subsection provides an analysis of the main pages within the web app. The pages are detailed in terms of their role, design choices, user interaction, and how these elements are influenced by the user personas and questionnaire.

Landing page

The web app adopts a user-centric approach, with the landing page (Figure 10) serving as the initial point of contact for the user. In accordance with transparency principles identified in the literature review, the page aims to avoid manipulative patterns while communicating the purpose and objectives of the platform. The layout provides a concise overview of the features available on the platform as well as access points for either login or registration (Figure 10). Following successful authentication users are redirected to the dashboard.

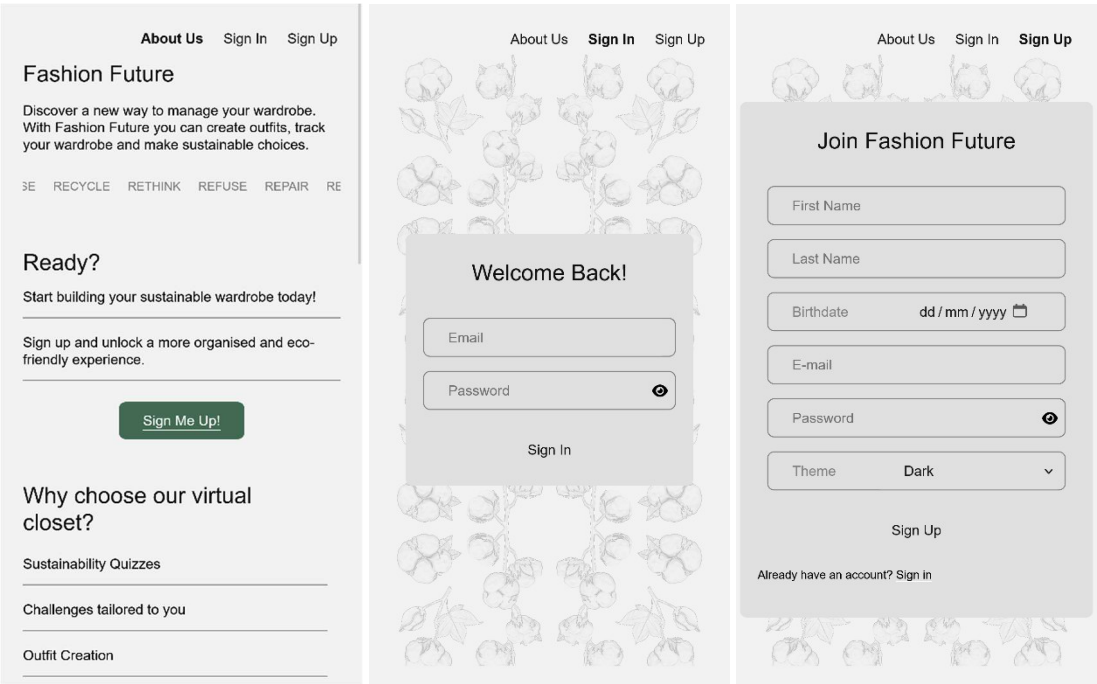

Figure 10 - Fashion Future landing page (left), login screen (centre), and registration screen (right)

Dashboard

The dashboard is intended to function as a central hub displaying the streak, daily quiz, challenge, and tip, as well as the user personality. As depicted in Figure 11, the interface implements a card-based grid layout. All cards, except for the streak card, incorporate user interaction, whereby the card expands for further interaction, or the user is redirected to the pertinent page.

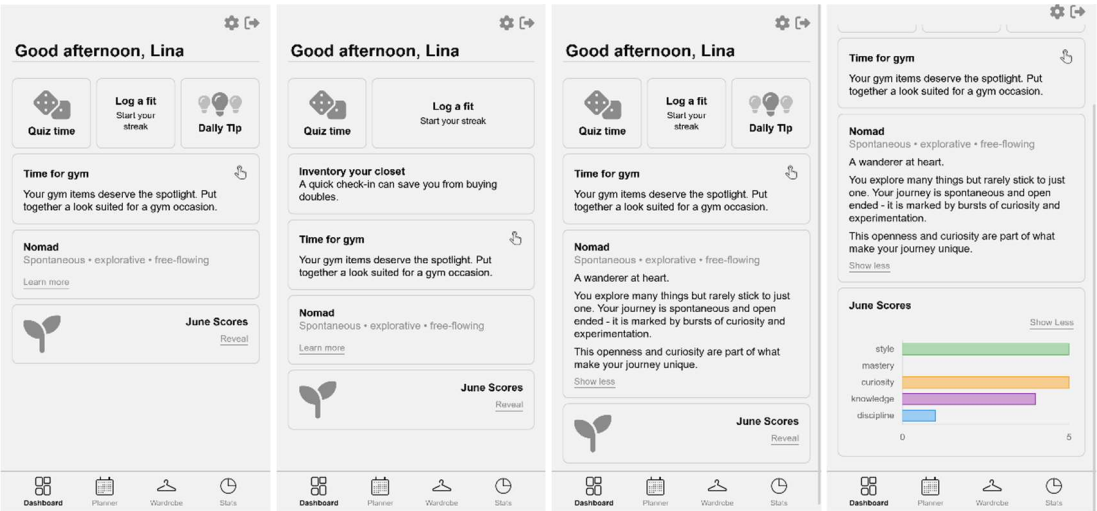

Figure 11 – Dashboard page

The streak feature was implemented to monitor the number of consecutive days a user logged their outfits. This feature was designed to encourage consistent engagement by providing a visual indicator of user activity.

