Sustainability-Driven Consumer Experience Design of an Online Retail System for Household Appliances

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Abstract

INTRODUCTION: Mobile-based platforms have become essential in information system design. This study examines how a household appliance brand incorporates sustainable responsibility into the consumer experience of a retail mobile application through experience design.

OBJECTIVES: The primary objective is to develop sustainable consumer experience design strategies that promote the adoption of environmentally friendly consumption behaviours, benefiting the environment, public life, and brand values.

METHODS: Quantitative and qualitative methods were used, including user interviews, surveys, and in-depth interviews. This research explored sustainability comprehension, consumption demands, habits, and expectations. Design strategies were derived through insight clustering analysis, considering information, interaction, and marketing.

RESULTS: The research showcased sustainable consumer experience design through interface and interaction design of a retail mobile application. Usability and consumer experience tests confirmed the design's effectiveness in improving the application.

CONCLUSION: Three key elements for sustainable retail mobile system design were identified: highlighting product sustainability, enhancing consumer autonomy and competence, and aligning marketing with sustainable values.

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1. Introduction

Sustainable development is widely acknowledged as a prominent future societal trend, prompting companies in various industries to prioritize it in their strategic planning [1]. Advancements in household appliances have brought forth critical environmental and societal challenges. Consequently, household appliance brands are transitioning towards sustainability to promote sustainable resource utilization and harmonious human development.

The dissemination of sustainable concepts by these brands is pivotal, with online media serving as a platform for dialogue, interaction, and maintaining relationships with consumers [2]. Household appliance brands therefore have an opportunity to innovate consumer experiences and communicate sustainable values.

With a focus on sustainability, we conducted design research of consumer experiences in the context of online retail systems for household appliances. Following user-centred research approach [3], we offer guidance for developing sustainability-driven design strategies and implementing design solutions. Taking brand Midea as an example, our study formulated the information architecture and interface interaction prototypes of the retail mobile application, conducted prototype testing, and ultimately delivered specific design strategies.

2. Related research

Sustainability-driven consumer experience design resides at the intersection of two distinct research domains: persuasive design and mobile application experience design.

2.1. Persuasive design

Persuasive design, originating from the interdisciplinary field of captology (computers as persuasive technologies), was introduced by BJ Fogg as a combination of psychology and computer science aimed at influencing user behaviour through persuasion and social influence, rather than coercion [4] [5].

The term "behaviour change support system" (BCSS), inspired by persuasive technology, was coined by Oinas-Kukkonen. It is defined as an "information system designed to shape, modify, or strengthen attitudes and behaviours without resorting to deceit, force, or incentives" [6] [7].

In the domain of information system design, web- and mobile-based platforms play a crucial role. The widespread use of smartphones offers an opportunity to implement behaviour-change interventions on a large scale and at a lower cost [8], with the mobile domain identified as the future platform for persuasion and behaviour change [9].

Recent applications of Fogg's model have focused on environmental sustainability, addressing various issues such as energy consumption, water and fuel use, indoor air quality, and transportation [10] [11]. Design strategies tailored to reducing CO_2 emissions include organizing groups, ensuring anonymity, facilitating mutual surveillance, cultivating mutual aid, and combining positive and negative feedback [12]. For promoting sustainable travel behavior through mobile apps, persuasive strategies such as social comparison, normative influence, competition, and recognition have been identified [13]. Additionally, persuasive design principles for sustainable energy use include four key components: observing cause-and-effect links, providing performance-tracking systems, offering timely suggestions, and presenting visually attractive praise [14].

2.2. Mobile application experience design

The acceptance of a mobile application is influenced by the perceived quality of user experience [15]. In understanding user experience elements in internet products, Zhao [16] introduces the EPI model, which incorporates expectations, process, and impact as primary elements. Online user experience comprises four essential ingredients: branding, usability, functionality, and content [17]. Creating a positive direct experience through application design is crucial for effective brand establishment [18]. Personalization, identifiability, and perceived enjoyment of mobile services have significant positive impacts on brand equity, including loyalty, perceived quality, awareness, and associations [19].

Application usability includes effectiveness, efficiency, satisfaction, learnability, memorability, error handling, and cognitive load [20]. Holtzblatt emphasizes the importance of designing applications that users can effortlessly enjoy, without training or assistance, by adapting the contextual design and customer-centred design processes [21].

Brauer et al. identify five functions of Green apps: informing, transforming, educating, collaborating, and gamifying [22]. These apps enable sense-making, sustainable practices, and participation while fostering reassessment, behavior conditioning, and work virtualization. They also contribute to outcome assessment, belief formation, and action formation processes in environmental sustainability [23].

According to Boiano, Bowen, and Gaia, mobile app information content encompasses various types, including text, images, audio, video, maps, and social features [24]. Chen, Meservy, and Gillenson highlight that the quality of mobile app information, which includes factors such as timeliness, relevance, and overall quality, positively influences the perceived usefulness, user confirmation, and intention to continue using mobile apps [25].

3. User study

This research utilized a user-centred design research approach, integrating both quantitative and qualitative methods. The methodology involved preliminary user

interviews, surveys, and in-depth interviews to gather comprehensive user information, uncover latent needs, and develop customized design strategies. Subsequently, the design strategies informed the development of a design proposal, which was ultimately evaluated. Figure 1 shows the design research process.

The design research process

Figure 1. The design research process

3.1. Preliminary user interviews

To investigate the experiential touchpoints associated with the three stages of "consumption expectation, consumption process, and consumption impact," initial investigations were conducted through in-home and telephonic interviews. The interview questions focused on the following areas:

 (i) User purchasing habits for household appliances, such as information channels utilized, preferences, product comparisons, purchasing challenges, and post-purchase service experiences.
 (ii) User awareness of online experiences with sustainable-driven household appliance brands, including engagement in environmentally and socially meaningful consumption behaviours and evaluations of current online services.
(iii) Expectations for service content and experiences, including the relevance of existing content to sustainable development concepts, desired content and experiences, and the reasons behind these preferences.
(iv) The recorded responses from 25 interviewees were organized and summarized in an Excel spreadsheet. A total of 33 pain points or demands were identified and categorized into six main aspects: online information search, product comparison, purchase decision-making, payment and purchase, after-sales service, and feedback experiences.

