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RESEARCH ARTICLE /ARAŞTIRMA MAKALESİ

KEY REQUIREMENTS IN MOBILE BANKING: DESIGN FOR SUSTAINABLE DECISION-MAKING

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Abstract

Sustainability has become a practical necessity rather than a theoretical ideal because of increasing environmental challenges and consumption-driven lifestyles. In this context, user experience (UX) design offers significant potential to support sustainable habit formation through digital behavior-change interventions. Mobile banking applications, which are widely adopted tools embedded in everyday financial routines, provide a suitable environment for integrating sustainability-oriented interaction mechanisms. This study aims to identify key design requirements that support sustainable decision-making in mobile banking applications and propose a user-centered conceptual model grounded in behavioral change theories. Adopting a Research through Design (RtD) and Design Thinking approach, the study combines a literature review of behavioural change models with a needs analysis based on a user survey and case study evaluations. As a synthesis of these stages, the Deneko prototype was developed to enhance users' financial and environmental awareness, encourage positive habit formation through small and incremental actions, and strengthen motivation through community-based interaction. The conceptual framework of Deneko is structured around three dimensions: Balance, Experimentation, and Community. Interaction mechanisms, such as personalized goals, progress tracking, gamification, micro-rewards, and social interaction, were implemented in alignment with established behavioral change models. The findings indicate that behavior change–oriented interaction mechanisms can enhance user motivation and support sustainable decision-making processes in mobile banking experiences.

Keywords: Sustainability, Mobile Banking, User-Centered Design, Behavioral Change, Digital Intervention

SÜRDÜRÜLEBİLİR KARAR ALMA: MOBİL BANKACILIK TASARIMINDAKİ TEMEL GEREKSİNİMLER

Öz

Artan çevresel zorluklar ve tüketim odaklı yaşam tarzları nedeniyle sürdürülebilirlik, teorik bir ideal olmaktan ziyade pratik bir gereklilik haline gelmiştir. Bu bağlamda, kullanıcı deneyimi (UX) tasarımı, dijital davranış değişikliği müdahaleleri yoluyla sürdürülebilir alışkanlık oluşumunu desteklemek açısından önemli bir potansiyel sunmaktadır. Günlük finansal rutinlere entegre edilmiş yaygın olarak benimsenen araçlar olan mobil bankacılık uygulamaları, sürdürülebilirlik odaklı etkileşim mekanizmalarını entegre etmek için uygun bir ortam sağlamaktadır. Bu çalışma, mobil bankacılık uygulamalarında sürdürülebilir karar almayı destekleyen temel tasarım gereksinimlerini belirlemeyi ve davranış değişikliği teorilerine dayalı kullanıcı merkezli bir kavramsal model önermeyi amaçlamaktadır. Tasarım Yoluyla Araştırma ve Tasarım Odaklı Düşünme yaklaşımını benimseyen çalışma, davranış değişikliği modellerinin literatür incelemesini, kullanıcı anketine ve vaka çalışması değerlendirmelerine dayalı bir ihtiyaç analiziyle birleştirmektedir. Bu aşamaların bir sentezi olarak, kullanıcıların finansal ve çevresel farkındalığını artırmak, küçük ve kademeli eylemler yoluyla olumlu alışkanlık oluşumunu teşvik etmek ve topluluk tabanlı etkileşim yoluyla motivasyonu güçlendirmek için Deneko prototipi geliştirilmiştir. Deneko'nun kavramsal çerçevesi üç boyut etrafında yapılandırılmıştır: Denge, Deneyimleme ve Topluluk. Kişiselleştirilmiş hedefler, ilerleme takibi, oyunlaştırma, mikro ödüller ve sosyal etkileşim gibi etkileşim mekanizmaları, yerleşik davranış değişikliği modelleriyle uyumlu olarak uygulanmıştır. Bulgular, davranış değişikliğine yönelik etkileşim mekanizmalarının, mobil bankacılık deneyimlerinde kullanıcı motivasyonunu artırabileceğini ve sürdürülebilir karar alma süreçlerini destekleyebileceğini göstermektedir.

Anahtar Kelimeler: Sürdürülebilirlik, Mobil Bankacılık, Kullanıcı Odaklı Tasarım, Davranış Değişikliği, Dijital Müdahale

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Introduction

The ongoing climate crisis, driven by excessive and unreflective consumption patterns, has intensified the need for individuals and societies to adopt sustainable lifestyles. Sustainability-oriented habits not only reduce environmental impact but also contribute to long-term societal wellbeing (Corral Verdugo, 2012). Within this context, the design of interactions between users and digital systems plays a critical role in shaping, supporting, and sustaining behavioral change. Digital behavior change interventions (DBCIs)(Zhu et al., 2024) employ interaction mechanisms that encourage users to adopt and maintain environmentally responsible behaviors over time. As mobile banking applications have become deeply embedded in everyday life and have extensive user bases (Suluk, 2023), they present a promising platform for promoting sustainable decision-making. Even minor behavioral adjustments facilitated through such applications can accumulate into meaningful environmental and social impacts. To realize this potential, it is essential to integrate human–computer interaction (HCI) and UX design principles into mobile banking systems in a manner that goes beyond transaction-oriented functionality. Interaction design strategies, such as gamification, feedback, and personalization, can simultaneously support financial awareness, intrinsic motivation, and sustainability-oriented behavior (Wu et al., 2021). Therefore, embedding behavior change–driven interaction mechanisms into mobile banking applications represents a significant opportunity to foster sustainable decision-making.

Aim

This study aims to examine the interaction design mechanisms that support sustainable behavior change in mobile banking applications and to derive design recommendations grounded in behavioral theory and empirical findings. Accordingly, this study addresses the following research questions:

1. Which behavioral and psychological theories can inform the design of interaction mechanisms that support sustainable behavioral change in mobile banking applications?
2. Which interaction design mechanisms (e.g., gamification, personalization, digital nudges) may users perceive as effective in encouraging sustainable financial and environmental decisions?
3. How can sustainability-oriented interaction mechanisms be integrated into mobile banking applications, and what are their potential effects on user experience and behavior change?