The daily quiz was designed to assess and refine the users' knowledge on sustainability-related topics. These topics include but are not limited to the following: circular economy practices, laundry and garments care, and the environmental impact of specific practices. Although the set of questions is common to all users, the system adapts to the user by removing questions that have been answered correctly in a consistent manner. This ensures that the quizzes remain challenging without becoming repetitive. Furthermore, complex questions are paired with simpler, more intuitive answer options, thus creating an experience that balances difficulty with accessibility. In order to further clarify the scope and structure of the content, a selection of sample quiz questions and their corresponding answer options is provided in Table 9 (see Appendix B).

Each quiz comprises a maximum of six questions, an approach intended support user engagement without inducing fatigue. This design approach was informed by the data from the user personas, both of which indicated a moderate interest in educational content on an app. Furthermore, in consideration of the preference for straight-forward, low commitment interactions from persona 1, the quiz is presented in an expanded format directly on the dashboard. A design choice intended to minimise page changes or redirects and preserve the user's flow allowing them to seamlessly engage with the quiz without unnecessary navigation. By temporarily clearing the remaining elements of the dashboard, during quiz activity, the design aimed to further enhance user concentration and potentially facilitate a smoother uninterrupted learning experience.

On the dashboard, the users are also presented with a daily tip, which is derived from a collection encompassing various themes including garment care, energy conservation, waste reduction, among other concerns. The aforementioned tips are directed towards behaviours identified in the survey (Table 7) as being infrequently adopted. The tips provide actionable information on these matters to address the identified gaps. The tips are presented in a structured format, with a primary call-to-action (henceforth referred to as CTA) followed by a short description. While the tips are

not personalised to the user, they provide general guidance aligned with the focus of the app. The following are illustrative examples of the aforementioned tips:

1. “Thrift while traveling: It makes for the best souvenirs.”
2. “Add layers instead of heat: Cozy up without cranking the thermostat.”
3. “Carry a repair kit: Great for travel or fashion emergencies.”
4. “Explore upcycling for old clothes: Get creative and give your pieces a second life.”

The objective of the quizzes and tips is twofold: to educate users on the importance of environmentally conscious behaviour, and to motivate them to act in an eco-friendly manner. Moreover, it is imperative to acknowledge that while artificial intelligence, specifically ChatGPT, was employed as a tool to assist in the generation of some of the questions, answers, and tips, the author defined the specific topics to be addressed and carefully curated the content. The content was then reviewed and edited by the author to ensure clarity, accuracy and relevance.

The dashboard also facilitates the daily visualisation and completion of challenges. This feature is initially locked, and to unlock it, the user must log a specific number of outfits, which was set to five. The challenges were designed to promote diverse usage of clothing and garment care through two distinct types of challenges: (1) clothing challenges and (2) care challenges.

With regard to clothing challenges the system identifies underused clothing items based on their attributes (e.g., colour, occasion, category). The items are then displayed to the user as challenge items, and the user is required to incorporate one of those items into a new outfit to complete the challenge and earn points. The challenge aims to encourage a balanced use of the user’s wardrobe.

The latter type of challenges, the care challenges, prompts users to record details from the care labels of their clothing items. The system highlights the garments for which this information is absent, and in order to complete the challenge, the user must select one of these items and record the care label information. The objective of this challenge type is to motivate users to document care instructions, thereby promoting greater attention to care information and maintenance.

The challenge system was designed not only to promote diverse clothing usage and garment care but also to address two critical features valued at different degrees, by

both user personas – specifically garment care (washing and repair) and outfit planning. For persona 1, the care challenges are straightforward and quick to complete. In the context of persona 2, the clothing challenges are a solution devised which incorporate fashion creativity, with outfit planning and wardrobe rotation.

As a contingency, an initial version of the challenges was designed, where users would complete challenges by ticking a checkbox. This approach was developed as a provisional measure, while the final interactive challenge system was being designed. The checkbox-based system was not intended to be the final outcome. From the outset, the objective was to develop an engaging challenge experience through user interaction. The final version, presented above, is aligned with this vision, transforming the challenges into meaningful, user-driven tasks that enhance educational and motivational values.

Lastly, within the dashboard, the users gain access to their personality, which, like the challenges, is initially locked. In order to unlock this feature, it is necessary for the user to engage with the app through activities such as participation in quizzes, completion of challenges, and logging of outfits. These activities enable users to accumulate points and reveal their identity once they reach 10 points.