3.2. Questionnaire survey

The questionnaire consisted of four sections: (1) user information, (2) consumer behavior and habits, (3) perception of sustainable consumption, and (4) perception and expectation of online experiences with sustainable-driven household appliance brands. The questionnaire comprised 18 questions, including various question types such as single-choice, multiple-choice, ranking, and combined multiple-choice and open-ended questions.

A total of 228 valid questionnaires were collected, with 128 male and 100 female respondents. The age range mainly included users above 20, representing various occupations such as students, salespeople, marketing/public relations personnel, managers, and technical/research and development professionals. The findings are as follows:

 (i) Over 90.0% of users proactively search for home appliance information online when they have a purchase need.
 (ii) Brand online stores (87.5%) and official brand websites (75.0%) were the primary sources of product and brand information, while 43.8% of users obtained information through brand-specific mobile apps.
(iii) Regarding recycling, 62.5% of users were aware of the recyclability of their purchased home appliances, but only 12.5% knew how to access recycling services.
(iv) Over 60% of users had a positive impression of brands embodying brand culture and social responsibility, with nearly 90.0% believing that an environmentally and socially impactful consumption experience would leave a good impression.
 (v) Additionally, nearly 70.0% of users considered a humanized service experience to be impactful.

These findings underscore the significance of environmentally and socially beneficial features, as well as a humanized consumption experience, in the online context of household appliance brands.

3.3. In-depth user interviews

The interviews targeted individuals aged 24-55 with online product experience, focusing on economic stability, purchasing needs, and awareness of energy efficiency, environmental protection, and sustainable consumption. Priority was given to users familiar with relevant apps, websites, and brand WeChat accounts. Six typical users were interviewed to ensure effective research outcomes.

The objectives of the in-depth interviews were threefold: firstly, to explore users' awareness of sustainable development concepts and their influence on consumer preferences and habits, contributing to user profiling; secondly, to identify typical users' online shopping paths for home appliances, uncovering their consumption habits and demands; lastly, to understand users' awareness of sustainability attributes and preferences for related experiences.

Key findings from the in-depth user interviews were as follows:

(i) Users prioritize energy-efficient and environmentally friendly products that align with their values, preferring responsible brands.
(ii) The visual style and appeal of brand online platforms significantly impact users' consumption experience.
(iii) Users generally have limited awareness of the sustainable value concepts promoted by home appliance brands.
(iv) Technical terminology used to display information, such as energy efficiency ratings and power consumption parameters, poses challenges for user comprehension.
(v) Home appliance brands lack differentiation in consumer experiences, resulting in limited brand recognition among consumers.

3.4. Insight extraction

We analysed the data from preliminary user interviews, questionnaire survey and in-depth user interviews. The analysis of the online consumer experience resulted in clustering dimensions, guiding the identification of design opportunities, and generating preliminary ideas (Figure 2).

Expectation stage
The Expectation Stage comprises 10 key insights related to brand and product understanding, awareness and social image, lifestyle, and value realization. During this stage, users form initial impressions, develop brand awareness, and consider lifestyle attitudes and values.

Process stage
The Process Stage includes 15 key insights, reflecting the process of users developing initial purchase intentions and making consumption decisions. Insights in this stage can be clustered into three categories: product guidance and information display, auxiliary information for decision-making, and services and benefits related to the purchase decision.

Impact stage
The Impact and Feedback Stage encompasses 11 key insights, primarily focusing on users' post-purchase experience needs for home appliance products. This includes aspects of usage and operation, service acquisition, feedback on sustainable consumption behavior, and the dissemination of sustainable consumption concepts.

The design opportunities derived from these insights are as follows:

(i) Content design oriented towards the demands of sustainable consumption.
(ii) Effective presentation of product sustainability attributes information.
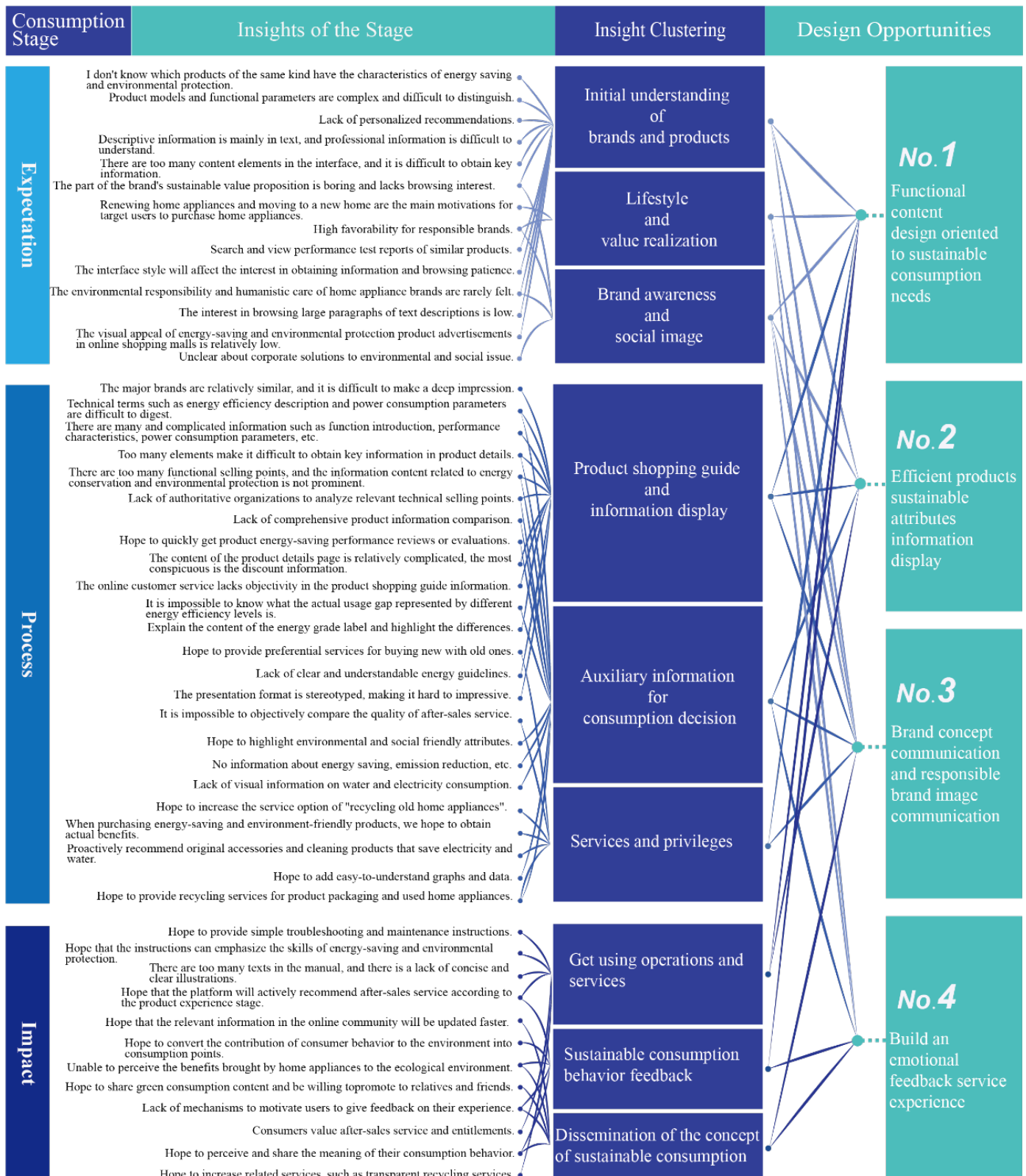(iii) Incorporation of brand philosophy and storytelling related to sustainable actions.

(iv) Creation of emotionally captivating service experiences driven by feedback.

Figure 2. User study insights

4. Design strategies

Design strategies were formulated for Midea's online retail platform, with an emphasis on functional information, interactive experiences, and sustainable brand marketing interactions.

4.1. Emphasizing product sustainability attributes

The information design strategy places emphasis on the sustainable attributes of the product by addressing content pathways for information acquisition, forms of information presentation, and data visualization. It considers user demands for sustainable attribute content and the characteristics of product information.

Facilitating quick decision-making through adverse information assistance

(i) Providing intuitive information comparisons
Enable users to compare key details intuitively. For instance, simplify and integrate information on the product details page, reduce informational distractions, and visually present the sustainable performance advantages and distinctive features of products through charts. This allows users to make informed comparisons of the sustainability attributes of their intended products.

(ii) Visualizing data information
Visualizing brand sustainability actions and the sustainable attributes of home appliance products helps consumers understand the brand's environmental contributions. Representing annual energy consumption as cards or tooltips during product comparisons provides vivid cues for users to assess energy efficiency. This directs attention to sustainable attributes and facilitates visual energy efficiency comparisons among similar products.

Optimizing functional information layout for the gradual presentation of sustainable attributes

To effectively display home appliance product sustainability attributes, emphasize them by considering their proportion to other basic information in the online platform design. Extract and highlight core attribute information, such as energy consumption, recycling, and reuse, using engaging multimedia content like animations and videos.

Concisely explaining technical parameters

When designing technical information on online retail platforms, consider users' limited knowledge of sustainable development and home appliances. Use simple language and visuals to explain product information, reduce technical terminology, and provide explanatory notes if needed. Simplifying and making information relatable enhances user satisfaction by reducing cognitive load and negative emotions.

Enhancing the visual perception of sustainable attribute information to highlight characteristics

(i) Enhancing visual hierarchy for important information distinction
Optimize the information hierarchy of online retail platforms and adhere to application guidelines for color schemes and font styles across different visual hierarchies to provide visual emphasis on key information.

(ii) Including differentiated designs for sustainable attribute information
Differentiate sustainable attribute information for brands and products in online consumer experiences driven by a sense of sustainability. Incorporate consumer sustainable consumption psychology models and attribute characteristics for detailed design.

(iii) Harmonizing brand visual perception across touchpoints
Unify sustainable content visually in the online consumer journey by blending brand visual identity with sustainable values.

4.2. Enhancing sustainable consumption interactive experience

The enhancement of the sustainable online shopping experience involves addressing the challenges users face in comprehending product sustainability and establishing impactful interactions. This is achieved through the introduction of innovative pathways that align with users' aspirations for sustainable consumption, optimizing the purchase process, and fostering memorable experiences.

Enabling multiple access paths to targeted content

To facilitate the transition from sustainable consumption awareness to behaviour, online platforms for home appliance brands should provide multiple pathways for accessing product sustainability attributes. This can be achieved by incorporating dedicated sections, recommended product lists, and search bar functionality with relevant keywords. By offering diverse consumption paths throughout the online journey, users are guided towards sustainable choices while enhancing the brand's image as environmentally and socially responsible.

Creating clear page information architecture and hierarchy

The information architecture and hierarchy on mobile platforms significantly impact users' interaction steps in accessing information and services. Considering user scenarios on the Midea online platform, it is essential to reorganize and rearrange the existing architecture and hierarchy to cater to the characteristics of mobile applications.