Methodolody

This study employs a mixed-method approach by integrating Research through Design (RtD)(Zimmerman, Forlizzi, & Evenson, 2007; Koskinen et al., 2011) and Design Thinking (Zamakhsyari & Fatwanto, 2023) methodologies to explore interaction mechanisms for sustainable behavior change in mobile banking. The study follows a "theory–design–reflection" cycle, utilizing established behavioral frameworks such as the COM-B Model (Michie et al., 2011), the Fogg Behavior Model (Fogg, 2009), and Self-Determination Theory (SDT)(Deci & Ryan, 1987) alongside the App Behavior Change Scale (ABACUS)(McKay et al., 2019) to establish foundational design requirements. During the initial empathy and definition phase, a needs analysis (Norman, 2013) was conducted through a Likert-scale online survey with 30 active mobile banking users. Participants were selected through random sampling (Creswell & Creswell, 2018), and the collected data were evaluated using percentage and frequency analyses. In addition, a case study–based evaluation (Yin, 2018) of six existing banking applications was conducted. These findings informed the ideation stage, during which three distinct personas and user journey maps were created, followed by concept mapping to link behavioral theories to the development of the "Deneko" prototype, which is structured around the dimensions of Balance, Experimentation, and Community. The reflection phase involved testing the prototype with 12 participants using the Think-Aloud Protocol and a Likert-type evaluation questionnaire to assess its impact on the user experience and ecological awareness.

Significance of the Study

The financial sector is one of the most critical domains in which sustainability awareness must be strengthened, and mobile banking applications have emerged as a key touchpoint with the potential

to promote sustainable behavioral change. However, this potential remains underutilized in most existing applications, where interaction design tends to be transaction-oriented rather than experience-oriented. Because guidance and support elements for helping users develop sustainable habits are limited, achieving long-term behavioral changes remains challenging.

1. Theoretical Framework: Behavioral Change and Digital Interventions

This study adopts a holistic perspective on the concepts informing the design of digital behavior change interventions (DBCIs) for sustainable living. The literature identifies four key dimensions: habit formation, goal-directed behavior, interaction mechanisms and digital behavior change strategies (Table 1). Habits are learned behaviors that become automatic through repeated performances within specific contexts (Pinder et al., 2018). Two complementary perspectives on habit formation can be identified. Habit formation is conceptualized as a process of initiation, learning, and stabilization (Gardner et al., 2012), whereas contextual cues, repetition, and self-monitoring are emphasized as central mechanisms (Lally et al., 2011).

Advancements in Human–Computer Interaction (HCI) have transformed technology from a purely functional tool into an environment that supports behavioral transformation (Mankoff et al., 2007). DBCIs operate at the intersection of conscious decision-making and automatic behavior (Evans 2009), with motivation playing a central role in sustaining long-term change. While hedonic design emphasizes short-term pleasure and rewards, eudaimonic design focuses on long-term meaningful growth aligned with intrinsic goals (Waterman, 1993). Balancing these motivational approaches provides a foundation for a sustainable digital experience.

Behavioral change models further inform this framework. The COM-B Model proposes that behavior emerges from the interaction of capability, opportunity, and motivation (Michie et al., 2011), whereas the Fogg Behavior Model emphasizes the alignment of motivation, ability, and triggers (Fogg, 2009). Self-Determination Theory (SDT) highlights autonomy, competence, and relatedness as essential for intrinsic motivation and lasting change (Deci and Ryan, 1987). Together, these models suggest that DBCIs should move beyond information provision toward interactive systems that foster intrinsic motivation, support habit formation, and expand environmental opportunities for sustainable living.

Digital strategies such as gamification, eco-feedback, digital nudges, and learning loops operationalize these theoretical principles. Gamification enhances engagement through points, badges, levels, and social interaction (Hamari et al., 2014; Piccolo et al., 2012). Eco-feedback increases awareness by visualizing resource consumption, as demonstrated by systems such as What-a-Watt (Quintal et al., 2015; Zapico et al., 2016). Digital nudges shape choice environments through reminders and defaults (Thaler & Sunstein, 2008; Van Dessel et al., 2022), whereas learning loops enable reflection and behavioral adjustment through feedback and experience (Kolb, 1984). Collectively, these strategies support the transition from short-term actions to long-term, sustainable habits.

Model / Strategy	Definition	Impact on Digital Design
COM-B Model	The emergence of a behavior requires the integration of capability, opportunity, and motivation. Michie vd., 2011	Enhancing users' financial literacy, providing automated savings tools, and supporting sustainable goals in a motivating manner.
Fogg Behavior Model	Behavior requires motivation, capability, and triggers, where triggers serve as cues that initiate the action. Fogg, 2009	Guiding users toward desired behaviors through real-time notifications, reminders, and recommendation systems, facilitating behavior change.
Self Determination Theory	Meeting individuals' needs for autonomy, competence, and relatedness enhances intrinsic motivation and supports the maintenance of long-term behavior change. Deci ve Ryan, 1987	Enabling users to select their own goals and engage in context-based planning.
Gaminification	The application of game design elements to non-game contexts. Hamari vd., 2014	Increasing user motivation and fostering long-term habits through points, badges, levels, rewards, and social interaction.
Eco-feedback	Visualizes the outcomes of users' environmental behaviors to facilitate informed decision-making. Froehlich vd., 2010	Energy and water consumption tracking systems make environmental impact visible and encourage sustainable choices.
Digital Nudging	Guiding user behavior through the design of choice architecture, influencing actions without restricting autonomy. Thaler ve Sunstein, 2008	Guiding users toward desired behaviors through default options, reminders, and suggestions, supporting long-term habit formation.
Learnig Loops	A cyclical learning process involving active experimentation, reflection, and abstraction. Kolb, 1984	Step-by-step evaluation of financial decisions and sustainable behaviors, with personalized feedback, progress tracking, and user-appropriate challenge levels.

Table 1. *Behaviour Change Models and Strategies*

2. Design Process

2.1. Empathize

This study aims to identify user requirements for the prototypical design of a mobile banking application that promotes sustainable behavior. User requirements were examined using quantitative and qualitative methods, including an online survey and case study analysis. Survey questions were developed based on the principles of measurement in social sciences, motivational assessment frameworks, and theoretical studies measuring sustainability awareness. Additionally, the App Behavior Change Scale (ABACUS; McKay et al., 2019), which assesses the behavior-change potential of mobile applications, was used as a reference.

The online survey included 30 adult participants and provided a quantitative basis for understanding user needs and motivations for sustainable banking. Regarding demographics, approximately 60% of participants were aged 25–34, indicating a predominance of young adults, while 56.7% were male and 43.3% were female. The group demonstrated high digital literacy, with 63.3% holding a bachelor's degree and 10% a master's degree, and the majority (83.3%) belonged to the middle-income group. All participants (100%) used mobile banking daily and rated the applications positively, with 96.7% stating that they found them easy to learn, beneficial in daily life, and a formed habit. Participants demonstrated high awareness of environmental responsibility: 86.7% considered environmental factors in their daily behaviors, and 90% emphasized the importance of preserving the quality of life for future generations. Furthermore, 96.7% believed that taking measures against climate change is critical, and that everyone should acquire the skills necessary for sustainable living. Personal responsibility was strong, as 86.7% of the respondents felt a duty to make the world a better place, and 80% felt guilty when wasting energy. Their commitment was evident in their habits; the participants regularly engaged in energy and water conservation, waste reduction, recycling, and selecting eco-friendly products. In terms of motivation and habit formation, 80% of users reported that long-term goals provided daily motivation, and 83.3% felt capable of focusing on daily tasks. External factors were also significant, as 66.7% were motivated by external influences, and 76.7% found reminders helpful for task completion. Interaction mechanisms were perceived as highly

effective, with 93.3% of participants valuing feedback on their actions and 90% found rewards and incentives attractive. Additionally, 80% stated that personalized goals increased their motivation, and 86.7% expressed a desire to track their progress. Finally, 93.3% were motivated by seeing the tangible results of their sustainable behaviors, and 86.7% felt more motivated when acting with their social circle.