Pending the unlocking of the personality, the current points of the user are displayed in lieu of the personality, thereby providing feedback on their progress. Upon attaining the requisite number of points, the personality that most closely aligns with their engagement style is revealed. This personality profile is accompanied by a chart that visually represents the distribution of the distinct types of points earned within the month. These points are categorised into the following types: knowledge, mastery, discipline, curiosity, and style.

The absence of a traditional level system is a deliberate choice, shifting the focus from competition to self-awareness and personal growth. This approach is further supported by the user personas, which indicated a low interest in community engagement, and a low to moderate interest in gamification. As a result, gamification was intentionally focused on specific elements.

Whilst the dashboard presents information and activities for the current day, the subsequent planner page extends this functionality by highlighting the current day and also allowing users to navigate across dates.

Planner page

The planner page provides users with a broader perspective, enabling them to manage wardrobe activities across multiple days. The planner page functions in the following manner: positioned at the top of the page is a horizontal calendar view, which displays the months, and their respective days. Users can seamlessly navigate through these dates, with the current or selected day distinctly highlighted for ease of reference. The layout maintains a balanced design, providing ample space for the core features, while ensuring that all relevant information is accessible within a compact, visually clear layout, as shown in Figure 12.

The main section of the page initially presents two CTA: one for adding an outfit, and another for adding a care event. It is important to mention that both CTA change daily. Additionally, ChatGPT was utilised to assist in the generation of the initial CTA text, the suggestions were subsequently reviewed and refined by the author. Once an outfit, or care event is added, the corresponding CTA card is replaced by the newly created event, maintaining a clear and focused layout. In addition to the main CTAs, an action button is integrated within the bottom navigation bar. When tapped, this button triggers a modal which offers the aforementioned functionalities as buttons. This design choice allows the user to add multiple outfits or care events for the selected day, without overcrowding the main section of the page.

To create an outfit the user may either tap the CTA or access the option via the action button. With this action the users are presented with a grid layout of their clothing items, as shown in Figure 12. To create an outfit, they must select clothing items and save their selection. The outfit created is then displayed in the planner. The initial vision for the outfit creation process aimed to encourage user creativity by enabling the user to arrange the selected items freely on the screen. This approach was intended to provide a visual and interactive outfit creation experience. However, the approach was ultimately adjusted due to time constraints. The final implementation adopts a streamlined design thereby maintaining the core functionality while ensuring ease of use.

For the care event, the user must select from the various care activities, ranging from washing to drying, save these options and then select the garments associated with the event. Each care activity option is represented by an icon that aligns with the

standard garment care symbols found on clothing labels. Beneath each symbol, a small label is presented to facilitate the selection of the appropriate option. The decision to incorporate icons and labels for care activities was driven by the objective of enhancing ease of use, as with this approach the users are not required to have prior knowledge about the symbols' meanings. Additionally, the approach aims to streamline the user experience and empower them to make informed decisions without the need for external research or guesswork.

Once the care event settings are selected, the user is presented with a grid displaying all their clothing items, as displayed in Figure 12. When available, each item in the grid is accompanied by its corresponding care label icons, providing a clear guidance on the recommended care instructions for that garment. In the absence of user-recorded information a message is displayed in place of the icons. Users can then select the items they wish to include in the care event, in instances where the selected item is incompatible with the selected care settings, a warning message is displayed to prevent improper care. The user is then given the option to either retain the item or remove it from the selection. Items that lack care label information are treated as compatible by default – a necessary contingency to avoid obstructing the user experience, but one that may not always accurately reflect the garment's care requirements. After the care event is saved, it is displayed on the planner page.