Using interactive methods to highlight sustainable features in information presentation

Utilizing immersive context images as full-screen banners on the homepage creates a sense of involvement and service scenarios for users. Adopting a card-based product information display directs users' attention to key product details, emphasizing the brand's professionalism and efficiency concept.

Enhancing emotional experiences through persuasive design

Incorporating emotional design elements during the pre-purchase phase to engage users and promote sustainable behaviours, such as incentivizing energy-saving practices and maintenance activities. Persuasive design enhances user experience, fosters a sense of achievement, and encourages sharing.

4.3. Aligning marketing design strategies with sustainable values

The brand-consumer relationship progresses from unawareness to intimacy through brand communication and marketing efforts, encompassing stages of awareness, attention, interest, desire, action, and repeat purchase. Current online marketing strategies used by domestic home appliance brands primarily focus on discount promotions and coupon distribution to stimulate purchases. Additionally, they leverage video advertisements that tap into users' emotions and values to shape brand perception.

Creating marketing materials reflecting the brand's environmental and social attitudes

Marketing materials should revolve around sustainability's core principles and actions. This involves designing various interactive formats, such as interactive H5, short animations, and videos, for promotional advertisements, app interfaces, and sharing interfaces. The design process should integrate popular aesthetics, incorporating trendy visual elements and interactive formats, to make sustainable consumption appealing and aligned with a distinctive attitude.

Promoting user sharing through emotionally captivating green marketing interactive content

(i) Designing interactive content customized for stages of various consumer needs

To cater to users' needs and emotions throughout the consumer journey, interactive marketing content for the Midea online retail system was designed. This enhanced user interest and engagement. For instance, in the anticipation phase, create entertaining games with environmental and social themes. Offer brand coupons linked to sustainable consumption actions, like buying energy-efficient appliances or accessing professional cleaning services, to incentivize sustainable behaviour. In the post-purchase phase, express gratitude and encouragement through online thank-you letters, reinforcing emotional satisfaction and value alignment.

(ii) Designing reward mechanisms to stimulate user sharing

Create a reward system for registered users (members) on the Midea online retail platform, in addition to brand coupons and after-sales service incentives. This system includes green consumption points, achievement levels, badges, titles, and other honorary feedback to boost users' sense of achievement. By considering users' purchase history, appliance usage, and accumulated green consumption points, differentiate their achievement levels and membership benefits. Show exclusive titles and achievement levels in brand communities and social discussion platforms. Utilize users' aspirations to showcase their sustainable consumption accomplishments to encourage engagement in discussions and sharing experience.

5. Design proposal

5.1. Sustainable home appliance online retail system

The sustainable-driven online retail system for household appliances goes beyond traditional models, involving stakeholders such as users, online platforms, logistics, customer service, data centres providing environmental support, appliance recycling services, and environmental organizations. By integrating sustainable values, the system enhances the consumer journey through features like synchronized appliance data for recycling, valuation details, pickup services, and collaborations. This conveys the brand's commitment to environmental and social responsibility throughout the entire consumer journey.

When users use appliance recycling services, the information on the appliances is synchronized from the data centre to the recycling service organization. The organization estimates the value of the appliances based on their reuse potential. The brand displays the valuation details and recycling progress to users on the online retail platform. Users can access recycling services based on appliance size and model, including doorstep pickup, recycling centre information, and facility links.

The brand conveys its commitment to environmental and social sustainability to users throughout the entire consumer journey, from pre-purchase to post-purchase, through online platform features, services, and collaborations with stakeholders (Figure 3).
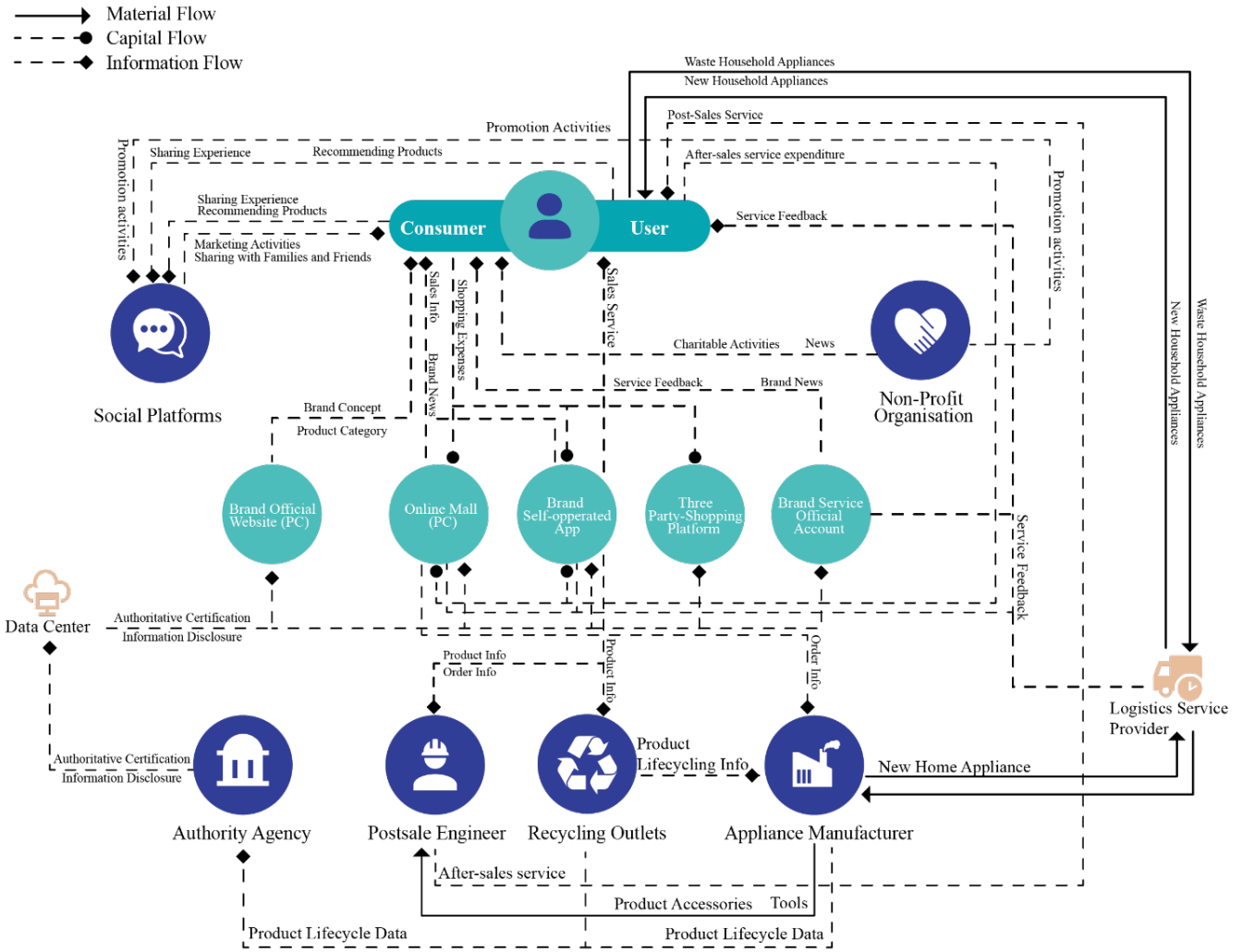
Figure 3. The online retail system for household appliances