The case study analysis examined Bunq, Tomorrow Bank, Acorns, Türkiye İş Bankası, Garanti, and Yapı Kredi applications. Evaluated according to the ABACUS categories, these applications provided informational tools that increased awareness of environmental and societal impacts, planning mechanisms that enabled users to set sustainable goals, feedback systems for monitoring and reinforcing behaviors, and reminders and reward systems that supported the implementation of actions.

The findings (Table 2) indicate that users are highly receptive to digital features that support sustainable behavior. Personalized goals, regular feedback, social interactions, and reward mechanisms enhance user motivation. These results provide a robust foundation for determining user-centered design decisions and integrating features into a mobile banking prototype that effectively promotes sustainable behavioral change.

ABACUS Category	User Observation	Example Mechanisms	Design Requirement
Knowledge and Awareness	High environmental responsibility and sustainability awareness	Carbon footprint visualization, sustainable investment information, and social impact awareness	Visualization of environmental impacts and transparent presentation to the user
Goal Setting and Planning	Motivation through long-term goals and progress tracking	Personalized goals, savings plans, and task-based progress tracking	Ensuring goal-setting and planning processes are user-friendly and guided
Feedback and Monitoring	Finding feedback and rewards motivating	Micro-rewards, badges, and real-time environmental scoring	Visual and clear feedback that allows users to track their progress
Action and Motivation	Social interactions and reminders encourage behavior formation	Reminders, recommendation systems, social interaction mechanisms, and sustainable habit guidance	Step-by-step guidance supporting daily habits and options for social motivation

Table 2. *ABACUS-Based Behavior and Design Relationship*

2.2. Definition and Ideation

In this study, a sustainable digital banking prototype was developed through a user-centered design process informed by the Definition and Ideation phases of the Design Thinking methodology. Insights from user survey data, literature reviews, and case analyses indicate that, although users demonstrate high awareness of sustainability issues, they often lack sufficient guidance, feedback, and motivational support to translate this awareness into consistent financial behavior. This finding identified the core problem as the predominantly transaction- and efficiency-oriented nature of existing mobile banking applications, in which mechanisms that support long-term, sustainable behavior are secondary.

Based on these insights, the design challenge was defined as creating a mobile banking experience that not only informs users about sustainability but also actively supports goal-setting, progress visibility, feedback, personalization, and motivation to facilitate habit formation. To systematically connect user behaviors with design components, opportunity areas were identified by mapping empirical findings onto behavior-change principles and interaction design requirements.

The ideation process was grounded in three representative personas derived from survey data, reflecting users aged 24–44 years and characterized as hedonic, eudaimonic (Figure 1), and pragmatic profiles. These personas were constructed to represent distinct motivational patterns, behavioral tendencies, and interaction needs. User journeys were developed for each persona to demonstrate how different user types might engage with sustainability-oriented banking features across everyday

financial scenarios. This approach ensured that the design decisions were informed by user representations rather than abstract assumptions.

Persona 2: Metin

EUDAIMONIC USER

"Thoughtful, deliberate, and conscious"

47 years old, Academician

SCENARIO

The user wants to align their financial goals with sustainable choices and reviews the carbon footprint report in the app to plan their savings targets.

EXPECTATIONS

Meaning and value alignment, long-term personal development, developing sustainable financial habits

STAGES	AWARENESS	CONSIDERATION	DECISION	SERVICE	RETENTION
GOALS	Exploring the meaningful and value-oriented aspects of the application	Identifying sustainable financial habits	Making informed decisions on goals and investment options	Practices sustainable habits and manages their investments	Pursuing long-term successes
ACTIONS	Downloads and opens the application	Fill out the survey and select your goals and interests	Reviews suggestions on the dashboard and evaluates investment options	Expense tracking, investment selection	Checks profile and investment performance and shares it in forums
THOUGHTS	"Does this app really create value?"	"Are my goals aligned with my personal values?"	"Will this choice provide long-term benefits?"	"Are my habits and investments creating value?"	"Am I achieving my goals?"
PAIN POINTS	Lack of information, overly superficial content	The survey may be long or complex	The decision-making process can be complex	The process can be long or confusing	Insufficient performance visibility
EMOTIONS	Curious, conscious	Thoughtful, planned	Determined, anxious	Satisfied, safe	Proud, motivated
TOUCH POINTS	App store, website, blog content	Onboarding screens	Dashboard, Investment menu	Dashboard, Expense tracking, Investment menu	Profile screen, Notifications, Community
OPPORTUNITIES	Provide value-focused messages and guidance content	Guided and explanatory survey modules	Providing detailed analyses and guidance	Step-by-step guidance and visualization	Detailed visualization of success and impact

Figure 1. *User Journey for Eudaimonic Persona*

Several design strategies emerged within the identified opportunity areas. Users' preference for simplicity and ease of use highlights the importance of intuitive interfaces, onboarding guidance, and micro-interactions. The need for motivation and continuity in sustainable behaviors emphasizes personalized goal setting, progress indicators, reminders, and feedback mechanisms to support habit formation. Additionally, visual representations of environmental impact, such as carbon footprint feedback, were identified as critical for enhancing sustainability awareness, whereas micro-rewards, badges, and community-based activities addressed users' desire for social motivation and engagement.

Following the evaluation of these opportunity areas through the Design Thinking approach, the prototype was further conceptualized using the "theory–design–reflection" cycle of the Research through Design methodology. Concept mapping grounded in behavior change theories, including the COM-B Model, the Fogg Behavior Model, and Self-Determination Theory, was employed to visualize design priorities and user-centered solution spaces (Figure 2).

