DESIGNING FOR USER INTENTIONS (DUI): SUPPORTING EARLY DESIGN PHASES FOR PROMOTING BEHAVIOR CHANGE IN PERSONAL CARE AND HYGIENE PRACTICES FOR WATER EFFECTIVENESS IN BATHROOM ENVIRONMENT

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ABSTRACT

DESIGNING FOR USER INTENTIONS (DUI): SUPPORTING EARLY DESIGN PHASES FOR PROMOTING BEHAVIOR CHANGE IN PERSONAL CARE AND HYGIENE PRACTICES FOR WATER EFFECTIVENESS IN BATHROOM ENVIRONMENT

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Across many regions of the world, the ever-increasing households water demand, mainly shaped through individuals' unsustainable behaviors, is threatening the water supplies. It is widely acknowledged that design offers possibilities to mitigate the environmental impacts of use behaviors through structuring the ways individuals engage with their surroundings. Though, since behaviors are determined through a range of factors that are difficult to influence, design interventions aimed at reducing the harmful effects of use may not ensure behavior change.

Advancing on this problem, this doctoral study aims to understand the behavioral reasons for intensive use of water, reveal the users' diverse intentions to adopt sustainable behaviors, and identify design strategies for behavior change to support the development of ideas for influencing behaviors for the effective use of water through a study focusing on personal care and hygiene practices in the bathroom environment. To achieve this, it adopts *a generative research approach* to reveal the individuals' existing behaviors, attitudes, and intentions concerning water

consumption and *a research through design approach* to effectively communicate the acquired knowledge to inspire the development of diverse ideas for behavior change. Through cycles of designing, implementing, evaluating, and revising, this thesis offers a generative tool *(inspiration cards)* and a generative method *(DUI workshops)* and evaluates their implications on the ideation process through a series of design workshops. The proposed inspirations cards and the DUI workshop provide a valuable knowledge source and guidance for the design researchers and practitioners to influence behaviors towards sustainable directions through enabling them to *explore* the problem area and the user, *generate* diverse ideas, *refine* the developed ideas, *reconsider* the ideas for different user intentions and *support* their design decisions.

Keywords: Design for User Intentions, Behavior Change, Design for Sustainability, Household Water Consumption, Personal Care and Hygiene Practices

ÖZ

KULLANICI EĞİLİMLERİNE YÖNELİK TASARIM: BANYO ORTAMINDA SU ETKİNLİĞİ İÇİN KİŞİSEL BAKIM VE HİJYEN PRATİKLERİNDE DAVRANIŞ DEĞİŞİKLİĞİNİ TEŞVİK ETMEK AMACIYLA ERKEN TASARIM AŞAMALARININ DESTEKLENMESİ

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Bireylerin sürdürülebilir olmayan davranışlarıyla şekillenerek sürekli artan evsel su talebi, dünyanın birçok bölgesinde su kaynaklarını tehdit etmektedir. Tasarımın, bireylerin çevreleriyle etkileşim kurma biçimlerini etkileyerek, kullanım davranışlarının çevresel etkilerini azaltmaya yönelik olanaklar sunduğu yaygın olarak kabul edilmektedir. Ancak, davranışlar etkilenmesi zor olan birtakım faktörler tarafından belirlendiğinden, kullanımın zararlı etkilerini azaltmayı amaçlayan tasarım müdahaleleri davranış değişikliğini sağlamayabilir.

Bu doktora çalışması banyo ortamındaki kişisel bakım ve hijyen pratiklerine odaklanarak, yoğun su kullanımının davranışsal nedenlerinin anlaşılması, kullanıcıların sürdürülebilir davranışları benimsemeye yönelik farklı eğilimlerinin tanımlanması ve davranış değişikliği için tasarım stratejilerinin belirlenmesi aracılığıyla suyun verimli kullanımı için davranışların etkilenmesine yönelik fikir geliştirme sürecinin desteklenmesini hedeflemektedir. Araştırma, su tüketimiyle ilgili mevcut davranışları, tutumları ve niyetleri ortaya çıkarmak için *yaratıcı araştırma yöntemlerini* ve bu bilginin etkili bir şekilde paylaşılarak davranış

değişikliği için çeşitli fikirlerin geliştirilmesine ilham vermek amacıyla *tasarım yoluyla araştırma yaklaşımını* benimser. Tasarlama, uygulama, değerlendirme ve düzenleme döngüleri aracılığıyla bu tez kapsamında bir yaratıcı araç *(ilham kartları)* ve yöntem *(DUI çalıştayları)* geliştirilmiş ve bunların fikir geliştirme süreçlerine yönelik etkileri tasarım çalıştayları aracılığıyla değerlendirilmiştir. İlham kartları ve DUI çalıştayı, problem alanının ve kullanıcının keşfedilmesini, çeşitli fikirlerin üretilmesini ve detaylandırılmasını, farklı kullanıcı eğilimleri için fikirlerin yeniden ele alınmasını ve tasarım kararlarının savunulmasını destekleyerek, davranışların sürdürülebilir yönlerde etkilenmesine yönelik tasarımcılar ve tasarım araştırmacıları için değerli bir bilgi kaynağı ve rehber niteliği taşır.

Anahtar Kelimeler: Kullanıcı Eğilimleri için Tasarım, Davranış Değişikliği, Sürdürülebilirlik için Tasarım, Evsel Su Tüketimi, Kişisel Bakım ve Hijyen Pratikleri

To my family…

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CHAPTER 1

INTRODUCTION

1.1 Problem Background

Water scarcity has been a significant concern across many regions of the world and threatening the sustainable development of society. Increasing water demand resulting from population growth and overconsumption, and the contamination of water resources put a significant strain on the natural ecosystem. As part of the Sustainable Development Goals (SDGs), the United Nations has introduced the importance of enabling safe access to clean water resources for everyone, improving the water quality and increasing efficient use of water by 2030 (The United Nations, 2015), which highlights the necessity of taking serious measures with the soonest. In Turkey, which is considered as a water-stressed region, water consumption through households (%15), agricultural irrigation (%74), and industry (%11) have a significant impact on the water resources (Gleick et al., 2014). Despite its relatively lower ratio to other areas, household water consumption provides opportunities for change since every individual can relate to this issue and take action. In this thesis, considering the richness of water-consuming practices and their overall contribution to household water demand (68%) (Energy Saving Trust, 2013), household water consumption is narrowed down to the bathroom environment with a particular focus on personal care and hygiene activities.

To influence the growing water demand in households, several interventions have been developed in the *organizational* (e.g., legislations for restricting water use, water pricing strategies), *technological* (e.g., water-saving devices, water-efficient appliances), and *individual level* (e.g., information and awareness raising campaigns,

personalized information and feedback) (Ramli, 2021; Orr et al., 2018; Schultz et al., 2016). Even though existing interventions for encouraging pro-environmental behaviors hold potentials for change since the individuals are at the core of all these levels, mitigating water consumption to support sustainable development requires significant alterations in individuals' behaviors.

Behaviors can be considered as a design-related problem through which the way individuals interact with their surroundings is shaped (Lockton, 2013). Acknowledging the significant contributions of behaviors on environmental problems, how behavior can be influenced through design has become a growing research interest (Lilley & Wilson, 2017; Lockton, 2013; Lidman & Renström, 2011; Elias et al., 2009; Wever, van Kuijk & Boks, 2008; Lilley et al., 2005). Altering behaviors, however, requires an understanding of what constructs them in the first place. Research studies aiming to influence sustainable behaviors suggest utilizing diverse research methods to capture behaviors and the factors affecting them (Daae & Boks, 2015). The main reason for this is the difficulty of understanding the behaviors and the limitations and possibilities the different user research methods hold for acquiring diverse behavioral determinants. Though, receiving behaviors and their reasons provides limited guidance to alter them towards the intended directions. Along with it, recognizing the diversity of users in terms of their intentions to adopt change is quite significant to enhance the acceptance of the proposed design interventions (Coşkun, 2020; Coşkun, 2015; Coşkun & Erbuğ, 2014; Lilley et al., 2013; Lockton et al., 2012).

Despite the growing interest in designing for behavior change and a range of research studies conducted in this field with varying emphases, design researchers and practitioners still need guidance while facilitating research on behavior change or developing design interventions to influence sustainable behaviors. Considering these expectations, as well as exploring diverse reasons of intensive use of water and individuals' diverse intentions for change, investigating alternative means of

conveying this knowledge to designers and design researchers is of great importance to support this field.