5.2. Household appliance online retail service blueprint

To provide a holistic consumer experience, home appliance brands must plan for backend and offline services in addition to the online store. We analyze the design elements of sustainable-driven online consumer experience from perspectives on user behaviour, frontend, and backend services. The household appliance online retail service blueprint is shown in Figure 4.
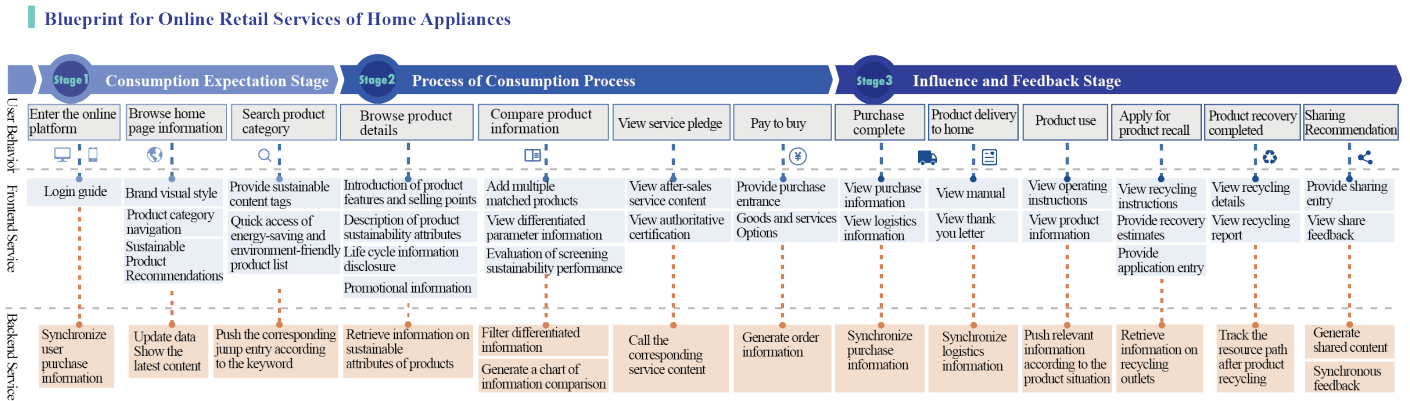
Figure 4. Household appliance online retail service blueprint

5.3. APP core workflow design

The information architecture design of the household appliance retail service App is shown in Figure 5.
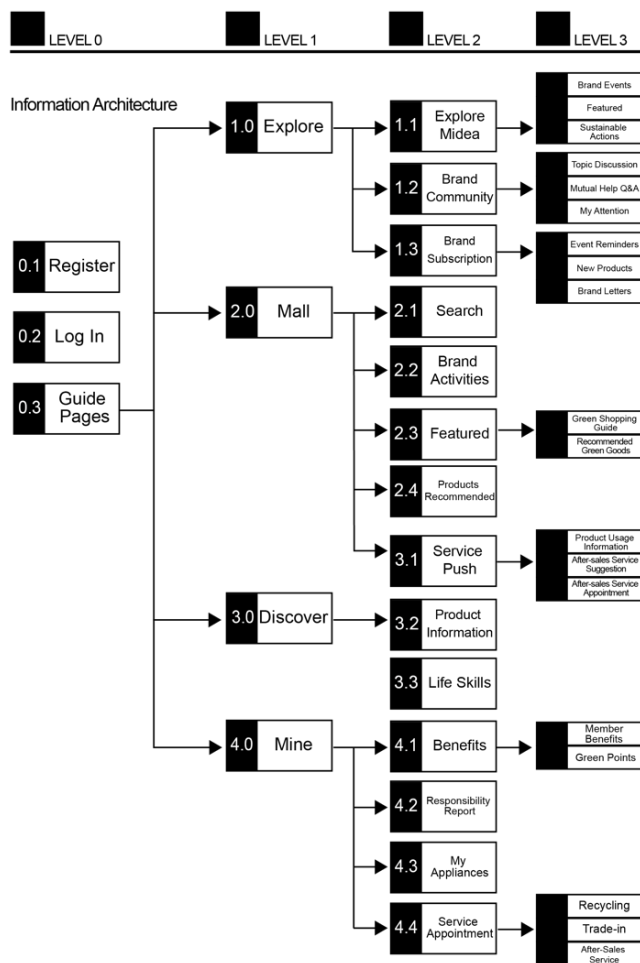