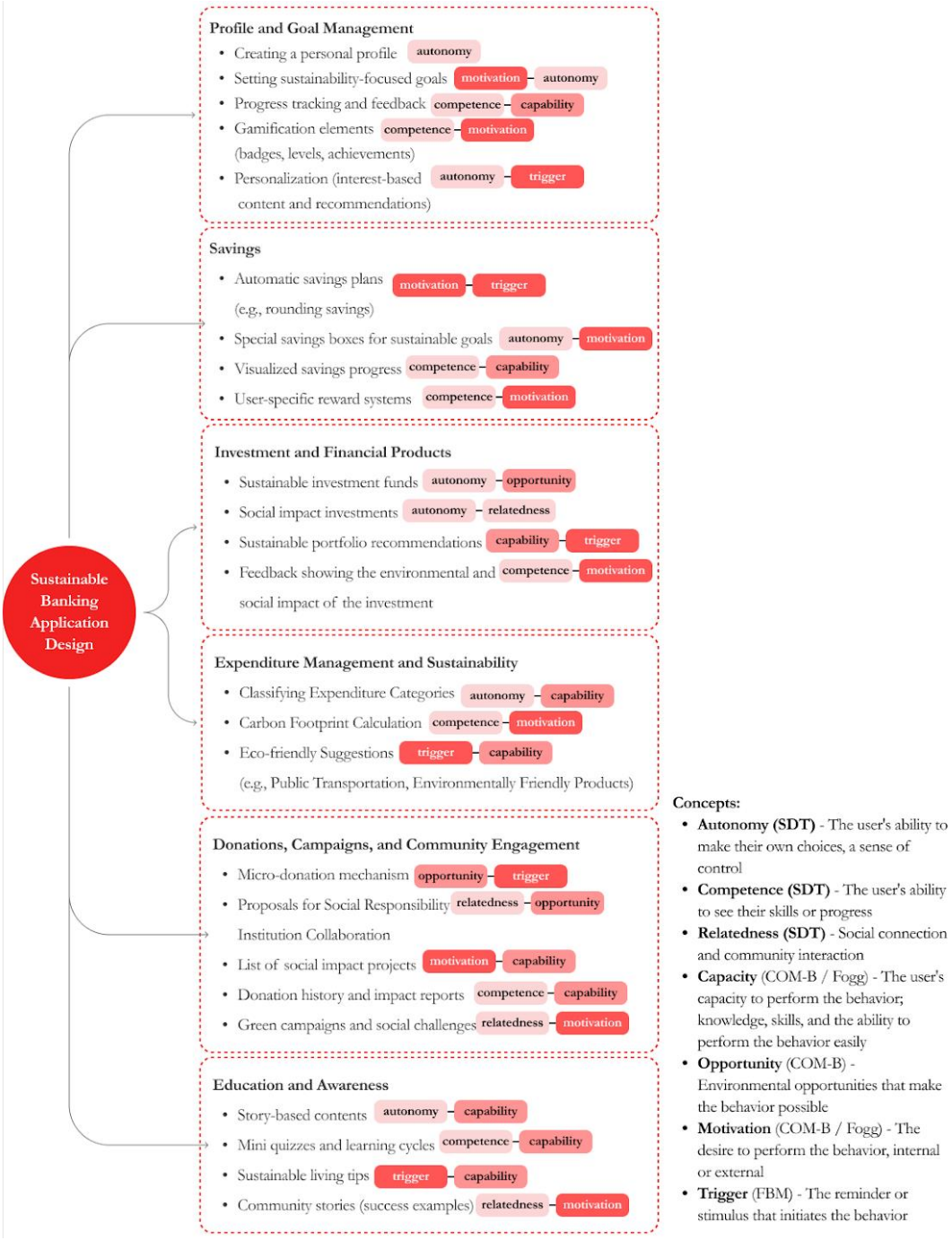

Figure 2. *Concept Mapping*

This mapping process enabled the translation of theoretical constructs, such as motivation, capability, autonomy, competence, and relatedness, into concrete interaction mechanisms.

The resulting Deneko concept represents a behavior change–oriented mobile banking approach that supports users in maintaining financial balance while strengthening ecological responsibility. By embedding behavior change principles into everyday banking interactions, the prototype translates abstract sustainability goals into actionable, user-centered design mechanisms that address users' motivation, capability, and opportunity for adopting sustainable behavior.

2.3. Prototype

Based on insights derived from the empathize and define stages, a sustainability-oriented mobile banking prototype was developed to investigate how interaction design can support the formation of positive, sustainable behavior. Rather than proposing a finalized product, the prototype functioned as an exploratory design artifact, enabling the examination of how sustainability principles, behavior change strategies, and everyday banking interactions can be meaningfully integrated within a single digital environment.

Before defining the interface structure and functional components, a mood board was created as an initial design exploration tool (Figure 3). The moodboard aimed to establish the visual, emotional, and experiential direction of the prototype by translating abstract sustainability values into tangible design attributes. Themes such as transparency, trust, calmness, balance, and environmental responsibility guided the visual exploration of the project. Therefore, sustainability was approached not only as a functional objective but also as an experiential quality embedded in routine financial interactions.