1.2 Significance of the Topic

Based upon the arising concerns on design for behavior change, four diverse issues come forward for supporting designers and design researchers for influencing behaviors for a sustainable transition that will form the main contributions of this doctoral study:

1. *Diversity of behaviors leading to intensive use of water and their reasons:*

Water consumption behaviors are shaped through a range of individual, social and material factors. Emotional and physiological needs associated with being clean, rituals and daily routines (Kuijer, 2014; Scott et al., 2012), available technologies and materials for cleaning (Kuijer, 2014), physical abilities, individual characteristics, and demographic differences (Grafton, 2014) are among the previously discussed factors for structuring the individuals' behaviors as performing personal care and hygiene practices. As these examples suggest, understanding behaviors is beyond focusing on the interactions between the individuals and products and requires the exploration of the dynamics of practices (Hoolohan & Browne, 2020). In that sense, inquiring into existing practices to understand established behaviors and various factors shaping them is of great importance; thereby, design can be used as a powerful means to predict future needs and expectations and manipulate them towards sustainable directions. To fulfill this need, the user research phase of this doctoral study will adopt a *generative research approach* through which a range of projective tools and tasks are developed and adopted to gain insights into the personal care and hygiene practices and user behaviors performed in a sensitive environment like a bathroom, and to enable individuals to share their understandings, beliefs, and attitudes towards water consumption that are difficult to express through acts or words *(Section 3.1 Research*

Design: Generative Research). The adopted methodology, including generative research tools and tasks, will provide a valuable source of knowledge for researchers who will conduct user research in such sensitive environments, whereas the revealed information on the reasons for intensive use of water will support design practitioners while designing for change with a particular focus on water effectiveness.

2. *Diversity of user intentions for adopting change:*

It is often assumed that individuals would perform pro-environmental behaviors if the design interventions inform, enable or constraint them (Lockton et al., 2012). However, individuals may hold diverse interests, concerns, constraints, beliefs, and attitudes towards environmental issues that are influential in their overall intentions to adopt pro-environmental behaviors. There are a number of studies in the sustainability field aiming to explore and identify user types for behavior change with varying emphasizes (Coşkun, 2020; Coşkun, 2015; Coşkun & Erbuğ, 2014; Lilley et al., 2013; Lockton et al., 2012) *(see Section 2.6 Significance of User Diversity for Influencing Sustainable Behaviors).* The existing user typologies developed by the researchers focusing on behavior change for sustainability support that diverse target behaviors (i.e., mending behaviors, food waste behaviors) reveal different user types. Hence, this doctoral study intends to investigate and uncover the individuals' *practice-specific intentions towards adopting change for the effective use of water*, an area, which has not been explored before. This understanding is believed to support design practitioners during the development of ideas through enhancing the acceptance of the design interventions for effective use of water by individuals with diverse tendencies towards change.

3. *Communicating diverse behavior change strategies for inspiring ideation:*

Previous design research on the possibilities for behavior change for sustainability proposed a range of strategies and developed varying categorizations for them (Coşkun, 2015; Yun et al., 2013; Lidman & Renström 2011; Froehlich et al., 2010; Tang, 2010; Lilley, 2009; Wever et al., 2008; Elias et al., 2007; Lilley et al., 2005).

Even though these provide a valuable source for inspiring potential design interventions for behavior change, the lack of common terminology among them and limited guidance for selecting design strategies make it difficult to integrate them into the ideation process effectively. Advancing on this problem, this doctoral study proposes *a new categorization of design strategies* through a comprehensive review and comparison of nine diverse categorizations of design strategies aiming to influence sustainable behaviors *(see Section 2.5.3 Proposed Categorization for Design Strategies).* It includes five design strategies *(i.e., informing, engaging, motivating, guiding, and determining)* and diverse techniques for their implementation for influencing behavior change. The proposed design strategies are not specific to a particular practice or a behavior and provide opportunities for design practitioners to incorporate them into diverse design projects to support generating ideas for behavior change on diverse sustainability topics.

4. *Effective communication of research findings for influencing sustainable behaviors:*

For influencing sustainable behaviors through design, various behavioral theories, strategies, and techniques has been previously proposed by design researchers *(see Section 2.4 Approaches for Influencing Sustainable Behavior through Design and Section 2.5 A Review of Design Intervention Strategies for Influencing Sustainable Behaviors).* However, since designers may not be familiar with this theory-based field, they need information that they can easily grasp and integrate into the idea generation as designing for behavior change. In that sense, besides acquiring the reasons for the intensive use of water and user intentions for adopting change, how it is conveyed to designers to inform the generation of ideas for behavior change is of great importance. In the related literature, there appear several idea generation tools developed with the intention of informing and guiding the ideation process for behavior change for sustainability (Hoolahan & Browne, 2020; Artefactgroup, 2018; Toxboe, 2016; Coşkun, 2015; Daae, 2014; Lockton et al., 2010). With the aim of supporting the development of ideas for encouraging behavior change, these ideation

tools adopt diverse approaches and incorporate a range of strategies, examples, and exercises, most of which are derived from a literature review *(see Section 2.7 Idea Generation Tools for Influencing Sustainable Behaviors).* Some of these ideation tools provide insights related to a specific problem area or a target behavior concerning sustainability (Hoolahan, 2020; Coşkun, 2015), while others adopt an inclusive approach for behavior change and provide guidance that can be adapted to diverse research areas, including sustainability. Despite the differences, their incorporation into design projects focusing on diverse problems concerning sustainability (e.g., eco-friendly driving, reducing energy consumption) shows the value of equipping designers with the appropriate tools, procedures, and information in generating various ideas for behavior change. Nevertheless, as previously emphasized, promoting pro-environmental behaviors requires a comprehensive understanding of the individuals' practice specific behaviors along with the factors shaping them and the users' intentions for change to be able to influence them towards sustainable directions. This highlights the need to *facilitate a context specific research* (i.e., personal care and hygiene practices in the bathroom), *incorporate the findings into a generative tool* to inform the ideation process on particular problems and *develop a procedure* for designers to follow while integrating this knowledge into idea generation. This approach will support designers to familiarize themselves with the problem space and the user and recognize potential strategies and techniques to be adopted for designing for behavior change.

Considering the existing problems and expectations of designers, this thesis proposes *a generative tool* and *a generative method* for its integration into the early design process with a particular focus on informing the development of ideas for influencing behaviors for the effective use of water. The proposed tool differs from the previous examples in terms of its *scope* (i.e., effective use of water), *content* (i.e., behavior types, attitudinal and contextual determinants of behaviors, user intentions, and a new categorization of design strategies), and *origins of the content* (i.e., including findings, examples, and statements from the user research study and literature

review). Even though each component of the proposed generative tool provides a valuable knowledge source to mature this field, its main contribution is bringing together the *reasons for intensive use of water*, *user intentions* for adopting water effective use behaviors, and *design strategies* for altering behaviors in a single tool through adopting a holistic manner. The study also proposes a generative method including various tools, tasks, and a structured procedure for the effective integration of the generative tool into ideation that can be considered as one other contribution of this study to the field. The proposed generative tool and the method will provide guidance for design practitioners to directly incorporate or adapt them into diverse design projects to inspire the development of ideas for promoting pro-environmental behaviors and for design researchers to consult them while facilitating research on behavior change for sustainability.

As a designer and a design researcher, the issues mentioned above formed my main motivation for carrying out this doctoral study to explore the potential paths for guiding the design process to inspire design solutions aiming to support sustainable transition through enabling the effective use of water.

1.3 Aim, Goal Statement and Research Questions

This doctoral study aims to provide guidance for generating ideas for influencing behaviors for the effective use of water through revealing the reasons for intensive use of water, identifying the users' diverse intentions to adopt change, and proposing ways of delivering strategies for behavior change with a study focusing on personal care and hygiene activities in the bathroom environment.

To achieve this aim, the study will investigate (i) diverse behaviors that are responsible for intensive use of water and their attitudinal and contextual determinants, (ii) individuals' diverse intentions towards adopting water-effective behaviors, and (iii) diverse approaches and strategies for influencing sustainable behaviors. Then, it will (iv) transfer the research findings and insights into the

ideation phase of the design process to support generating diverse ideas for influencing water-effective behaviors through a generative tool (i.e., inspiration cards), and (iv) evaluate the implications of the generative tool for developing design solutions for sustainable behavior change. The findings from this study and the proposed generative tool intend to be used by designers and design researchers interested in promoting pro-environmental behaviors through design.

In pursuit of reaching its goals, the study asks the following main question:

- How can we support designers to understand the reasons for intensive use of water, recognize the users' diverse intentions to adopt responsible behaviors, and generate ideas for influencing behaviors for the effective use of water?

Intending to respond to this main question, it asks a range of sub-questions:

1. What are the diverse behaviors leading to intensive use of water while performing personal care and hygiene practices? What are the determinants that affect individuals to adopt these behaviors?
2. What are the individuals' diverse intentions for adopting behaviors for effective use of water while performing personal care and hygiene practices?
3. How can we communicate diverse techniques and strategies for behavior change to designers to inspire ideas for influencing sustainable behaviors?
4. How can we transfer the research findings and insights into the ideation to support generating diverse ideas for influencing behaviors for the effective use of water?
5. How does the incorporation of the proposed generative tool and the workshop procedure support the ideation process for developing solutions for the effective use of water?