Figure 5. The information architecture of household appliance retail service App

Engage in online green marketing interactions with the brand

Green marketing interactions are a crucial feature of Midea's app driven by a sense of sustainable responsibility. On the homepage of the brand exploration section, full-screen cards are displayed to promote online materials related to green marketing activities. When users click on them, they can participate in interactive experiences through engaging content like H5 games and interactive animations. During the interactive process, appropriate guidance on Midea's home appliances is provided to encourage conversion and consumption (Figure 6&7). Additionally, by demonstrating sustainable actions and recommending green purchasing options, we enhance consumers' perception of brand responsibility and commitment (Figure 8&9).
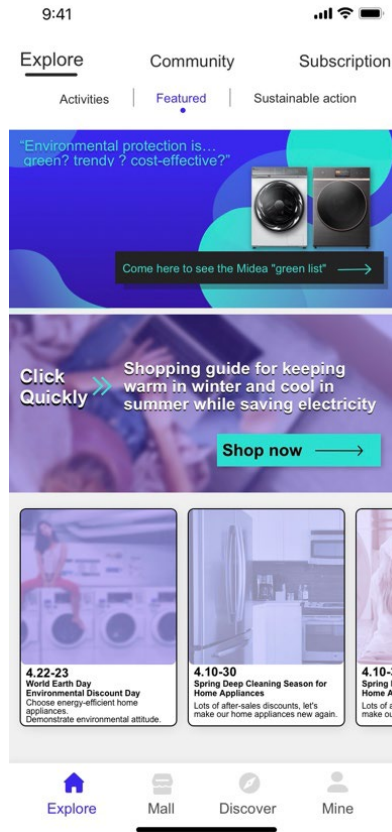
Figure 6. Green marketing activities
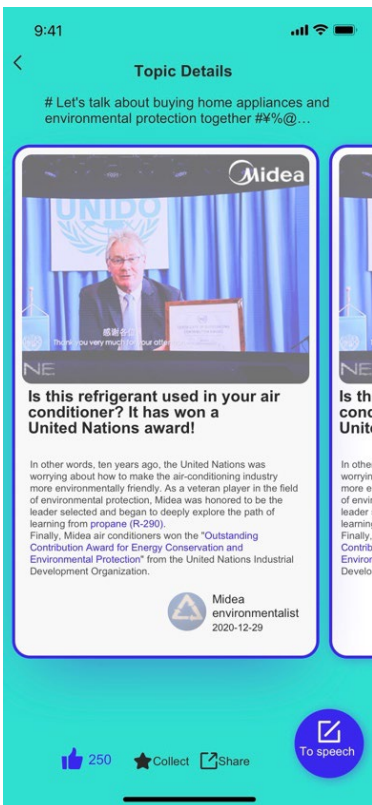

Figure 8. Green purchase solution

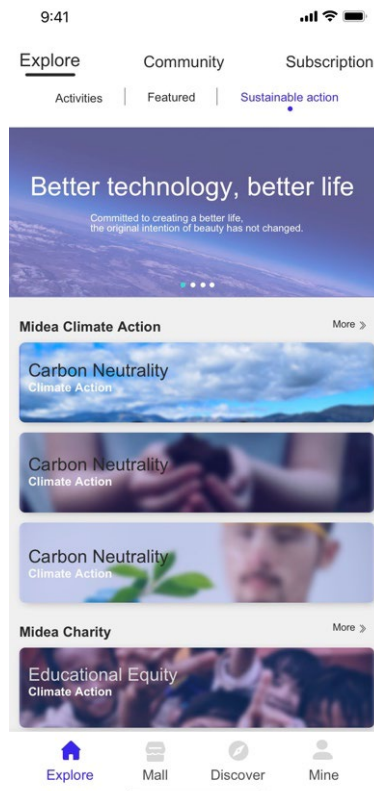**Figure 7.** Green marketing conversation

Figure 9. Brand sustainable action

Purchasing sustainable household appliances

User research indicates that users tend to overlook the sustainable attributes of products displayed in online stores, which diminishes their significance in the purchasing decision. However, these users emphasize sustainability when using and recommending such products to others, showcasing their values. To address this, it is crucial to integrate and categorize sustainable features, patents, and performance advantages on the product details page, highlighting key sustainability-related content (Figure 10). Additionally, designing a brand appreciation letter on the payment success page encourages user sharing, expressing gratitude, and stimulating engagement (Figure 11). This approach enhances users' value recognition and emotional satisfaction and expands Midea's reach in sustainable responsibility.

Figure 10. Product sustainable features

Figure 11. A brand appreciation letter

Service push for after-sales demand tracking

Curated information and service notifications play a significant role in cultivating users' awareness of sustainable consumption and fostering good home appliance usage habits. The environmentally responsible report leverages synchronized household appliance purchase information and product lifecycle data to deliver targeted information and after-sales services to users (Figure 12). For appliances with longer usage periods, self-diagnostic and deep cleaning services as well as consultations are recommended. Additionally, for aged appliances nearing the end of their lifespan, users are provided with suggestions and application access for product recycling (Figure 13).
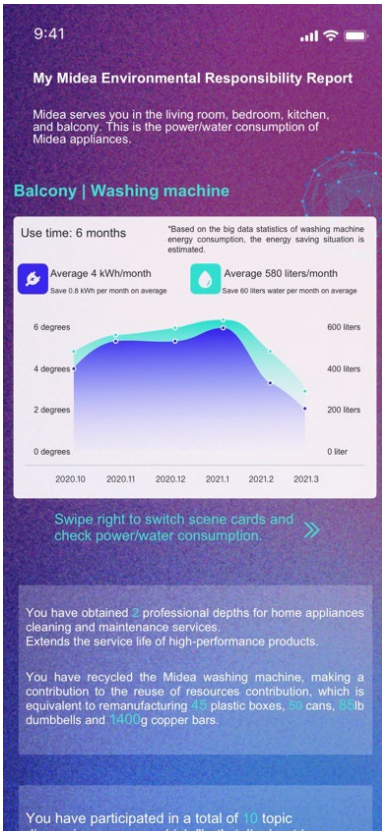
Figure 12. The environmentally responsible report

Figure 13. Old household appliance recycling

6. Evaluation

To validate the effectiveness of the design solutions, the evaluation in this study was divided into two parts: 1) App usability testing and 2) App sustainable consumption experience testing.