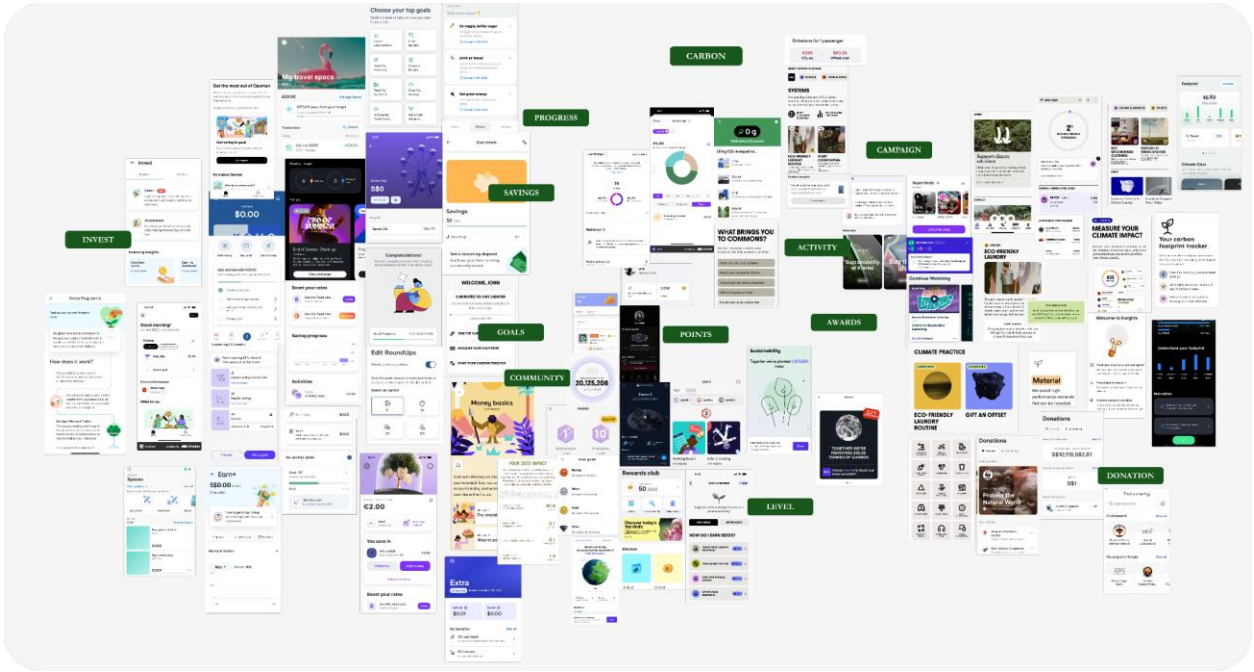

Figure 3. *Moodboard for Interface Design Inspiration*

The moodboard informed several key design decisions, including color palette selection, visual hierarchy, iconography, typography, and the tone of communication. Soft color transitions, natural textures, and minimal visual noise were prioritized to reduce cognitive load and foster a sense of calm and reliability. Instead of persuasive or alarming visual cues, the design language emphasizes clarity, positive reinforcement, and subtle guidance. This approach aligns with the principles of Sustainable Human–Computer Interaction (S-HCI), which emphasize long-term engagement, reflective interaction, and the seamless integration of sustainable practices into daily life (Blevis, 2007).

Following the visual and experiential framing, the prototype's interface structure and core functions were designed in alignment with behavior change theories and the App Behavior Change Scale (ABACUS). Features supporting knowledge and awareness were integrated through contextual sustainability information and educational content embedded in financial flows. Goal setting and planning were enabled by allowing users to define personalized sustainability goals related to saving, spending, and investment behavior. Feedback and monitoring mechanisms visualize progress over time, making behavioral outcomes visible and comprehensible. Additionally, motivational elements

such as reminders, symbolic rewards, and progress indicators were incorporated to sustain engagement without overwhelming the user.

The prototype, named Deneko, was conceptualized as a digital banking ecosystem in which sustainability is embedded in everyday financial routines rather than presented as a separate or optional feature. Financial interactions, such as payments, savings, and investments, were deliberately used as entry points for reflecting on environmental and societal impacts. This framing positions the banking application as an active facilitator of sustainable behavior, rather than solely as a transactional tool.

As a result of this conceptual approach, a structured set of design ideas was developed, including personalized goal management, progress tracking, visualized feedback, micro-rewards, automated savings mechanisms, and Environment, Social, and Governance (ESG)-oriented investment options. These components were organized within the prototype's information architecture according to three core dimensions: Balance, Experimentation, and Community (Figure 4). Each dimension integrates financial tools, educational content, and interaction mechanisms to support the different stages of sustainable behavioral change.

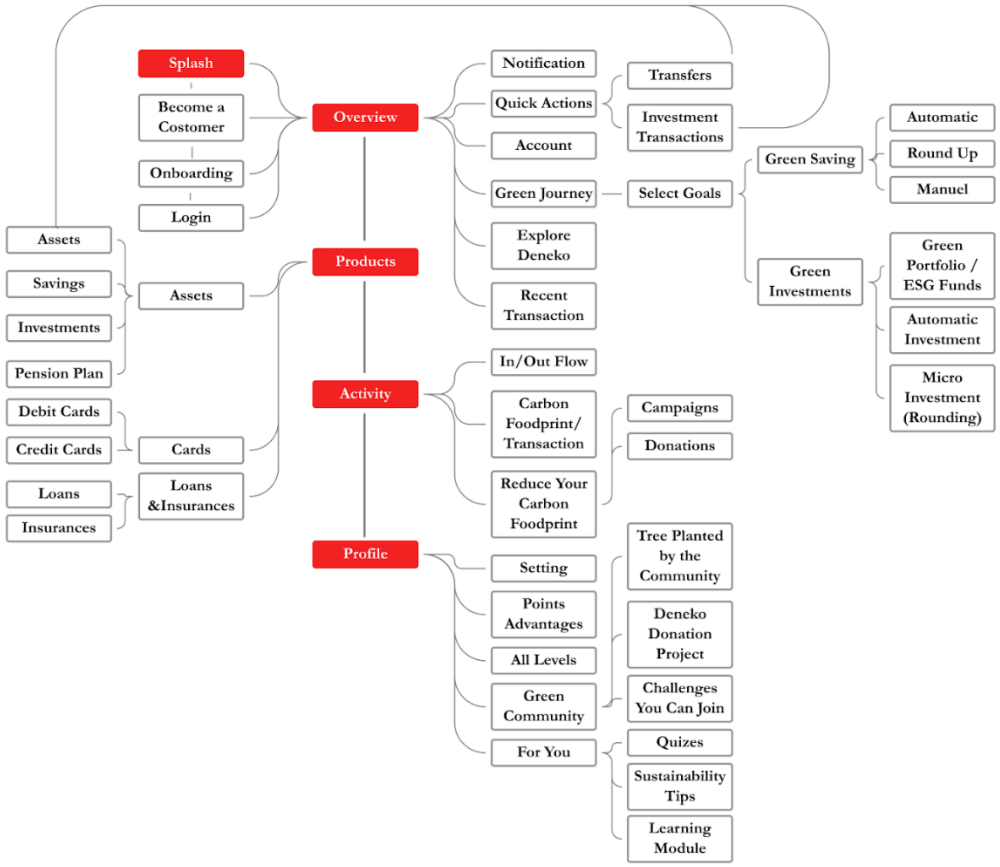

Figure 4. *Deneko Application Information Architecture*

The Balance dimension focuses on helping users understand the environmental consequences of their financial actions while maintaining personal financial stability. Experimentation dimension encourages users to experiment with sustainable behaviors through small, low-effort actions embedded in daily banking activities. The Community dimension extends individual action to collective participation by connecting users through shared sustainability goals, social challenges, and donation mechanisms. Together, these dimensions establish a progressive sustainability experience that evolves from individual awareness to collective engagement.

To support personalization within the Balance and Experimentation dimensions, the "Become a Customer" flow includes a brief set of questions that allow users to specify their motivations and sustainability interests (Figure 5). This information is later used to tailor goals, recommendations, and feedback mechanisms, reinforcing user autonomy and relevance, which are key components of sustained behavior change.