1.4 Research Framework

In line with the objectives of the research, this doctoral study involves *a literature review*, *a generative user research study* on personal care and hygiene practices in the bathroom environment, and *a research through design study* for the development and evaluation of the generative tool and the workshop process for supporting the generation of ideas for the effective use of water (Figure 1.1).

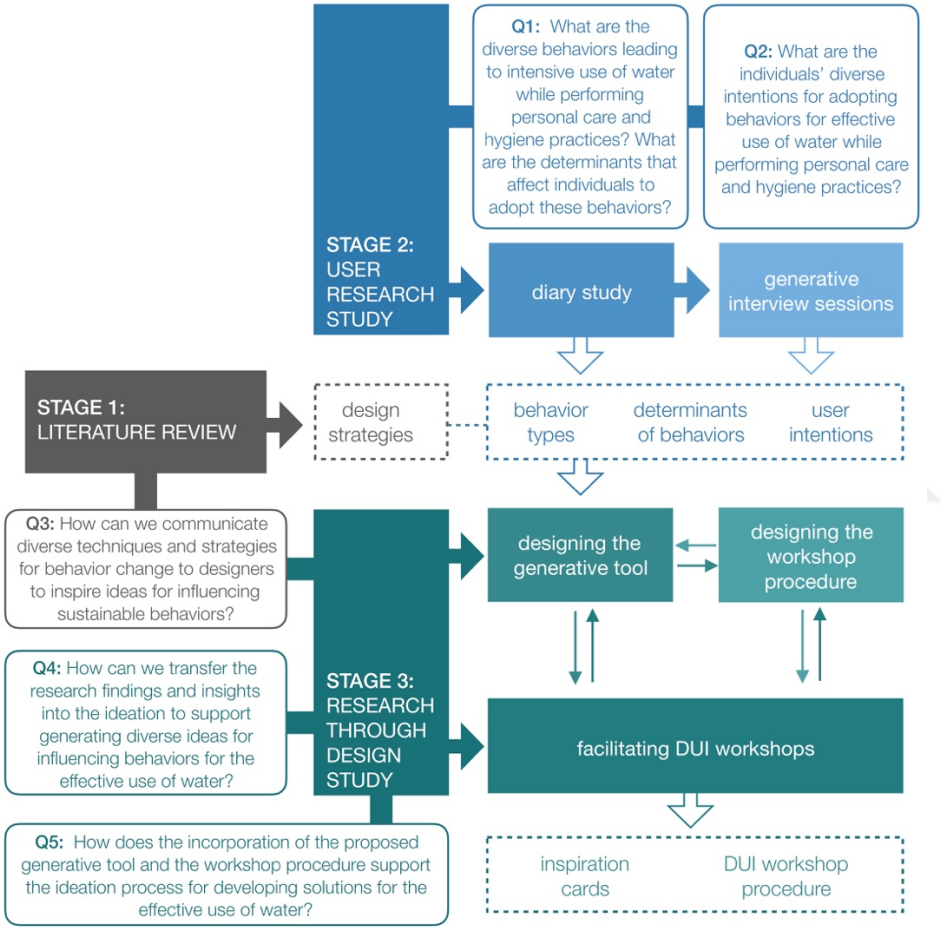


Figure 1.1: Research framework of this doctoral study

Through the literature review, current issues related to water consumption, behavioral theories and sustainability approaches for behavior change were explored. This phase supported (i) the identification of the focus of this doctoral

study, (ii) recognizing diverse research methods and approaches that can be used for acquiring individuals' behaviors and behavioral determinants, and also informed (iii) the development of a new categorization of design strategies for behavior change through a comprehensive review of the existing research on the area.

During the user research study, *a diary study,* enabling individuals to recognize their personal care and hygiene practices through tracking and recording their behaviors, and *generative interview sessions,* revealing the rationale behind individuals' water-consuming use behaviors, understandings about water consumption, and intentions for adopting change, were facilitated as complementary to each other. This stage of the doctoral study adopts a *generative research approach* through utilizing a range of projective tools and tasks designed and developed with the aim of supporting individuals to effectively convey their behaviors, experiences, concerns, suggestions, expectations, and understandings in relation to the problem area.

In the last stage of the study, how the findings and insights from the literature review and user research study would inform the development of ideas for behavior change was explored. This final stage adopts a *research through design approach* in which a generative tool and a workshop procedure were developed, revised, and refined through a series of design workshops facilitated with graduate and undergraduate design students. The implications of the proposed generative tool and the workshop procedure were evaluated to reveal how they support the ideation process for influencing water effective use behaviors as performing personal care and hygiene practices in the bathroom.

1.5 Structure of the Dissertation

This dissertation is composed of five chapters. Chapter 1 introduces the problem background and highlights the significance of this study. Then, it defines the scope of this dissertation by explaining the aim and objectives of the research and the

research questions and presents the research framework to respond to these questions.

In Chapter 2, an overview of the background of the research topic, including the current state of the household water consumption, behavioral theories and models to identify the determinants of behaviors, diverse approaches (i.e., theories, strategies, tools, and user research methods) for influencing sustainable behaviors through design are presented. It contributes to locating this doctoral study among others through highlighting research gaps to be addressed.

Chapter 3 is allocated for the user research study (i.e., a diary study and generative interview sessions), which shares the details of the adopted methodology, the research process, and the analysis of the study, and reveals and discusses its main findings through reflecting on the limitations.

Chapter 4 presents the design workshop sessions by introducing the study methodology, the development of the generative tool and the workshop procedure, the research process of the design workshops, and the analysis of the study. Sharing the main findings from the three workshop sessions, it discusses the implications of the proposed tool and the workshop procedure in relation to designing for behavior change.

Through answering the research questions, Chapter 5 discusses the main contributions of this doctoral study for design research and practice, its limitations, and the opportunities it provides for further research.

CHAPTER 2

INFLUENCING SUSTAINABLE BEHAVIORS THROUGH DESIGN

The growing interest in designing for behavior change and the increasing number of research studies conducted in this field with various emphases provide a valuable source for designers and design researchers intending to promote sustainable behaviors through design. The purpose of this literature review is to understand existing approaches for behavior change and sustainability and reveal the possibilities they offer for designing for influencing behaviors for the effective use of water. After a brief introduction related to current issues on household water consumption, this chapter continues with discussing how behaviors occur through highlighting significant behavioral determinants for pro-environmental behaviors. Then, it presents diverse approaches and theories, behavior change strategies, ideation tools, and user research methods with a particular focus on influencing sustainable behaviors through design and discusses their implications for this study. It concludes with discussing how this review contributes to identifying the research gaps and locating this doctoral study among others.

2.1 Household Water Consumption

As one of the most significant socio-environmental challenges, water scarcity is affecting the lives of people across many regions of the world. Although water is a renewable resource, the increasing pollution and its contamination with hazardous materials and chemicals and overuse have been threatening the world water supplies. Within the last century, the dramatic increase in the global water demand by 600 % (Wada et al., 2016) highlights the necessity of taking serious measures. This global

issue has also been underpinned by one of the Sustainable Development Goals (SDGs), *"ensure access to water and sanitation for all"* (Goal 6), which emphasizes the importance of safe access to clean water resources for everyone, improving the water quality and increasing efficient use of water (The United Nations, 2015).

This global problem is experienced significantly on the regional level since water, unlike energy and other resources, is quite difficult to transport. Turkey is defined as a water-stressed region with annual water consumption of 1386 cubic meters per person (Hakyemez, 2019), and this is estimated to decrease as a consequence of the increasing population and unsustainable water consumption patterns. Around 15% of the overall water supply of Turkey is consumed through households, while the rest is linked to agricultural irrigation (74%) and industrial purposes (11%) (Gleick et al., 2014). Even the overall ratio of household water consumption may seem lower compared to other areas; it is an issue that every individual can relate to and take action.

With the individuals' reshaped behavioral routines and hygiene practices during the pandemic, water consumption and household water demand have been affected significantly. If individuals prefer to pursue the adaptations in their everyday lives (e.g., working from home, repetitive hand washing, etc.), this may result in long-term alterations of practices and an increase in the related water demand (Lüdtke et al., 2021). Together with the existing climatic effects (e.g., higher temperatures associated with climate change, droughts, etc.), the implications of the crisis on water consumption are estimated to be a long-term phenomenon and result in the inadequacy and inaccessibility of clean water resources. Unless new ways of managing water consumption are considered, it is likely to experience water shortages in the near future of Turkey.

In households, water is mainly utilized for the purposes of preparing food, performing personal hygiene practices, and cleaning (Orr et al., 2018). Along with the indoor functions, a considerable amount of water is also used outside the home

for gardening and car washing. Within the households, considering the richness of water-consuming practices, the bathroom environment holds many opportunities for influencing water effective use behaviors where showers (25%), toilets (22%), baths (8%), and bathroom sinks (13%) consume more than two-thirds (68%) of the overall household water use (Energy Saving Trust, 2013).