6.1. App usability testing

This study involved six representative and typical users in testing the prototype interface. During the testing process, the researchers observed and recorded users' actions while they completed assigned tasks (Figure 14). Users were also asked about their doubts and difficulties encountered during the operation. After the six participants completed the designated tasks, the researchers utilized the System Usability Scale (SUS) to assess users' perceptions of the prototype interface's usability and user-friendliness. The evaluation criteria included the rationality of information hierarchy and functional layout, as well as the ease of locating core functions, receiving feedback, and understanding prompt messages. The process is illustrated in the figure.

Figure 14. The usability test

Results

The identified issues in the user interface include excessive text information leading to poor readability, inadequate visibility of product energy efficiency information, lack of explanation on green points and membership benefits, difficulty in understanding plain text labels, insufficient prominence of sustainable consumption information on the purchase page, unclear hierarchical classification of functions, limited visibility of the brand's commitment to the environment during production and transportation, unfamiliarity with the content of social responsibility reports and energy guides, preference for more videos and animations in product details, infrequent usage of the home appliance app, desire for marketing interaction integration with the official account, and difficulty in locating reviewed thank you notes (Table 1).

Table 1. Summary of usability issues for prototype testing

No.	Issue	Priority
1	Excessive text information leading to poor readability.	★★★★★
2	Inadequate visibility of product energy efficiency information.	★★★★
3	Lack of explanation on green points and membership benefits.	★★
4	Difficulty in understanding plain text labels.	★★★★
5	Insufficient prominence of sustainable consumption information on the purchase page.	★★★★★
6	Unclear hierarchical classification of functions.	★★★★★
7	Limited visibility of the brand's commitment to the environment during production and transportation.	★★★★★
8	Unfamiliarity with the content of social responsibility reports and energy guides.	★★★
9	Preference for more videos and animations in product details.	★★★★
10	Infrequent usage of the home appliance app and desire for marketing interaction integration with the official account.	★★★
11	Difficulty in locating reviewed thank you notes.	★★★

6.2. App sustainable consumption experience testing

This study recruited 18 participants who were invited to use the demo version of the mobile application and subsequently complete a questionnaire assessing their experience with sustainable consumption. The questionnaire consisted of two parts. The first part evaluated participants' levels of agreement regarding six design strategies for consumer sustainable experience: 1) encouraging user engagement in sharing green marketing campaigns, 2) encouraging users to participate in brand community discussions, 3) assisting users in selecting eco-friendly solutions and promoting sustainable consumption, 4) inspiring users through emotional experiences, 5) enabling users to perceive the brand's dedication to sustainability, and 6) addressing users' personalized after-sales needs. The second part utilized the Self-Determination Scale, consisting of four subscales: intrinsic regulation, identified regulation, integrated regulation, and external regulation, comprising 12 items.

Results

The Cronbach's α coefficient value of 0.937 indicates excellent reliability for the questionnaire. The consumer sustainable experience design strategy received an average score of 3.6 to 4.1 out of 5 (Figure 15). Among the tested strategies, "meeting users' personalized after-sales needs" achieved the highest score of 4.1, followed by "inspiring users with emotional experiences" with a score of 4. The lowest two scores were observed for "encouraging users to engage in brand community discussions" (3.6) and "encouraging users to share green marketing campaigns" (3.7).

The average score for all indicators on the Self-Determination Scale is 3.7 out of 5, ranging from 3.1 to 4.2. The top three indicators are "I want others to perceive me as someone with a sustainable mindset" (4.2), "Using apps like the aforementioned one is something I am willing to do" (4.1), and "I can learn about sustainable development related to household appliances from apps like the aforementioned one" (4). On the other hand, the lowest two indicators are "I would feel disappointed if I don't use apps like the aforementioned one" (3.1) and "If I stop using apps like the aforementioned one, I would feel less confident about my ability to consume electronics sustainably" (3.2).

The average interclass correlation coefficient (ICC) values for the following constructs are as follows: intrinsic regulation ($0.92 > 0.75$), identified regulation ($0.83 > 0.75$), introjected regulation ($0.51 < 0.75$), and external regulation ($0.77 > 0.75$). With the exception of the introjected regulation construct, the other constructs exhibit high-reliability consistency.
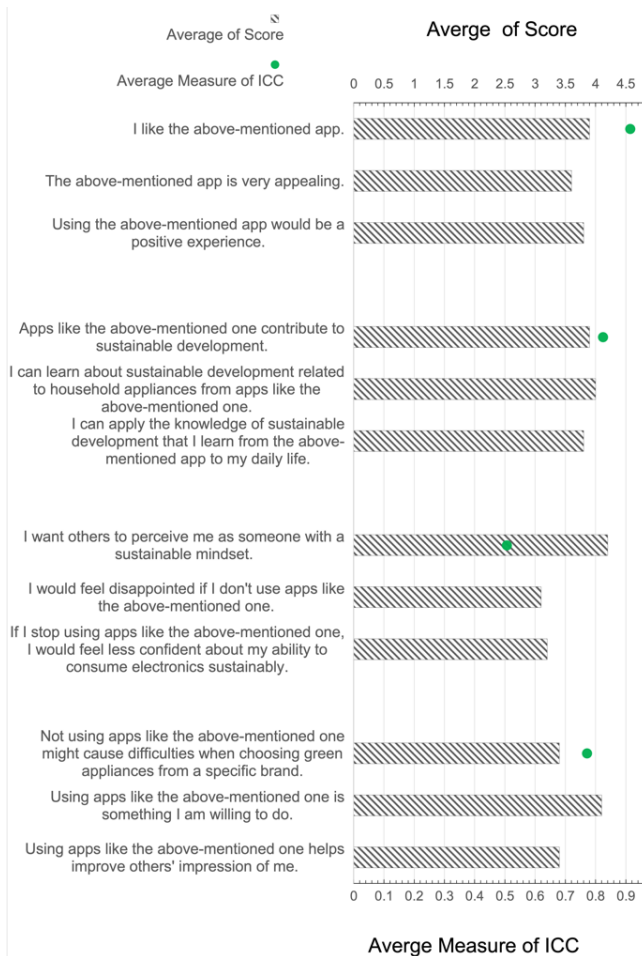
Figure 15. The user experience evaluation results