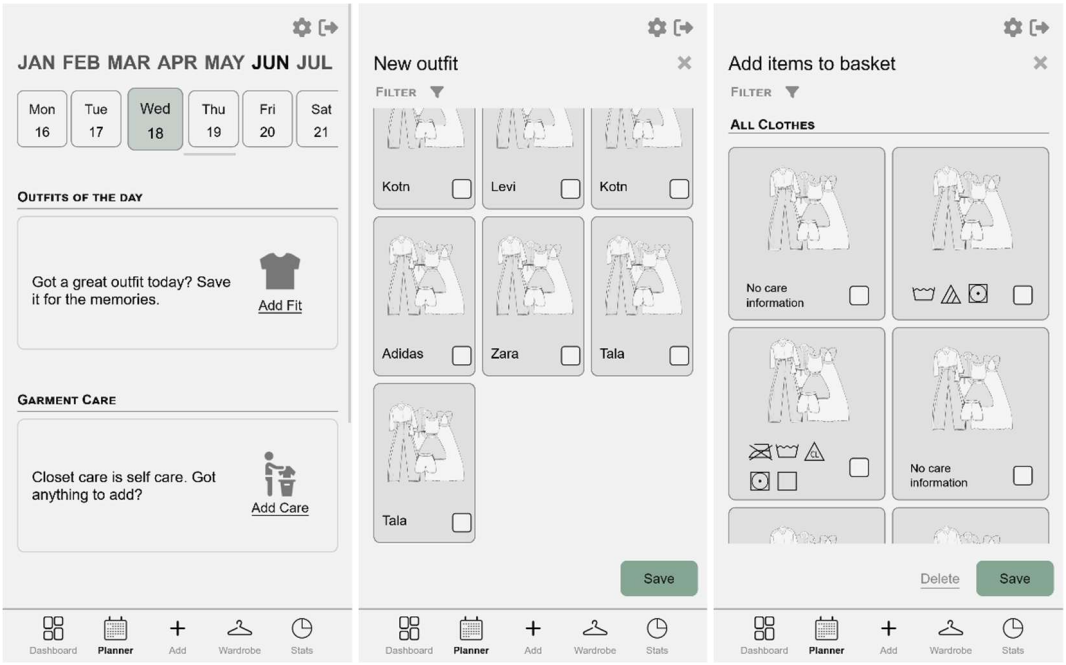

Figure 12 – Planner page (left), outfit item selection (centre) and care event item selection (right)

The planner page aims to balance simplicity and functionality catering to both user personas. To effectively create outfits, or add care events, users must first populate their wardrobe with clothing items, a process facilitated in the wardrobe page – the hub for clothing management.

Wardrobe page

The wardrobe page functions as the central location for users to manage their clothing items. On this page, users can add new items by filling in a form, as shown in Figure 13, in which they can input, and select details, such as brand, category, colour, occasion, among other attributes. Moreover, the users are able upload a photo of the item, and record the care label information, by selecting the appropriate icons. The items are then presented in a grid format, with each item visually represented by the image uploaded and the item's brand. In instances where an image was not provided, or is unavailable, a generic fallback illustration, crafted by the author, is displayed. Furthermore, users have the option to tap on any item to access its full details, make edits, or delete the item. This organisation of clothing items supports the planner page, as the quality of the care events and outfit selection relies on the information recorded by the user.

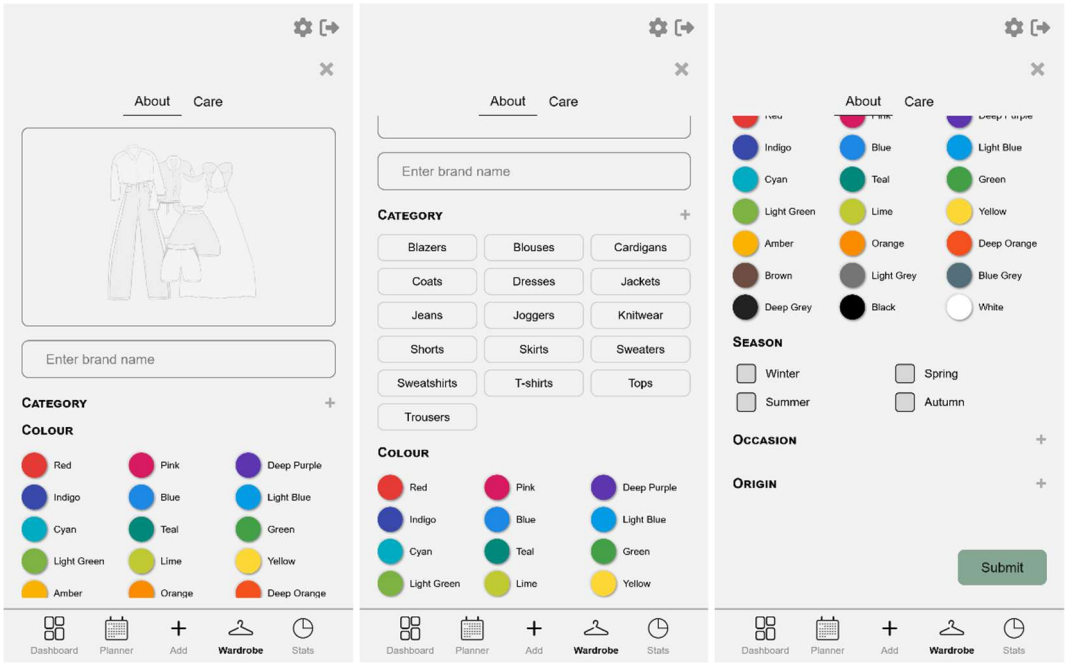

Figure 13 – Virtual item form

While the dashboard and planner pages support daily management and activities, and the wardrobe provides item control, the subsequent statistics page (referred to as the stats page within the app) offers users a deeper understanding of their wardrobe habits.

Statistics page

The statistics page comprises two groups of statistical insights, as displayed in Figure 14, each of which is subject to specific conditions that must be met to be unlocked. The design and functionality of the page is directly aligned with the data from the user personas. Both sets of data revealed curiosity about statistical information.