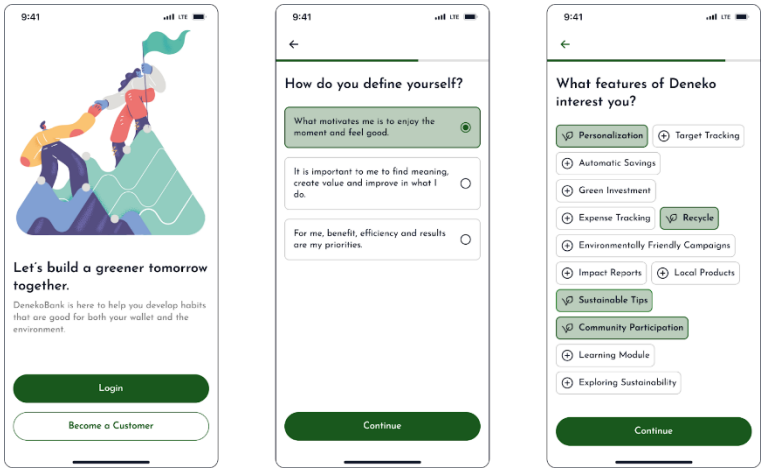

Figure 5. *Personalization During the Customer Onboarding Process*

After onboarding, Deneko's gamified "Green Journey" mechanism promotes sustainable behavior and supports positive habit formation (Figure 6). Users earn points, badges, and level progressions by completing their financial and environmental goals. Gamification elements were intentionally designed to remain symbolic rather than competitive, reinforcing intrinsic motivation over extrinsic pressure.

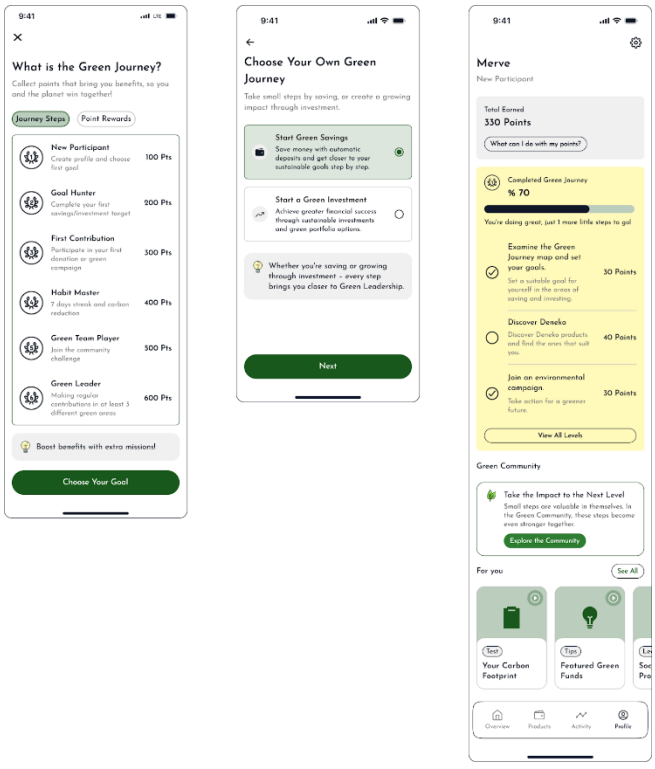

Figure 6. *Green Journey Goal Setting and Levels*

Sustainability is consistently prioritized across the application's modules and embedded within core banking interactions. Rather than being confined to a single feature or section, sustainability-related elements are distributed across multiple modules to ensure continuous exposure during daily use. For instance, the "Round-Up" mechanism integrated into transfer and payment processes (Figure 7) allows users to contribute to sustainability initiatives seamlessly as part of their routine financial activities.

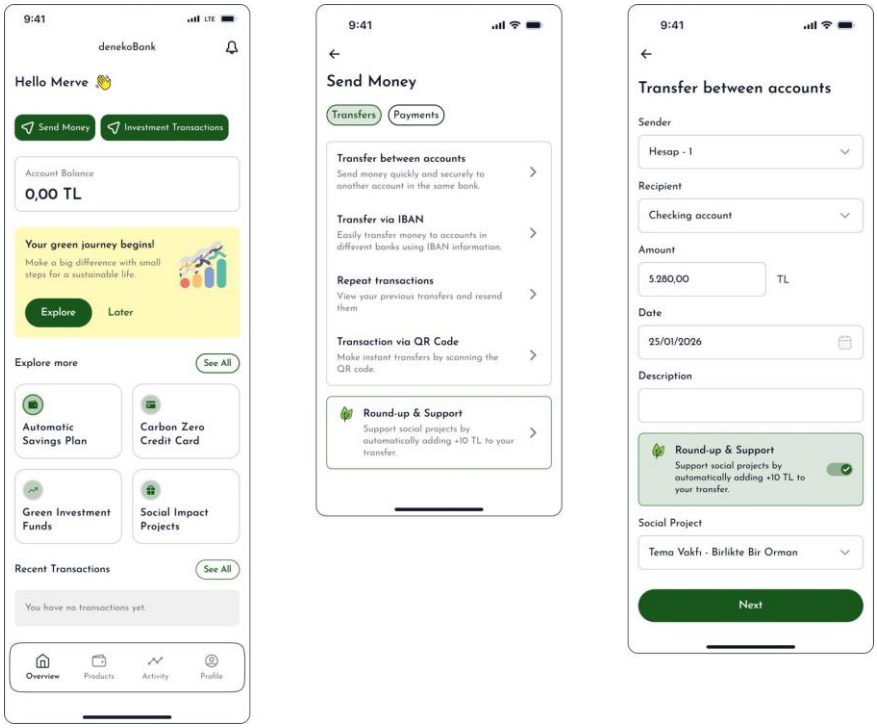

Figure 7. *Round-Up*

Within the **Products** section, savings and investment plans are designed according to sustainability-oriented criteria, including environmental and societal implications. Users are encouraged to consider the environmental and societal implications of their financial choices through ESG-focused investment options and green savings mechanisms. These features aim to integrate sustainable decision-making into routine financial planning, rather than presenting it as an additional task.

Environmental impact awareness is further supported by **carbon footprint visualization** based on users' completed financial and sustainability-related activities. By making the estimated impact visible, the application provides immediate feedback and opportunities for further reflection. In response to this feedback, users are presented with **green campaigns and donation options**, allowing them to actively reduce or offset their footprints through low-effort actions.

The **Profile** section functions as a personal sustainability dashboard, where users can view their Green Journey status, accumulated points, earned badges and available reward-related actions. This space reinforces a sense of progress and continuity, supporting long-term engagement by making achievements both visible and meaningful over time. To maintain motivation and prevent disengagement, the application incorporates **microtasks**, **visualized progress indicators**, and **community-based challenges**. These mechanisms are designed to support gradual behavior change by breaking sustainability goals into manageable steps and providing regular, positive feedback. Finally, sustainability is reinforced by social and educational components. The **Green Community** module enables social interaction, collective challenges, and shared sustainability goals, emphasizing the social dimension of behavior change. In parallel, the **learning** module provides accessible, contextual

information to strengthen users' sustainability awareness and understanding, supporting informed decision-making and action (Figure 8).