With the aim of controlling this growing water demand in households, there have been many interventions at the organizational, technological, and individual levels. Temporary *legislation for restricting water use* for specific purposes (i.e., gardening and car washing), *regulations for building standards* to follow the water efficiency requirements, and *pricing strategies* (Orr et al., 2018) are among the commonly adopted organizational interventions to reduce household water consumption. Pricing strategies, for instance, such as peak-time pricing and increase in water price, have shown little impact on the individuals' behaviors and overall water consumption (Ramli, 2021). Yet, in the related literature, the available data evaluating the long-term implications of all these organizational measures are often limited. At the technological level, mounting *metering mechanisms* to relate the cost of water to the consumed amount, installing *water-saving devices* (e.g., reduced capacity baths, dual flush toilets, low flow taps), and utilizing *water-efficient appliances* contributes significantly to the reductions in water consumption. At the individual level, a range of intervention strategies is adopted, including *information and awareness-raising campaigns*, *personalized information and feedback on water consumption*, *engagement, advice, and prompts* on using water more efficiently (Orr et al., 2018; Schultz et al., 2016). Even interventions at the individual level are found more promising for encouraging pro-environmental behaviors (Ramli, 2021); others criticize overemphasizing the contribution of individual decisions in water consumption (Shove, 2003). It is argued that practices are shaped around many factors, including habitual behaviors, technologies, and infrastructures, cultural and social aspects influencing practices, beliefs about cleanliness and comfort (Pullinger et al., 2013). Even individuals are always in the center, the factors affecting practices

that are responsible for intensive use of water need to be thoroughly understood for altering them towards the intended directions.

2.2 Personal Care and Hygiene Practices in the Bathroom Environment

Personal care and hygiene practices have been transitioning over time due to changing expectations of comfort and cleanliness and the introduction of new technologies and materials in bathroom environments (Shove, 2003). Along with the time, practices also show differences within diverse age groups. For instance, with the increased emphasis on personal care in general, new types of hygiene practices have emerged, particularly among the new generations (Pullinger et al., 2013). While younger generations tend to shower and bath more frequently, older generations prefer to take hot and long showers to ease aches and pains.

There appear several *emotional and physiological aspects* of performing personal care and hygiene practices, including getting warm or cool, relaxing muscles, feeling good and refreshed, getting ready, softening skin, styling hair, smelling good, feeling clean, looking presentable, removing sweat, getting clean, having a good mood, waking up and relieving stress (Kuijer, 2014). While getting clean to wash off the dirt, germs, sweat, and odor is often considered a simple and quick process, feeling clean requires more work, heat, time, environmental setting, and necessary materials (Scott et al., 2012). Individuals also perform some rituals such as getting clean to feel relaxed, revive, prepare for the day and relieve stress. These *emotional needs* through which the water is not used for any functional cleaning purposes are often significant contributors to intensive water consumption.

Current modes of cleaning the body with constantly flowing water are also criticized for not being the most effective method of achieving personal hygiene since much of the water touches the body and then flows down the drain while still warm and relatively clean, and a considerable amount of heat is lost to the surroundings (Scott et al., 2012). The situation is quite the same in the washbasin area, where a

considerable amount of water flows unnecessarily and is wasted as splashing water to the face, soaping hands, and brushing teeth.

In a study focusing on bathing practices, frequency, duration, water flow, and water temperature are revealed to be the main predictors of intensive water consumption (Kuijer, 2014). The frequency of personal care and hygiene practices is mainly determined by the daily routines of individuals, including waking up in the morning and preparing for the day, going out to work or school, exercising, or preparing for bed. Duration is closely related to the situations (e.g., time constraints, weather), bodies (e.g., long hair, physical ability), and material things (e.g., foaming up and rinsing off cleaning materials) (Kuijer, 2014). High flow rates are linked to the individuals' need to feel relaxed and energetic while cleaning themselves. Finally, high temperatures are associated with comfort, and individuals tend to increase the temperature throughout the diverse stages of the activities with various purposes (Kuijer, 2014).

In previous research on water conservation, researchers have not reached a consensus on the implication of demographic factors on water consumption such as education level, environmental knowledge, income, residence type and ownership, and household size, yet they discussed their diverse contributions to household water demand (Grafton, 2014). While some researchers associated water conservation behaviors with high income and education, others proposed a direct relation between water conservation and lower income and education (Grafton, 2014). Even low-income families tend to engage in water saving behaviors, their ability to invest in resource-efficient technologies is determined mainly by socio-economic variables (Hasan et al., 2021). However, having water-saving technologies may not necessarily turn into adopting water-effective behaviors unless individuals possess positive attitudes towards this issue.

The reviewed studies and approaches suggest that household water use is part of a comprehensive system affected by a variety of individual, social, contextual, and

demographic factors. This supports the need to go beyond the interactions between individuals and products but look at the personal care and hygiene practices as a whole and understand the diverse factors that shape individuals' behaviors responsible for intensive use of water. Thoroughly understanding the existing water-consuming personal care and hygiene practices is quite significant for projecting the future needs and expectations and developing design interventions accordingly in a holistic manner.

2.3 What Determines Behaviors

Understanding the reasons for a behavior to occur is a complex topic that is related to many disciplines. Behavioral and social sciences devoted great efforts to understand what drives behavior through proposing numerous theories and models (Klöckner & Blöbaum, 2010; Fogg, 2009; Stern, 2000; Ölander & Thøgersen, 1995; Ajzen, 1991; Triandis, 1977; Fishbein & Ajzen, 1975) that encompass various factors to explain the reasoning behind a behavior. However, there is not a single definitive explanation of what motivates behavior since it is influenced by various factors. In the related literature, some researchers deliberately focus on particular aspects of behaviors (Ajzen, 1991), whereas others adopt a more comprehensive approach for explaining behaviors and include multitude of diverse factors to explain what mediates them (Klöckner & Blöbaum, 2010; Triandis, 1977). Considering their relevance to understanding pro-environmental behaviors, various behavior models, including *Theory of Planned Behavior (TPB)* (Ajzen, 1991), *Theory of Interpersonal Behaviour (TIB)* (Triandis, 1977), *Attitude-Behaviour-Context (ABC)* (Stern, 2000), *Motivation-Opportunity-Ability (MOA)* (Ölander and Thøgersen, 1995), Fogg Behavior Model (FBM) (Fogg, 2009), and *Comprehensive Action Determination Model (CADM)* (Klöckner and Blöbaum, 2010) have been reviewed in this doctoral study. Within these reviewed behavior models, attitudinal approaches suggest that understanding a behavior requires an understanding of the individuals' cognition

(e.g., thinking, understanding, and making decisions), whereas contextual approaches focus on the context in which a behavior occurs.

Attitudinal approaches to behaviors mainly focus on the internal factors and assume that our thinking processes affect the way we behave. They suggest that for a behavior change to occur, it is essential to change individuals' thinking processes (e.g., perceived behavioral control, beliefs, subjective norms, attitudes); thereby, they would perform intended behaviors or not behave in certain ways.

In relation to pro-environmental behaviors, influencing individuals' attitudes towards environmental consequences of behaviors, values about the correctness of behaviors, or beliefs about the perceived difficulties to perform behaviors could motivate them to engage in responsible behaviors. In that sense, comprehending the internal factors shaping behaviors is quite significant to mediate them towards the intended directions.

While exploring behaviors, it is rather difficult to separate *attitudinal* and *contextual* factors since all cognition occurs in a context. However, the implications of contextual factors for mediating behaviors are often overlooked in widely used behavioral models, whereas some recognize their significance (Klöckner & Blöbaum, 2010; Stern, 2000; Ölander & Thøgersen, 1995).

Context includes the physical as well as the social environment in which the behaviors occur. Individuals use context-specific cues to determine appropriate behaviors to be adopted and perform these within their social environments (Stern, 2000). Physically designed environments, similarly, have the power to guide people to behave in certain ways by making it easier, less reinforcing, and sometimes impossible to perform behaviors.

Contextual approaches to behaviors encompass a wide range of determinants, including all external sources of support or opposition to behaviors (e.g., constraints and physical capabilities, monetary incentives and costs, interpersonal influences [social norms], and institutional and legal factors) (Stern, 2000). The lack of time,

cost, and effort that the user is expected to perform can be significant barriers to adopting behaviors.

In the case of adopting pro-environmental behaviors, products, systems, services, and the social and physical environment that surround them could mediate the individuals' behaviors through affecting their attitudes, habits, and intentions while they could also directly determine their interactions and experiences with their surroundings. In that sense, investigating the behaviors in relation to their contexts is of great importance to understand, predict and influence intended behaviors.