The first group provides general wardrobe statistics, visually representing the composition of the user's clothing collection. The statistics are displayed in a series of charts, either doughnut or bar charts, created using Chart.js. The charts present the quantity of clothing items aggregated by the different clothing attributes. In order to maintain a focused design, the section is locked and is only unlocked once the user has added 10 items to their wardrobe. In lieu of the charts, the current number of items is displayed in a card, along with a button that invites users to add items to the wardrobe.

The second group of statistical information focuses on item usage, showing how frequently different clothing attributes are worn. Rather than displaying individual item usage, or clothing items, this section aggregates wear data by attribute. For instance, if items tagged with the summer season are worn 20 times while those labelled winter are worn 50 times, the chart will reflect these totals, highlighting which attributes are most frequently worn. To unlock this section, it is necessary for the user to have a minimum of 20 clothing items that are featured in outfits.

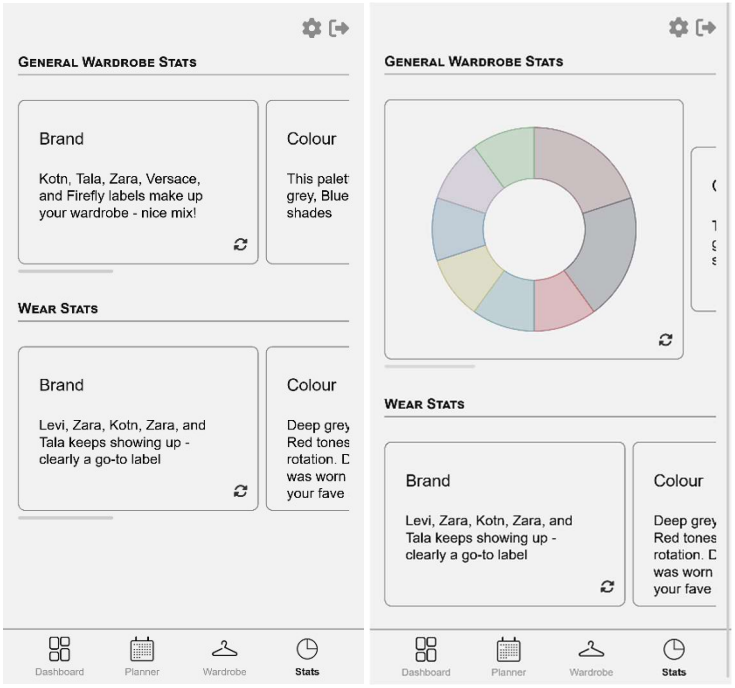

Figure 14 – Stats page.

The charts in both sections are initially presented as summary cards providing brief insights drawn from the data. Users can flip each card to reveal the detailed chart. This approach is intended to prevent the page from appearing visually overwhelming, while maintaining a clear focus on actionable insights. The summarised insights were generated with the assistance of ChatGPT and subsequently reviewed and refined by the author.

4.3 Technological stack

The development of the web app was supported by a carefully selected technology stack. The front end was constructed on the foundations of HTML5, CSS3, and JavaScript. Furthermore, Bootstrap 5 was integrated. However, an alternative approach was adopted in lieu of reliance on inline utility classes. Core design tokens, specifically colours, spacing, and corner radii, were redefined via CSS custom properties in a global stylesheet, with the application of these through semantic CSS classes and some IDs. A selection of icons was made from FontAwesome and Icon8 while the remaining icons were crafted by the author. Moreover, Chart.JS was integrated to facilitate the generation of dynamic, interactive charts that present user data in a clear and visual format.

Supabase was selected as the backend solution for its seamless integration and built-in authentication services. Moreover, the RESTful API endpoints simplified CRUD (Create/Read/Update/Delete) operations while the underlying relational schema – defined through tables, with primary and foreign keys, ensured data organisation. Overall, Supabase was found to be a highly effective solution, which combined ease of integration with a comprehensive feature set for data and user management.

The development workflow was anchored in Visual Studio Code. For rapid inspection of layouts, the Mozilla Firefox Responsive Design Mode was employed. Furthermore, for on-device and cross browser layout validation, the Python HTTP server was utilised. This solution enabled a more accurate depiction of layouts on mobile browsers without the necessity for additional tools; it is imperative to note that no user data was transmitted through this server.

4.4 User testing

The user testing phase was designed as an initial validation step for the developed web app, with the primary objective of gathering macro-level insights into the overall user experience and perceived functionality. The approach adopted was unmoderated and unstructured, with participants invited to freely explore the app and subsequently complete a questionnaire. The open-ended nature of the test aligned with the early stage of development, at which point the objective was not to perform detailed usability analysis, but rather to assess general sentiment, identify any critical blockers, and validate the core proposition of the solution.

The materials used for the evaluation included the web app link [3] and a questionnaire. These were distributed via Discord communities dedicated to fashion, and through TikTok. The testing period took place between the 23rd of May 2025 and the 2nd of June 2025. A total of 19 participants completed the questionnaire, however the data from one respondent was excluded from the analysis due to uniform responses. The participants were predominantly women, with an age range of 24-35 years (n=13, 72%).