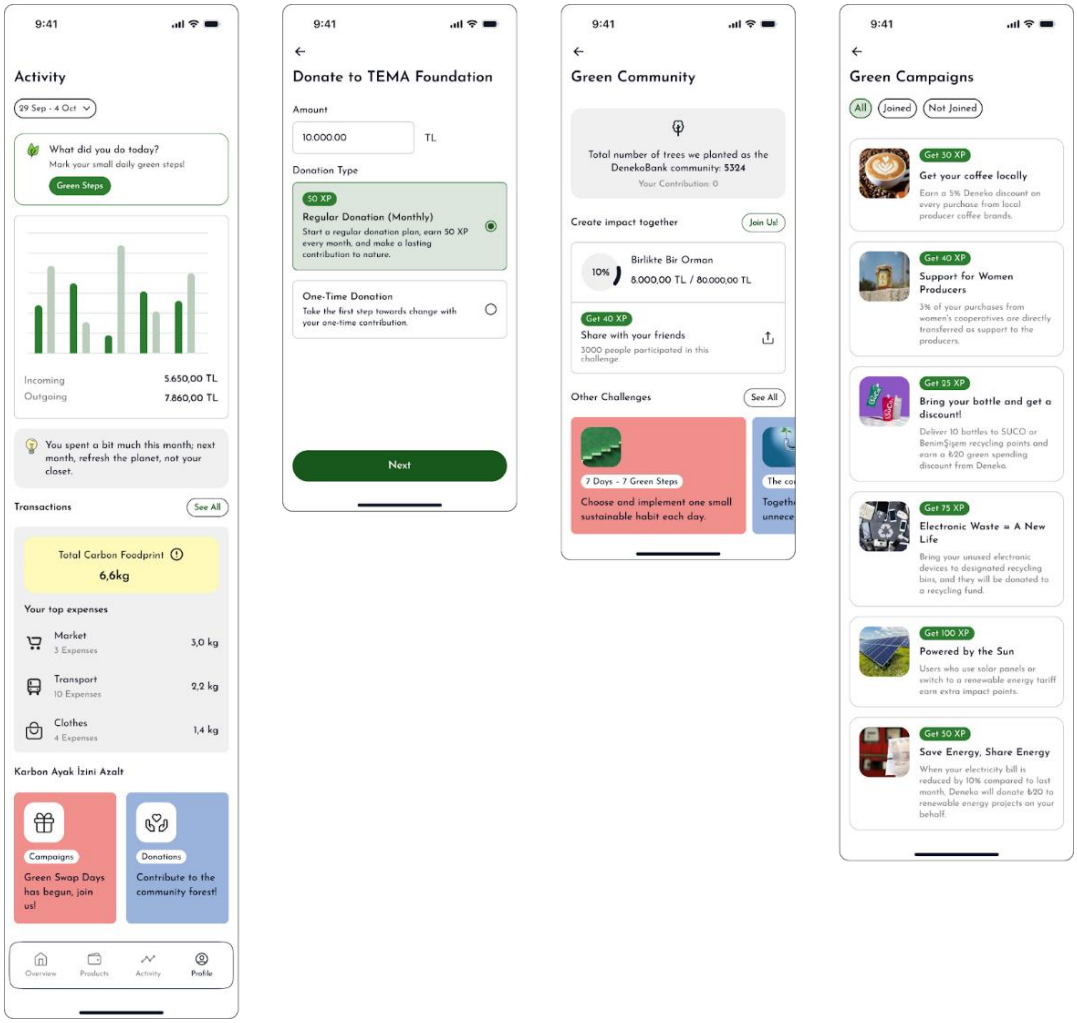

Figure 8. *Modules Promoting Sustainability: Activity Page, Donations, Green Campaigns and Green Community*

Table 3 summarizes the relationship between Deneko's screen modules, their behavior-change functions, and the corresponding ABACUS dimensions. The onboarding and account creation processes provide initial guidance and motivational framing, whereas personalized goal-setting features enhance sustained engagement. Core banking interactions contribute to increasing users' awareness of their financial and environmental behaviors, whereas sustainability-focused modules reinforce both individual and community-oriented action. Profile, community, and learning features support motivation, belongingness, and reflective engagement. In addition, the settings module enables self-regulation and personal control, thereby strengthening the application's overall sustainability-oriented interaction framework.

Tab / Main Screen	Subscreen / Module	Function / Feature	ABACUS Item	Behavior Change Potential
Onboarding	Welcome Page	App introduction, general information, user guidance	1.3, 1.4	Familiarization with the app, initial motivation provision
	Become a Customer	Account creation process, basic information collection	1.3, 1.4	Learning the app, initiating behavior change
	Define Yourself	Hedonic / Eudaimonic / Pragmatist selection	1.1	Personalized motivation
	Interests	Learning which features are engaging in Deneko	1.1	Interest-driven behavior
Overview	Green Journey	Goal selection and method choice (e.g., green savings, investment, etc.)	1.1, 2.1, 2.2	Personalized goal-oriented motivation
	Account Balance	Current balance display	1.3, 3.2	Raising awareness
	Send Money / Investment Transfer	Money transfer and payment transactions	1.3, 4.2	Quick and accurate action, behavioral motivation
	Recent Transactions	Transaction history	3.2	Awareness and behavior tracking
	Explore more	Green products, mini tasks, tips	3.7	Behavior reinforcement, reminder
	Notifications	Viewing notifications via the navigation bar	3.1, 3.4, 3.7	Behavior trigger
Products	Assets	Accounts, Investments, Pension, Savings Plan, Popular in Deneko	2.3, 3.2, 4.4	Goal-oriented behavior and awareness
	Cards	Debit and credit cards	3.2	Spending awareness
	Loans & Insurances	Viewing loans and insurances	3.2	Financial decision support
Activity	Week Range Filter	Weekly filtering, adjustable	3.2	Behavior monitoring
	In/Out Flow	Visualization of expenses and savings	3.2	Awareness and behavior tracking
	Carbon Footprint	Displaying the environmental impact of expenses	3.2, 3.3, 4.6	Reducing undesired behavior
	Green Campaigns	Participation in campaigns	3.6, 3.7, 4.2	Social motivation and engagement
	Donations	Make a donation	3.6, 3.7, 4.2	Social responsibility and motivation
	Sustainability Checklist	Marking your sustainable actions in daily life	3.4, 4.1, 4.3	Inquiry, awareness gathering, behavior reinforcement.
Profile	My Points Card	View total points and redeem rewards	2.1, 3.2, 3.7	Motivation and reward management
	Green Journey Card	Progress bar and tasks	1.4, 2.3, 3.1, 3.2, 3.7	Goal-oriented behavior
	Green Community	Challenges, community tree count	3.3, 3.5, 3.6, 4.5	Social motivation and sense of belonging
	For you	Quizzes, tips, learning module	3.7, 4.2, 4.3	Education and awareness
	Settings	Personal goal, reminder, notification management	1.1, 1.2, 4.4	Self-regulation and personalization

Table 3. *Evaluation of Deneko Screen Modules According to ABACUS Scale*

3. Prototype Testing and Evaluation

The Deneko prototype was evaluated with 12 participants to examine its usability, motivational qualities, and perceived capacity to support sustainable behaviour through digital interaction mechanisms. A mixed-method evaluation approach was adopted, combining qualitative insights obtained through the Think-Aloud Protocol with quantitative data collected via a Likert-type questionnaire. The evaluation framework was informed by the App Behavior Change Scale (ABACUS), enabling interpretation of the findings across the dimensions of Knowledge and Information, Goals and Planning, Monitoring and Feedback, Actions.