In this doctoral study, rather than focusing on a single behavior model, multiple models have been explored to have a more comprehensive understanding of the factors affecting pro-environmental behaviors. In line with the findings from this review, prominent *attitudinal* (internal) and *contextual* (external) factors will be presented by discussing their relevance for understanding and influencing pro-environmental behaviors.

Intentions

In many behavior models, *intentions* are considered as the main component of the construction of a behavior (Klöckner & Blöbaum, 2010; Ölander & Thøgersen, 1995; Ajzen, 1991; Triandis, 1977). Intentions can be defined as individuals' subjective probability, readiness, and determination to act in a certain way (Ajzen, 1991). If a person's intention to perform a behavior is stronger, then the particular behavior is more likely to be performed.

Diverse behavior models suggest various factors contributing to the establishment of intentions, including attitudes, norms, beliefs, emotions, habits, and external factors. Because of this diversity of factors influencing intentions, two individuals with different beliefs about the environmental consequences of their transportation habits, for instance, may have equally strong intentions towards using public transportation to reduce their carbon footprint.

It should be recognized that behavioral intention is strongest when the individual has the power to choose whether or not to adopt a certain behavior (Ajzen, 1991). Performing some behaviors, for instance, may be dependent on non-motivational variables, including the availability of necessary skills, financial opportunities, time, and collaboration of others. In such cases, the individual needs to possess both the requisite resources and the intention towards the behavior, then it would be possible to perform it. In the case of water consumption, for example, individuals' positive attitudes towards reducing water consumption and strong intentions to alter their behaviors need to be supported with contextual opportunities (e.g., availability of water-efficient products, proper access to hot water, etc.) to empower them to perform intended behaviors.

Attitudes

Attitudes, which are the result of deliberative evaluations of people's beliefs about a behavior and its expected outcomes, have been considered by many researchers as one of the prominent factors determining the adoption of a behavior (Klöckner & Blöbaum, 2010; Stern, 2000; Ajzen, 1991; Triandis, 1977). As the behaviors are already valued as positive or negative, we simultaneously develop an attitude towards them. We acquire favorable attitudes towards the behaviors associated with desirable consequences, whereas those believed to have negative implications are considered unfavorable (Ajzen, 1991). If the attitude towards a behavior is more favorable, then the intention to adopt that behavior is stronger.

The relation between the behavior and attitude is often consistent, yet in some cases, this relation may be stronger or weaker than others. Stern (2000) suggests that the power of the attitudes to construct a behavior is directly related to how strongly the context influences the behavior. If the context has a strong influence on the behavior, either positive or negative, then the attitude affects the behavior very little. For example, if it is extremely easy to recycle, then the individuals' attitudes would not make a considerable impact on adopting that behavior. On the other hand, in a

situation where the contextual factors are weak (e.g., reutilizing water is possible but not relatively easy), the relationship between attitude and behavior is strongest.

Even though there is a common consensus that attitudes affect individuals' intentions which are directly transferred into behaviors (Ajzen, 1991; Triandis, 1977), attitudes may also be the result of the behavior itself. In that sense, designing with an intention to alter individuals' attitudes may result in behavior change, whereas designing for changing their behaviors may also result in influencing their attitudes (Lockton, 2013).

Regarding attitudes towards pro-environmental behaviors, each belief associates the behavior with a distinct negative or positive consequence. For instance, believing that waste sorting would not make any difference in overall environmental pollution would lead to a negative attitude towards adopting waste management behavior. Realizing the overall implications of attitudes on the formation of behaviors, investigating individuals' attitudes towards water consumption in relation to personal care and hygiene practices appears significant to stimulate behaviors for effective use of water.

Norms

Individuals are inherently social beings, and their behaviors are influenced by the existence, values, and expectations of other people as well as their own moral obligations. Individuals' beliefs about the correctness of a behavior and others' approval or disapproval of performing a behavior can be a powerful predictor of whether or not they will engage in that particular behavior (Fishbein & Ajzen, 1975; Triandis, 1977).

Subjective/social norms are socially constructed rules or perceived social pressure about what should and should not be done (Ajzen, 1991). In our everyday life, we often use the behaviors of others intentionally or unintentionally as a guide for constructing our own behaviors or feel pressure to act in certain ways, which are all guided by social norms. Along with the social rules, *personal norms*, defined as

feelings of personal moral responsibility in relation to adopting or rejecting to perform a behavior, are also significant drivers for determining a behavior (Ajzen, 1991). They are not developed during the decision-making process as performing behaviors, but they are relatively stable and related to individuals' value systems.

For adopting environmentally responsible use behaviors, social as well as personal norms can be strong determinants. For instance, being supported by others for cycling to work or seeing people as cycling may encourage individuals to adopt this behavior to reduce their carbon footprint. The findings from a study, where participants were provided with normative information about the water usage of other households in their neighborhood, showed that these households receiving social norms messages consumed less water (Schultz et al., 2016). Considering this, an exploration of norms that contribute to the development of behaviors for intensive use of water is important to be able to use them effectively for promoting sustainable behaviors.

Habits

According to the related theoretical frameworks, individuals often make rational decisions as performing behaviors. However, in many circumstances, rather than being guided by detailed reasoning, behavior is habitual and driven through automatic cognitive processes (Steg & Vlek, 2009). Several behavior models recognize the role of *habits* for mediating behaviors, which is often neglected in the earlier models (Klöckner & Blöbaum, 2010; Triandis, 1977; Ölander & Thøgersen, 1995). Habits are a set of learned behaviors that are performed as an automatic response to certain signs and often executed with little or no cognitive effort and awareness (Verplanken & Wood, 2006; Jackson, 2005; Triandis, 1977). As performing a habitual behavior, the individual does not engage in the reasoning of what may be the best thing to do or consider the expected outcomes associated with that behavior.

Habits are formed through creating connections in memory between behaviors and stable conditions under which they are performed (Klöckner & Blöbaum, 2010; Verplanken & Wood, 2006), implying that the past behaviors and the context are significant determinants of the habits. In that sense, habits can be triggered by prior responses, environmental cues (e.g., a product, specific time of the day), and internal states (e.g., certain moods like cleaning the house every time one is depressed) (Verplanken & Wood, 2006).

While performing a new behavior, the intention mainly determines the behavior, whereas when the behavior is old and over-learned and has been performed many times, the behavior is believed to be under the influence of habit (Triandis, 1977). Yet, when the context changes significantly, habits tend to be reconsidered highlighting the potentials of design to alter individuals' habits.

Individuals' habitual and routine everyday behaviors make their environmental consequences less visible to recognize since they are performed without detailed reasoning. For instance, leaving the tap on as brushing teeth or running water unnecessarily as it warms up are considerable contributors to overall household water consumption that are often performed without any conscious deliberation. Considering these, it is important to investigate how individuals' water-consuming habits are formed and sustained to influence them towards the desired directions through design interventions.

Constraints

The possibility of behaving in a certain way is influenced by individuals' understanding of an effort they feel that they must expend to perform a particular behavior. This understanding is often named as *subjective constraints* (Klöckner & Blöbaum, 2010) or *perceived behavioral control* (Ajzen, 1991), and it encompasses the factors that are considered as limiting or enabling to perform a behavior. Apart from actually having the required skills to perform a behavior, individuals' confidence in their capabilities to perform that behavior directly influences the

occurrence of the behavior (Ajzen, 1991). For example, when two people have strong intentions to reduce their carbon footprint through cycling to work, it is probable that the one who believes he/she can maintain this activity in the long-term would preserve the behavior while the one who is uncertain about his/her abilities would not.

Objective constraints, on the other hand, include external constraints that exist independently of individuals' perceptions and enable or limit the behavior directly (Klöckner & Blöbaum, 2010). They can be described as the existence or lack of the necessary resources and possibilities for a behavior to occur. For example, infrastructure or system-based problems (e.g., the layout of the environment, constraints designed into the products) may have implications on adopting environmentally responsible behaviors. In that sense, the availability and the ease of access to a composter in apartments may act as a facilitator to adopt composting behaviors. In the reverse case, where there is not any composter or one available, but far away, individuals may need additional motivations to perform this behavior.

When constraints are quite severe, individuals' attitudes will make very little difference in performing environmental behaviors. This clarifies that along with the internal factors such as attitudes and norms, "physical infrastructure, technical facilities, the availability of products, and product characteristics" (Steg & Vlek, 2009, p.312) are significant factors for affecting behaviors or contributing to the attitudes and motivations that shape them.

While influencing pro-environmental behaviors, altering individuals' perception of ease or difficulty to perform a desired behavior or creating actual physical possibilities to ease acting in a desired way can influence the established unsustainable use behaviors towards sustainable ones.

2.3.1 Reflections on Behavioral Determinants

This section discusses the behavioral determinants that are prominent for adopting pro-environmental behaviors and their importance in designing for influencing sustainable behaviors. It is apparent that behavior is influenced through cognition as well as physical and social contexts that are often interrelated to and influence each other.