[3] https://linax14.github.io/fashion-future/

The questionnaire comprised the standard User Experience Questionnaire (UEQ) along with four additional questions: two demographic items, and two, optional, open-ended questions. The UEQ results indicate that the solution was positively received, with the web app performing favourably in comparison to established benchmarks across key dimensions of user experience (see Table 5). These findings provide a strong initial validation of the solution's design and concept.

Table 5 – UEQ scale scores and benchmark comparison

Scale	Mean	Comparison to benchmark
Attractiveness	1.94	Excellent
Perspicuity	1.58	Above Average
Efficiency	1.71	Good
Dependability	1.58	Good
Stimulation	1.82	Excellent
Novelty	1.53	Good

In relation to the qualitative feedback, the two open-ended questions captured subjective impressions and suggestions. Regarding the first question: "Did you find the content clear, relevant and helpful?", the responses revealed strong positive sentiment. The participants highlighted the app's practicality and ease of understanding, responding to the question in the following manner: (R3) "Yes, very helpful and useful for keeping track and planning my wardrobe"; (R13) "Relevant and educational"; and (R9) "I found it easy to read and understand. It a hook of what the website is about on the top of the page which is great. I like the set up."

Some users also responded to the question with minor critiques, the substance of which was as follows: (R4) "Yes, but there were so many sections it was abit overwhelming at first glance" and (R18) "I found it hard to take pictures of the clothes and download them to the app.". Whilst the positive responses validate the content strategy and clarity, which are aligned with the UEQ's high scores in Perspicuity (1.58) and Attractiveness (1.94), the critiques indicate the potential for optimisation of the first-

time user experience as well as to improve task-specific instructions. Both of which could be addressed with a guided tutorial.

The second question: “Got any thoughts or suggestions? We'd love to hear them!” proved particularly valuable in identifying previously unrecognised usability issues and other opportunities for enhancement. The evaluation uncovered a critical visibility issue with the quiz’s answer-reveal functionality. Despite the implementation of a button beneath the quiz content, the analysis revealed that at least one participant failed to locate this functionality, as evidenced by the following suggestion: (R2) “On the quiz when the answer is wrong, show the correct answer at the same time.”. To address this issue, the interface was modified by: (1) repositioning the button higher in the viewport, and (2) reducing the required scroll distance, as shown in Figure 15.

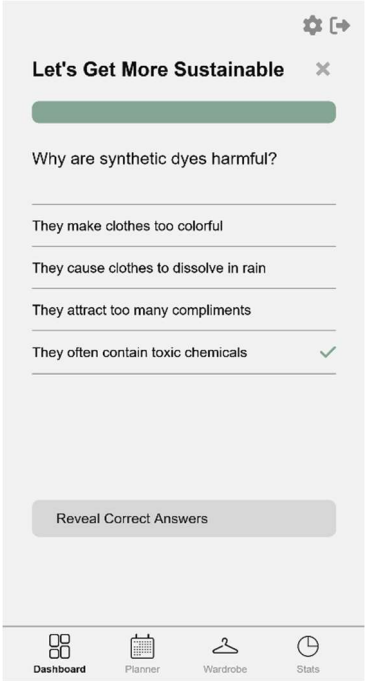

Figure 15 – Quiz interface: revised position of the answer reveal button

Furthermore, accessibility concerns were highlighted by a colourblind user who struggled with colour selection. Their suggestion to implement (R6) “different themes for accessibility”, was partially addressed by introducing colour labels in all relevant selection sections, as shown in Figure 16 .

Additionally, future iterations could expand on this by introducing customisable themes as a dual-purpose approach to both accessibility and personalisation. Given that

fashion is inherently personal, the web app could be adapted to reflect the user's individual style and aesthetics. This approach would simultaneously address participant feedback requesting more colours to make the interface (R9) "more enticing" as well as more (R13) "engaging and exciting".