7. Discussion

This section presents the findings of user research and evaluation results for the design proposal based on the three stages of the consumer experience: expectation, progress, and impact.

7.1. Expectation stage

User research reveals that stimulating purchase motivation and providing necessary information are crucial design objectives during the expectation stage. The design proposal aimed to engage consumers through green marketing campaigns and brand community discussions. However, the evaluation results indicate that these strategies were not particularly effective. Instead, presenting a brand's sustainable actions to convey responsibility and commitment proved slightly more successful. Consumers are more interested in brand reputation, product information, green purchasing options, highlighted lifestyle, and brand value when encountering a brand, rather than brand green activities.

Self-Determination Theory posits that intrinsic motivation necessitates the promotion of internalization and integration of values and behavioral regulations. Internalization refers to "the process of accepting a value or rule," while integration is "the more complete process by which individuals transform the rules into ones that are more fully their own, such that they emanate from their sense of self. In Expectation stage, to first provide information users eager to know helps to strengthen user experience of autonomy and thus facilitate the process of internalization and integration of sustainable values and behavioral regulations.

7.2. Progress stage

Within the progress stage, three significant components were identified through user research: comparison between different solutions, service experience, and completion of payment. The consumer experience evaluation demonstrates that the design strategy of assisting users in selecting green solutions and guiding them towards sustainable consumption worked well. Key design features contributing to its effectiveness include recommending green purchasing options, integrating energy efficiency performance advantages, intuitively displaying product energy efficiency information, conducting green promotional activities, and providing guidance for recycling old devices and packaging.

According to the FBM (Fogg's Behavior Model), ability is one of the three factors that contribute to a person performing the desired behavior [5]. The design strategy of assisting users in selecting green solutions through content, user operation, and social activities can facilitate sustainable consumption.

7.3. Impact stage

User research highlights service support and post-purchase service as key components during the impact stage. The consumer experience evaluation reveals that the design strategies of inspiring users with emotional experiences and meeting users personalized after-sales needs were the most successful among all the strategies. Design features such as sustainable consumption feedback in the form of brand thank-you notes and user-specific environmental responsibility reports enhanced the effectiveness of the "inspiring users with emotional experiences" strategy. Similarly, design features like personalized after-sales service recommendations, extended home appliance information updates, and old appliance recycling services contributed to the effectiveness of the "meeting users' personalized after-sales needs" strategy.

Inspiring users with emotional experiences and meeting users' personalized after-sales needs align with the principles of persuasive design for sustainable energy use, such as offering timely suggestions and presenting visually attractive praise [14]. Positive experiences have a

substantial impact on brand loyalty and contribute to maintaining long-term sustainable behavior change [19].

In summary, the user research and evaluation of the design proposal indicate several aspects to consider in design practice: 1) clear understanding of brand promise and responsibility, 2) intuitive comprehension of product energy efficiency performance, 3) seamless purchase of energy-saving and environmentally friendly products, 4) access to transparent product life cycle information, 5) comprehensive after-sales service and feedback, 6) incorporation of environmental factors into consumption decisions, and 7) reinforcement of sustainable consumption awareness and behaviour transformation.

8. Conclusion

This study conducted in-depth user research to explore consumers' sustainable awareness, consumption demands, behaviour habits, and experience expectations. Through insight clustering analysis, design strategies and solutions were derived in the areas of functional information, interactive experience, and marketing interaction. The aim was to help home appliance brands communicate their concepts, shape a sustainable brand image, and promote sustainable consumption behaviours. The study focused on the Midea online retail platform, particularly on the mobile app. Design strategies were proposed to emphasize product sustainability attributes, enhance the interactive design for a sustainable consumption experience, and align brand marketing with sustainable value concepts.

However, this study has the following limitations:

(i) The practical outputs mainly focused on the mobile app, requiring further research on sustainable content in the entire online and offline consumption experience.

(ii) The study primarily emphasized the expression of sustainable responsibility at the environmental level, calling for deeper and more systematic research on the relationship between sustainable responsibility and brand-related content.

For future studies, it may be beneficial to expand the scope to encompass the entire online and offline consumption experience of household appliances or other types of products. Additionally, incorporating societal and economic sustainability into content design could provide further value.

Another potential direction for future studies could be the integration of emerging technologies such as artificial intelligence, machine learning, or blockchain into the mobile application. This integration has the potential to enhance the personalized sustainable consumer experience even further.

Also, it would be valuable for future studies to provide practical guidance and considerations for organizations looking to adopt and implement sustainable consumer experience design in their mobile applications. This could

include discussing the necessary steps, resources, and considerations involved in incorporating sustainability into the design process.

Acknowledgements

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