Attitudinal determinants represent individuals' thinking processes, including their intentions, attitudes, personal norms, habits, and perceived behavior control that are further affected by their beliefs, values, and emotions. Design offers opportunities for influencing individuals' cognitive evaluations. For instance, providing information about an environmental consequence of a behavior may alter individuals' attitudes and inspire them to adopt intended behaviors. Developing design interventions can also be effective in influencing individuals' perception of ease to perform pro-environmental behaviors and even breaking or modifying their existing habits responsible for environmental consequences.

Contextual determinants encompass the context in which behaviors are performed, including the facilitators, constraints, and the structure of the society. Design is a powerful means to manipulate contextual factors as well as attitudinal ones. It can create possibilities such as making it easier, affordable, or rewarding to perform sustainable behaviors. Besides, revealing how other people behave to reduce their environmental impacts can provide peer pressure and support and motivate individuals to adopt pro-environmental behaviors. Considering these, comprehending the attitudinal and contextual determinants that structure the performance of behaviors is important to predict and alter them towards sustainable directions.

2.4 Approaches for Influencing Sustainable Behavior through Design

The significance of design as a means for influencing or altering behaviors has gained increased interest in many research areas, particularly within the field of sustainable design. Design researchers in this area suggest that the design of the products has a considerable effect on the individuals' behaviors through shaping how they engage with their surroundings. This suggest that design has the power to promote pro-environmental use behaviors among individuals if used intentionally.

The use phase of products is responsible for considerable environmental and social impacts regarding the intrinsic properties of products but mostly results from the individuals' use patterns. For instance, in the current kettles' heating system, there is very little to be optimized. But, if the use pattern that we repeatedly and unnecessarily boil water is altered, a considerable reduction in energy, as well as water loss, can be achieved.

This section presents different approaches adopted by design researchers for influencing sustainable behaviors*; practice oriented design, critical design, persuasive technologies,* and *design for sustainable behavior*. While the last one evolved particularly within the area of sustainability, others are broad approaches that are applied to sustainable design.

2.4.1 Practice Oriented Design

Practice is commonly defined as "a routinised way in which bodies are moved, objects are handled, subjects are treated, things are described, and the world is understood" (Reckwitz, 2002, p.250). Practices are inherently social in nature, and people learn practices from each other. They are also dynamic, can be reproduced, altered, stabilized, and destabilized over time. When new ideas or new products are introduced, existing practices may change, and new ones can be created. Practice theory provides a sociological understanding of the ways and reasons for individuals'

engagement with their surroundings. It offers a promising contribution for sustainable transitions in everyday life through enabling closer inspection of the daily routines and related social and material factors that structure the socially and environmentally unsustainable lifestyles (Hoolohan & Browne, 2020; Scott et al., 2012).

Practice oriented design, which is influenced by the social practice theories, adopts the idea that persistency or alterations in practices can contribute to sustainable transitions through establishing and encouraging responsible ways of living (Shove et al., 2007; Scott et al., 2012, Kuijer 2014; Pettersen, 2016). While User-Centred Design (UCD) explores user needs and expectations through focusing on products and individual users, practice-oriented design moves the emphasis from the individual and the product to the practices in order to enable a reflexive design approach (Hoolohan & Browne, 2020). The practice of food preparation, for instance, cannot be reduced to an oven, a cook, or a grill. Where the practice and the product co-evolve, the practice should be at the center of attention rather than the object or the user. The approach mainly aims to understand the dynamics of practices and identify the points for intervention to influence the evolution of practices over time. Consequently, it has a significant potential to change currently unsustainable behavior patterns through altering already established practices.

The understanding of the practices' contribution in sustainable transitions has been leading the recent research studies into how adopting a practice theory approach can inform the design processes, such as the study conducted on bathing practices by Scott et al. (2012) and thermal comfort by Kuijer (2014). The prior research enabled individuals to track their existing bathing practices and deconstruct them through experimenting with alternative ways of cleaning the body to reduce water use or improve the effectiveness of their routine. The adopted practice oriented design approach informed design solution areas that might support influencing bathing practices towards more sustainable directions (Scott et al., 2012). While Scott et al.'s (2012) research mainly focused on generating insights for product development, the

latter study went one step further and developed design prototypes and evaluated their implications. The study (i) explored and analyzed practices of thermal comfort from a sustainable design perspective and (ii) reconfigured practices of staying warm at home to enable resource effectiveness (Kuijer, 2014). In the reconfiguration phase, four prototypes (i.e., SnaP, IGNITE, SOE, and MANGO) offering opportunities for personal heating have been developed by master students (Figure 2.1). The particular emphasis was on exploring diverse ways of usages and how these interfere with or fit into the established heating practices rather than evaluating whether the product achieved to reduce energy consumption for the targeted practice. The findings from the study revealed promising opportunities for desirable change regarding domestic thermal comfort practices.



Figure 2.1: SOE; a wearable personal heat source containing integrated heat wires (Kuijer, 2014)

Practice-oriented design has great potential to support transitioning towards sustainable ways of living through (i) inquiring into the existing practices to understand established behaviors and individual, social and material factors shaping them and (ii) enabling individuals to reconsider and experiment with possible future practices. In this doctoral study, adopting a *practice oriented design approach* is considered to gain an in depth understanding of the routines and habits of personal

care and hygiene practices leading to intensive use of water and to identify opportunities for change to influence these practices towards sustainable directions.

2.4.2 Critical Design

Critical design was first introduced by Dunne (1997) as a design approach aiming to challenge individuals' understandings, preconceptions, and expectations about objects and the way they interact with them. Through the design of experimental objects, the approach criticizes cultural, technological, social and economic issues. Rather than problem-solving, a critical design is an approach for provocation which stimulates new ways of thinking about the products, their usages, and contexts to raise awareness and challenge assumptions. It mainly focuses on the "present social, cultural and ethical implications of design objects and practice" (Malpass, 2012, p.186), yet it is aware of the power of design to shape the future towards the desired directions (Jakobsone, 2017).

Within the area of sustainable design, the need for addressing contemporary challenges, particularly societal and environmental issues we face today, has inspired questioning and reconsidering the current design processes. Researchers adopting a critical design approach to explore means of promoting sustainable behaviors have so far investigated awareness of energy and water consumption, air pollution, and waste management issues (Pierce & Paulos, 2013; Maze & Redstom, 2008; Ernevi et al., 2007; Paulos & Jenkins, 2005; Gustafsson & Gyllenswärd, 2005). Yet, the focus of these studies has mainly been on making resources more visible as a material. *Element* (Figure 2.2), as one of the initial examples in the area, is a radiator design that is made out of 35 light bulbs. It has similar heat emission and power requirements to an ordinary electric radiator. It enables users to recognize the energy through visualizing the heat and raises questions regarding the properties and relationships among heat, light, and electricity (Gustafsson & Gyllenswärd, 2005).



Figure 2.2: Element; an electric radiator visualizing the energy level in real-time (Gustafsson & Gyllenswärd, 2005)

Pierce and Paulos (2010), adopting a different approach, suggested ways of materializing the energy to create critical debates about generating, distributing, consuming and storing energy. This study aimed to promote new ways of emotional attachment to and connection with energy. *Shake-light bottle* (Figure 2.3), for instance, collects energy by shaking the bottle (Pierce & Paulos, 2010). Then, through removing its cap, the stored energy is transformed into light energy and causes the bottle to glow. The bottle is suggested to be presented as a representation of one's personal energy. Another example, aiming to enable individuals to consider the sourcing and ownership of energy, is *Energy parasites* (Figure 2.3), developed by Paulos (2011). They are handcrafted objects designed from discarded product parts that harvest small amounts of energy across public spaces and landscapes such as escalators. The produced energy can be stored, expressed, or transferred to charge small electronic devices.

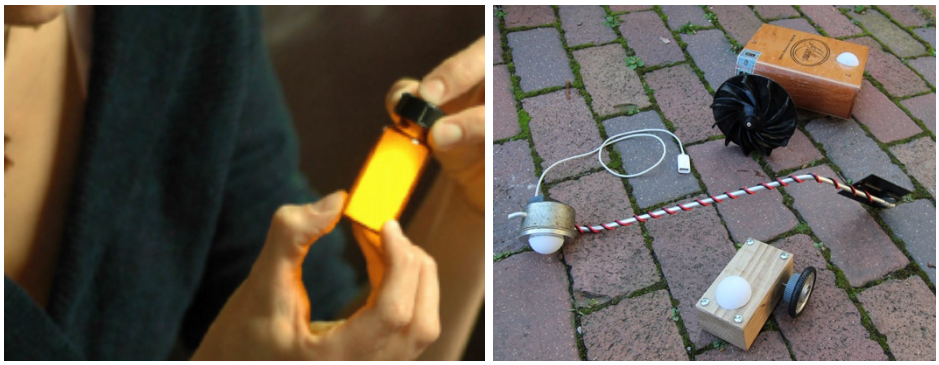


Figure 2.3: (left) Shake-light bottle (Pierce & Paulos, 2010); (right) Energy Parasites (Paulos, 2011)

Through these examples on energy consumption, it can be interpreted that the critical design approach provides possibilities for creating awareness related to contemporary issues through enabling individuals to engage with and question their surroundings. The provided design solutions are beyond simply presenting numeric data related to resource consumption which may remain limited for the user to perceive and comprehend the meaning of energy. Instead, they provoke critical debates on current patterns of intensive consumption and related environmental and social implications of unsustainable use patterns.