ABACUS Dimension	**Qualitative Insights (Key Observations)**	**Quantitative Data (Agreement Rate)**
Knowledge and Information	Carbon footprint visualization was found critical for making sustainability tangible. Users valued comparing their impact with the "Deneko average" and utilized info icons to learn technical terms like ESG. The " What Did You Do Today?" checklist encouraged reflection on daily choices.	**100%** find the app interesting. **91.6%** reported increased ecological awareness. **91.6%** agree the app provides practical sustainability info.
Goals and Planning	Users felt a sense of "ownership" due to the step-based goal structure. Personalization during onboarding allowed users to align the app with their motivation types (e.g., efficiency vs. meaning). Goal tracking was the most preferred feature among participants.	**91.6%** feel autonomous in setting their own goals. **100%** agree the app defines clear habits and offers strong guidance.
Monitoring and Feedback	Progress bars and points in the "Green Journey" triggered a sense of achievement and a "game-like" experience. Real-time notifications like “2 steps left to finish” acted as strong psychological prompts for task completion.	**100%** effectively tracked their sustainability movements. **91.6%** found gamification elements (badges, rewards) highly intriguing.
Actions	The "Round-Up and Support" feature was identified as the strongest behavioral trigger, perceived as "effortless goodness". The "Green Community" module fostered a sense of belonging by showing collective social impact (e.g., total trees planted)	**100%** motivated to improve daily actions.**91.6%** motivated by social interaction and community-based movement. **100%** would recommend the app to conscious peers.

Table 4. *Summary of Prototype Evaluation Findings Based on ABACUS Dimensions*

As summarized in Table 4, the findings indicate strong user engagement and a coherent alignment between interaction design mechanisms and behaviour change principles. Within the **Knowledge and Information** dimension, carbon footprint visualizations and contextual eco-feedback rendered sustainability more concrete and personally meaningful. Participants’ engagement with comparative indicators and explanatory elements suggests that information was cognitively processed, supporting reflective awareness as a basis for behavioural intention.

Regarding **Goals and Planning**, onboarding-based personalization and the staged goal architecture fostered a sense of autonomy and ownership. Sustainable actions were perceived as structured yet attainable, reducing behavioural burden and positioning goal-setting as self-directed rather than externally imposed.

In the **Monitoring and Feedback** dimension, visible progress markers and gamified feedback loops reinforced motivation by making advancement explicit. Participants associated these mechanisms with sustained focus and a sense of achievement, indicating their role in supporting behavioural maintenance.

Finally, within the **Actions** dimension, embedding low-effort sustainable interventions into routine banking flows reduced friction and lowered participation thresholds. Community-based impact displays further strengthened motivation by linking individual financial actions to collective environmental outcomes, enhancing perceived relevance and relatedness.

Taken together, the findings suggest that the Deneko prototype effectively operationalizes behaviour change principles within a mobile banking context. By combining personalization, eco-feedback, gamification, and social interaction, the prototype demonstrates potential to support awareness, motivation, and sustained engagement with sustainable financial behaviours.

Conclusion

This study explored how user-centered interaction design principles can support sustainable behaviour change within mobile banking applications and proposed the Deneko prototype as a conceptual design response. By integrating behavioural theories with empirical user insights and design practice, the research demonstrates how digital banking environments can move beyond transactional functionality to foster long-term, sustainable habits.

In response to the first research question, the findings confirm that behaviour change theories such as the COM-B Model, Fogg Behaviour Model, and Self-Determination Theory provide a robust and complementary theoretical foundation for sustainability-oriented digital interventions. The study highlights that sustainable behaviour is not driven by motivation alone but emerges through the alignment of users' capabilities, contextual opportunities, and meaningful triggers. Furthermore, user findings indicate that sustainable behaviours are more readily adopted when supported by both personal motivation and community-oriented interaction, underscoring the importance of intrinsic motivation and social relatedness in the design of digital behaviour change.

Addressing the second research question, the needs analysis and case study evaluation reveal a strong alignment between theoretical models and practical interaction mechanisms. Users identified long-term goals, personalised progress tracking, feedback mechanisms, reminders, and social interaction as particularly effective in supporting habit formation. The analysis of existing banking applications demonstrated that sustainability-oriented interaction strategies are primarily implemented through gamification, personalisation, eco-feedback, and digital nudges. Visualised progress indicators, micro-rewards, and low-effort nudging mechanisms—such as rounding features—were perceived as reducing cognitive and behavioural effort, thereby strengthening motivation and engagement. These findings underline the importance of embedding sustainability mechanisms seamlessly into everyday financial routines rather than isolating them as separate informational features.

In response to the third research question, the Deneko prototype translates these insights into a coherent interaction design framework structured around the dimensions of Balance, Experimentation, and Community. The prototype integrates behaviour change mechanisms that support knowledge and awareness, goal setting and planning, feedback and monitoring, and motivation, in alignment with the ABACUS framework. Features such as personalised goal tracking, sustainability-focused feedback, carbon footprint visualisation, donation mechanisms, and community-based impact indicators exemplify how sustainable behaviour change can be operationalised within a mobile banking context. Rather than positioning sustainability as an abstract

value, the prototype embeds it into daily financial decision-making, supporting both individual and collective behavioural awareness.

Overall, the findings suggest that sustainable mobile banking design can be effectively realised through the integration of behavioural theory, user-centred personalisation, gamification elements, and social interaction mechanisms. The study contributes to the field of Human–Computer Interaction by demonstrating how behaviour change theories can be systematically translated into interaction design decisions for financial technologies. While the prototype evaluation focused on perceived usability and behavioural potential rather than long-term behavioural outcomes, the results indicate a strong design foundation for future development.

Future research may involve longitudinal user testing and real-world deployment to further evaluate the impact of such prototypes on sustained behaviour change and to refine interaction strategies that support environmentally responsible financial practices over time.

Author Contributions

This study was conducted as part of Merve Aydın's master's thesis. Merve Aydın was responsible for 80% of the research execution, data analyses, and manuscript writing processes. Nur Cemelioğlu, as the thesis advisor, contributed 20% through methodological guidance and content review.

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Ethics Approval

The study was conducted following ethical approval obtained from the Yıldız Technical University Graduate School of Social Sciences Ethics Committee on April 14, 2025 (Meeting No: 2025.04)