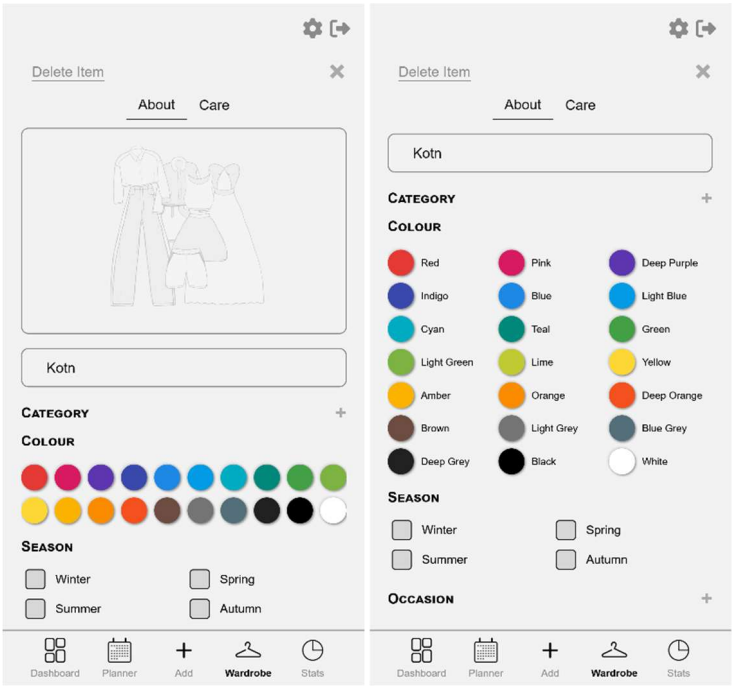

Figure 16 – Colour selection element: original version (left) and accessibility enhanced version with labels (right)

Lastly, one participant proposed multilingual support, a feature that would significantly broaden the reach of the app to non-English speakers.

4.5 Summary

The design of the solution was significantly guided by insights derived from the questionnaire, user personas, and literature review. The solution designed places a strong emphasis on intrinsic motivation, leveraging light gamification elements, to foster user interaction and promote sustainable behaviour. The decision to employ gamification without incorporating badge systems, leaderboards, levels, among other gamification elements, was a deliberate attempt to explore an alternative approach to this highly personal and reflective experience. The use of streaks, challenges, quizzes,

points, and personality profiles, aims to foster a perception of progression without the introduction of a competitive layer. This approach aims to prioritise learning, self-awareness, and habit formation over external rewards.

While the user testing was constrained by its unstructured and unmoderated format, and had limited ability to assess task efficiency, it nonetheless provided valuable data to assess the overall experience and sentiment. Although these limitations restrict the depth of insight, the findings still support the core proposition and highlight opportunities for refinement. Future iterations could benefit from structured, task-oriented testing and moderated sessions to gain deeper understanding. Despite the drawbacks, the results validate the current design direction but also provide a roadmap for iterative development.

CONCLUSION

This project sets out to address the pressing environmental challenges posed by the rapid production and consumption of fashion items and by unsustainable fashion habits, by designing and developing a web-based solution that promotes sustainability and informed wardrobe habits. Grounded in DSRM and informed by UCD, the solution was developed with the aim of bridging the gap between awareness and actionable behavioural change. From the outset, the motivation for this project stemmed from the recognition that while consumers are increasingly aware of fashion's environmental toll, many still struggle to translate that awareness into tangible and lasting behavioural changes.

By incorporating light gamification – streaks, challenges, quizzes, and personality profiles – the app sought to foster intrinsic motivation and transform wardrobe management from a passive task into an engaging and rewarding experience. The various pages, and functionalities, were designed to support both ease of use and depth of interaction, in order to cater to the diverse user needs. While limited, the positive UEQ results from testing revealed valuable insights. The web app achieved its technical objectives such as providing insights into wardrobe composition and fostering daily interaction, through features like outfit logging and quizzes. However, a key limitation was identified during the development process: the app's reliance on self-reported data which may lead to user fatigue during the initial wardrobe population phase. Future iterations could address this challenge by implementing features such as image recognition to reduce manual input.

Looking ahead, two key development pathways emerge. First, future expansions could broaden the reach of the app by introducing multilingual support, customisable themes for improved accessibility and personalisation, enhanced virtual item and outfit-creation functionalities, and tips and quizzes based on clothing usage behaviour and clothing attributes. Second, the platform could evolve into a comprehensive sustainable fashion hub by integrating location-based services for clothing rental shops and platforms, swap events, and donation centres.

This potential evolution aligns with Schiaroli et al (2024), who divide the use stage of fashion into personal use and collaborative use. While the solution devised

focuses primarily on personal use, future development could support collaborative practices, thereby addressing and supporting responsible fashion behaviours across the use stage. Additionally, longitudinal testing should be conducted to evaluate the solution's long-term effectiveness in cultivating lasting eco-conscious habits, streamlining wardrobe management and reducing textile waste.

In hindsight, the visual identity and overall design could have been more fully developed to convey a stronger sense of personality and aesthetic distinctiveness. While user feedback indicated a preference for more colour, it also underscores broader opportunities to strengthen the visual narrative. Similarly, the time invested in contingency handling in the challenge feature may have been more productively utilised in enhancing the creativity and flexibility of the outfit creation functionality. Looking back, it is evident that there was an opportunity to assume greater creative risks and adopt a more comprehensive and strategic approach during the development process.