In relation to this doctoral study, the *critical design approach*, which holds the potentials to empower individuals to create meaningful relationships with their surroundings through appealing to their emotions to recognize environmental problems and act responsibly, contributed to the recategorization of design strategies for promoting sustainable behaviors and defining the *engaging strategy* which will be covered through further sections *(see Section 2.5.3 Proposed Categorization for Design Strategies)*.

2.4.3 Persuasive Technologies

Persuasive technologies aim to guide people's attitudes and behaviors towards desired directions through the use and design of interactive, computational

technologies (Fogg, 2003). This interdisciplinary research field mainly focuses on digital objects, whereas previously mentioned approaches on sustainable behavior change mostly deal with the physical objects. Persuasive technologies are ubiquitous since we are surrounded by digital products that are intentionally or unintentionally developed to influence individuals' behaviors and perceptions (Fogg, 2003). The approach adopts persuasion and social influence to guide behaviors towards a particular way rather than coercion. According to Fogg's Behavior Model (FBM), which describes the variables influencing the effectiveness of a persuasive solution, individual's behavior is a result of three main factors which are motivation, ability, and trigger (Fogg, 2009). Persuasive technology experiences may be derived from interaction with a wide range of sources, including mobile phones (e.g., mobile applications, persuasive games), websites, or specialized consumer electronic devices (e.g., ambient displays, trackers) that act as a motivation or a trigger. A display of an activity tracker, for example, makes people aware of their daily activities (e.g., number of steps, burned calories, heart rate, sleep rate) that otherwise might have been invisible to them. It may provide suggestions or warnings to individuals and motivate or trigger increasing physical activity. Connecting with social networking platforms increases the visibility of the individuals' physical activities to others, and in turn may encourage performing intended behaviors. As designing for persuading intended behaviors, Fogg (2003) proposed seven persuasive tools to influence behaviors, including "reduction, tunneling, tailoring, suggestion, self-monitoring, surveillance, and conditioning" (Figure 2.4). These tools are suggested to be used in combination with each other to promote intended behaviors.

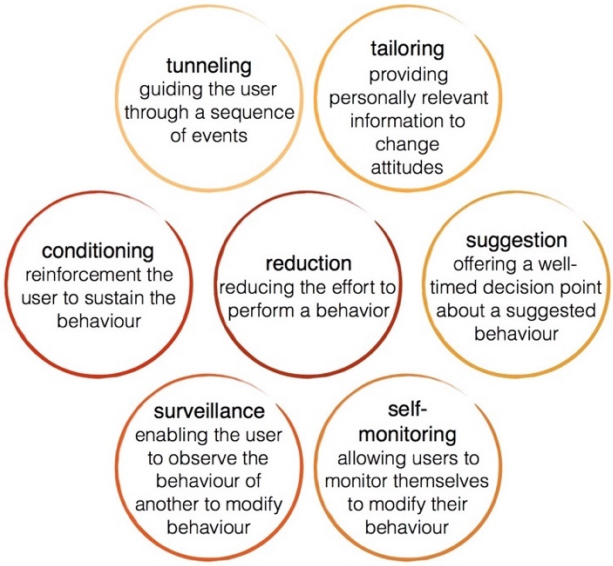


Figure 2.4: Fogg's seven tools for persuading intended behavior (reproduced from Fogg, 2003)

Since persuasive technologies are heavily based on computer interaction and interface design, it has gained significant interest in areas including Information and Communication Technologies (ICT), Human Computer Interaction (HCI), and software engineering. Researchers exploring sustainable behavior change suggest that many of the methods and strategies adopted in this field can be adapted into the area of sustainable design (Lockton et al., 2008). Considering that, there is an increasing number of research studies focusing on how persuasive technologies can reduce social and environmental impacts of product use. Even this particular research area is dominated by studies focusing on electricity consumption, studies within the areas of water consumption, sustainable transportation, waste disposal, and air quality are gaining interest (Agnisarman et al., 2018; Kjeldkov et al., 2012; Arroyo et al., 2005). As one of the early examples of persuasive technology on environmental issues, *Energy Aware Clock* (Figure 2.5) aims to make energy awareness a part of everyday life (Broms et al., 2010). The clock, which is wirelessly connected to an energy meter, visualizes household electricity use through an abstract representation of time. Once an electrical appliance is turned on, a longer

line appears on the clock's screen, and it leaves a trace behind as the time passes to demonstrate the history of energy use. Along with providing real-time feedback, it motivates users to make the pattern smaller each day and save energy.



Figure 2.5: The Energy aware clock (Broms et al., 2010)

Another example is *The Shower Calendar* which consists of a display reflected on the shower aiming to visualize the individual water consumption to encourage reducing water use while showering (Figure 2.6). The provided feedback fosters awareness of water consumption through adopting strategies including goal setting, comparison, competition, and communication (Laschke et al., 2011). Upon pressing a button, a large personalized colored dot appears on the calendar, and it gets smaller with consumption. The dots that remained on display represents the history of each individuals' water use. The prototype was tested in two households with six people for a month. The evaluation revealed that the design intervention has been effective in translating the received data into use behaviors and achieved a significant decrease in household water use in one of the families. Yet, there is a possibility that one might realize that others in the household consume more water and, in turn, adjust their consumption upwards.



Figure 2.6: (left) The shower calendar; (right) general setup of the functional prototype of the study (Laschke et al., 2011)

It is widely acknowledged that technology has a direct influence on shaping individuals' behaviors. Persuasive technologies can manipulate individuals' thinking processes and behavioral patterns, which can eventually enable them to reshape their everyday practices (Chiu et al., 2020). Yet, altering behaviors through technology requires a comprehensive understanding of interactions between the user and the technology. The main concern in relation to the persuasive technologies is the lack of large-scale and longitudinal evaluations of the adopted technologies on influencing intended behaviors (Anagnostopoulou, 2018), which makes it challenging to anticipate the long-term implications of the design interventions.

Within the scope of this doctoral study, even though the main intention is to investigate and understand diverse approaches aiming to promote sustainable behavior change, *persuasive technologies* and proposed strategies, which mainly motivate intended behaviors through triggering techniques, support the understanding of different approaches to behavior change. Since the approach does not specifically focus on sustainability but adopts an inclusive manner to behavior change and encompasses diverse problem areas, the proposed design strategies in this field are not included as recategorizing the existing design strategies for sustainable behavior change. Nevertheless, considering their potentials for triggering change, the techniques and strategies that emerged in this field (e.g., suggestion, tailoring, self-monitoring, and surveillance) have inspired the definition of the re-

categorized design strategies for sustainable behavior change, which will be covered through the following sections *(see Section 2.5.3 Proposed Categorization for Design Strategies)*.

2.4.4 Design for Sustainable Behavior

There is an increased interest in research focusing on the implications of design to intentionally steer change among individuals' unsustainable behaviors. *Design for Sustainable Behaviour (DfSB)* as an evolving research field was first introduced by design researchers from Loughborough Design School (Lilley et al., 2005), and has developed considerably since then through the numerous research studies being carried out, and various theories, strategies, and techniques proposed in the field. The particular focus of the approach is on understanding the users through behavioral theories and applying strategies to design products that can influence sustainable behaviors to be adopted during the use phase of products, systems and services (Lilley & Wilson, 2017; Lockton, 2013; Lidman & Renström, 2011; Elias et al., 2009; Wever et al., 2008; Lilley, 2007). It aims to mitigate environmental and social consequences of use through promoting effective and responsible behaviors with the help of product-led design interventions. The research area adopts diverse approaches, tools and techniques from multiple disciplines including sustainable design and interaction design.

So far, the focus of the area has been on (i) the identification and generation of strategies and techniques to explore potential ways of designing products to influence behavior (Yun et al., 2013; Lilley et al., 2005), (ii) the application of these in research and design processes through proposing design solutions to encourage intended behaviors (Tang 2010; Lilley, 2007), and (iii) the evaluation of the generated design solutions in terms of their acceptance and effectiveness (Kuijer, 2014; Lidman & Renström, 2011; Elias, 2011). Though existing studies put a great emphasis on understanding the user and its context, defining target behaviors to be

influenced, and selecting design strategies for the development of design solutions, the main omission of the approach is the limited attention on the evaluation of design interventions for assessing their implications in achieving sustainable behavior change (Lilley & Wilson, 2017).