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APPENDICES

Appendix A

Table 6 – Factors that influence clothing purchasing decisions

	Not influential at all		Slightly influential		Moderately influential		Very influential		Extremely Influential	
	n	%	n	%	n	%	n	%	n	%
Price	1	1%	3	3%	24	21%	51	45%	34	30%
Quality	2	2%	4	4%	31	27%	57	50%	19	17%
Style	2	2%	8	7%	27	24%	46	41%	30	27%
Comfort	1	1%	3	3%	19	17%	56	50%	34	30%
Brand	29	26%	44	39%	35	31%	5	4%	0	0%
Eco-Label	25	22%	42	37%	30	27%	15	13%	1	1%
Country of Origin	56	50%	31	27%	20	18%	5	4%	1	1%
Recommendation from friends and family	28	25%	34	30%	36	32%	10	9%	5	4%
Trends	36	32%	41	36%	29	26%	6	5%	1	1%
Social Media	41	36%	32	28%	29	26%	9	8%	2	2%

Table 7 – Sustainable fashion practices

	Never		Rarely		Sometimes		Frequently		Very Frequently	
	n	%	n	%	n	%	n	%	n	%
Upcycling	32	28%	31	27%	40	35%	7	6%	3	3%
Patchwork	55	49%	30	27%	23	20%	3	3%	2	2%
Donate	4	4%	9	8%	30	27%	44	39%	26	23%
Rent	96	85%	9	8%	7	6%	0	0%	1	1%
Repair	5	4%	22	19%	34	30%	33	29%	19	17%
Swap	39	35%	21	19%	27	24%	14	12%	12	11%
Sell	45	40%	17	15%	20	18%	14	12%	17	15%

Table 8 – Features interest on a fashion app

	Not Interested		Slightly Interested		Moderately Interested		Very Interested		Extremely Interested	
	n	%	n	%	n	%	n	%	n	%
Educational Content	10	9%	28	25%	42	37%	24	21%	9	8%
Planning outfits	10	9%	18	16%	27	24%	39	35%	19	17%
Personalised Recommendations	11	10%	25	22%	30	27%	31	27%	16	14%
Garment Care (washing and repair)	8	7%	20	18%	31	27%	34	30%	20	18%
Community Engagement (share on social media)	50	44%	24	21%	24	21%	10	9%	5	4%
Tracking item usage	28	25%	32	28%	25	22%	20	18%	8	7%
Gamification (rewards and challenges)	37	33%	29	26%	23	20%	15	13%	9	8%
Receive tips on garment care	8	7%	26	23%	24	21%	38	34%	17	15%
Organising and categorising clothes	9	8%	26	23%	24	21%	32	28%	22	19%

Appendix B

Table 9 – Sample quiz questions and answers

Question	Answers
What is fast fashion?	• Retail model that prioritises high quality and timeless designs • Quick production of garments at low prices • A type of clothing made from sustainable materials • A clothing style that focuses on exclusive and luxurious designs
What happens if you use too much detergent?	• Clothes come out cleaner • Clothes can get damaged • Clothes smell extra fresh • The washing machine works better
What's the best way to do the laundry when you've got a lot of clothes to get through?	• Always overload the machine to save water and detergent • Wash everything together in one large load to save time • Aim for smaller loads more often to ensure better cleaning and avoid overloading • Wash only a few items at a time to save energy
What's the best way to deal with stains before washing clothes?	• Wash at higher temperatures • Add extra detergent to the wash • Use a stain remover or pre-treatment • Wash immediately without treating the stain
What is patchwork?	• A method of dying fabrics to create patterns • A style of garment that uses only one type of fabric • A way to create new garments by tearing old ones apart • A technique of stitching together small pieces of fabric to create a larger piece
What practice helps extend the life of garments and reduces the need to buy new clothes?	• Freezing clothes • Repairing and mending • Weekly wardrobe rotation • Bulk purchases

Which innovation helps reduce fashion waste?	• 3D-printed clothing made to order • Making all clothes out of edible materials • Inventing a "clothing eraser" to vanish unwanted outfits • Selling invisible clothes to save fabric
What is "slow fashion"?	• Designing high-quality, long-lasting clothing • Only wearing clothes in slow motion • A trend where people walk slowly in fashion shows • A brand that takes 6 months to ship orders
What is one benefit of fashion rental services?	• Ensures wardrobe variety instantly • Provides fast turnaround trends • Reduces overconsumption • Requires frequent purchases for eligibility
What benefit does modular clothing design offer?	• Built-in reinforced seams • Textiles with temporary adhesives • Limited edition labels • Garment parts can be reconfigured
What’s a sustainable way to treat oil stains?	• Spraying with synthetic stain removers • Rubbing with baking soda and vinegar paste • Soaking in bleach overnight • Freezing the garment
What’s the best way to store neckties to prevent wrinkles?	• Rolling into a ball • Ironing before storage • Hanging on a tie rack • Folding tightly in drawers
How often should you wash jeans to maintain their quality?	• After every wear • Every 10+ wears (spot clean as needed) • Only when visibly stained • Weekly and with extra detergent
Which detergent type is gentlest on fabrics and the environment?	• Liquid detergent with synthetic fragrances • Powdered detergent with optical brighteners • Plant-based, biodegradable detergent • Bleach-based detergent

How should you store woollens to prevent moth damage?	• In plastic bags with mothballs • Folded in airtight containers with cedar blocks • Hanging in damp closets • Wrapped in newspaper