The approach adopts diverse design strategies to persuade intended use behaviors, which will be discussed through the following sections *(see Section 2.5 A Review of Design Intervention Strategies for Influencing Sustainable Behaviors)*. *The Aware Puzzle Switch* (Figure 2.7), for instance, is a household light switch aiming to lead users to turn off home lighting through exploiting people's intuitive desire for order (Broms, 2011). The switch, designed by Broms and Ehrnberger (2007), elaborates the idea of a pattern being complete when the light is switched off and asymmetrical when it is on. It uses *visual persuasion* and *scripts* embedded in products in order to influence users to perform intended behaviors.



Figure 2.7: The aware puzzle switch (Broms, 2011)

Another example is the *Flower Lamp* (Figure 2.8), designed by Interactive Institute that reflects the use of energy through changing its shape (Backlund et al., 2006). If the energy consumption in a household is intense, the lamp stays in a cylindrical shape affecting the quality of emitted light. As the consumption decreases, it rewards the user through opening up like a blossom of a flower. It employs *rewarding* and

punishment as a behavioral stimulant to influence energy conserving behavior among users.



Figure 2.8: The flower lamp (Backlund et al., 2006)

Exploring people's relationships with energy in everyday life, *Powerchord* (Figure 2.9), which is an energy meter visualizing electricity use through sonification, has been developed with the aim of raising awareness about energy consumption of appliances in the home (Lockton et al., 2014a). It provides a variety of birdsongs with different intensities in response to the instantaneous power readings from household appliances. Birdsong and bird calls were selected as a warning, since it is a natural, largely non-intrusive ambient sound that could serve to signify energy use information. Design intervention simply *provides feedback* on the energy use and leaves the user with the option of altering or maintaining existing behavior.

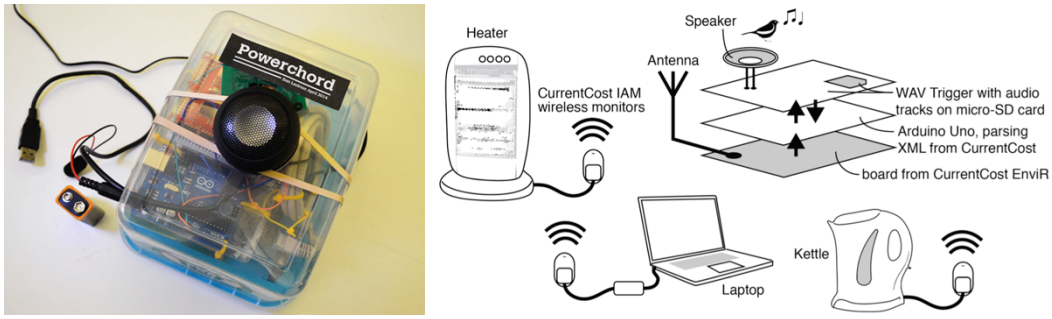


Figure 2.9: (left) Powerchord prototype and (right) its implementation into three diverse appliances (Lockton et al., 2014a)

As examples suggest, design can be used intentionally to inspire individuals to adopt sustainable use behaviors with the incorporation of diverse strategies (e.g., scripts, rewarding, providing feedback) to steer change. Within the scope of this doctoral study, adopting this approach is believed to support investigating and defining individuals' water intensive behaviors to be targeted to influence, and to explore ways to guide these behaviors towards sustainable directions through the theories, strategies and processes it suggests. The following section will present a comprehensive review and comparison of the existing design strategies for influencing sustainable behaviors that are proposed through adopting this approach and discuss how it inspired the development of a new categorization of the design strategies for their effective integrating into ideation.

2.5 A Review of Design Intervention Strategies for Influencing Sustainable Behaviors

Behavior, influenced by a multitude of factors, is a complex issue that makes it difficult to understand and alter. Therefore, design researchers exploring the possibilities for influencing pro-environmental behaviors have proposed a range of strategies and developed varying categorizations for guiding behaviors. The comprehensive review of the strategies in the related literature (Coşkun, 2015; Yun et al., 2013; Lidman & Renström 2011; Froehlich et al., 2010; Tang, 2010; Lilley, 2009; Wever et al., 2008; Elias et al., 2007; Lilley et al., 2005) supported that there is not any consensus on the nomenclature of the design strategies. Though what they have in common is the existence of a spectrum that defines the distribution of power in decision making between the user and the product (Lilley & Wilson, 2017). In the reviewed categorizations, at one end of this spectrum, strategies empowering users in the decision-making process to behave in certain ways are placed. At the other end, products have the control and decide on behalf of the users to behave in certain ways or act automatically responsible.

In the following sections, the reviewed categorizations of the design strategies will be discussed under two titles (i) strategies developed through the reviews of existing approaches, and (ii) strategies supported by field research and design interventions. Before going further, however, a comprehensive list of the reviewed strategies and their meanings are provided in Table 2.1 to effectively discuss the approaches adopting them. The strategies within different categorizations having the same or very similar meanings and adopting very similar techniques for altering behaviors are group together for clarity (e.g., advice and suggestion; eco-steer and scripting).

Table 2.1: A comprehensive list of existing strategies for influencing behaviors and their definitions

Strategies for Influencing Sustainable Behaviors	Definitions
educational interventions[9] / consumer education[8] / eco-information[5] / information[4] / education[2] / enlighten[3] / inform[1]	providing information that would influence people's knowledge, values, attitudes and norms for encouraging pro-environmental behavior
advice[2]	providing suggestions on how to reduce unsustainable impacts of use
eco-feedback[9,7,6,5] / feedback[8,4] / enlighten[3] / self-monitoring[2] / inform[1]	providing real-time information related to the consequence of use behaviors to encourage responsible use behaviors
engagement[2]	motivating to perform pro-environmental use behaviors through appeal to people's emotion or curiosity
goal setting[4, 2]	requiring achieving a predetermined goal to stimulate desired behavior
commitment[4]	asking individuals to make a commitment to engage in a pro-environmental behavior or attain a certain goal that results in sustainable use
comparison[4,2] / inform[1]	demonstrating the consequences of performing a behavior and comparing these with the others' results to encourage change
communication[2]	providing communication with people sharing same interest to promote sustainable behaviors
incentives and disincentives[4] / spur[3] / eco-spur[5] / support[1]	encouraging / discouraging users to adopt pro-environmental use behaviors through antecedent motivation techniques
rewards and penalties[4] / reward[2] / support[1]	prizing / punishing the performance of sustainable / unsustainable behaviors
eco-choice[5]	encouraging individuals to think over their use behaviors and offering them options and possibilities to act responsibly

Table 2.1: A comprehensive list of existing strategies for influencing behaviors and their definitions (continued)

scripts and behaviour steering[9] / scripting[7] / behaviour steering[6] / eco-steer[5] / steer[3] / control[2] / enable-disable[1]	providing the opportunity for the user to perform an action through making desired behaviors possible or easier / limiting the opportunity for the user to perform an action through making undesired behaviors harder or impossible
functionality matching[7] / match[3] / user-centred eco design[8]	adapting to the user's existing behavior, or to a behavior already desired by the user to reduce unsustainable impacts of use
forced functionality[7] / persuasive technologies[6] / eco-technology[5] / force[3] / automate[1]	controlling or compelling the desired behavior upon the users, through limiting or restraining the undesired behavior
technological interventions[9] / user-centred eco design[8] / automate[1]	reducing product's impacts during use through technological improvements and innovation
intelligent products and systems[9] / clever design[5]/ automate[1]	products acting automatically environmentally or socially responsible without increasing awareness or altering user behavior

[1] Coşkun, 2015; [2] Yun et al., 2013; [3] Lidman & Renström 2011; [4] Froehlich et al., 2010; [5] Tang, 2010; [6] Lilley, 2009; [7] Wever et al., 2008; [8] Elias et al., 2007; [9] Lilley et al., 2005

2.5.1 Strategies Developed Through the Review of Existing Approaches

In this section, strategies for influencing sustainable behavior and their categorizations developed through reviewing diverse disciplines (e.g., behavioral psychology, sociology, sustainability, environmental psychology, persuasive technologies, HCI, etc.) will be presented through comparing and reflecting on them. As one of the pioneers in the DfSB area, Lilley, Lofthouse and Bhamra (2005) proposed a categorization named *"interventions to change behaviour"* and divided it into three sub-categories which are "*educational interventions, technological interventions and product-led interventions"* (Figure 2.10). The first strategy aims to encourage individuals to act responsibly through organizing governmental campaigns, rewards or penalties and triggering the feeling of guilt. Technological intervention, rather than use behaviors, focuses on technological enhancements to mitigate consequences resulting from the use phase of products. Despite its potential, the impact of the intervention may be unpredictable considering the user's actual use

behavior and related rebound effect. The third strategy includes *"eco- feedback, scripts and behaviour steering,* and *intelligent products and systems"*. This initial categorization has been extended further through the authors' following research studies.

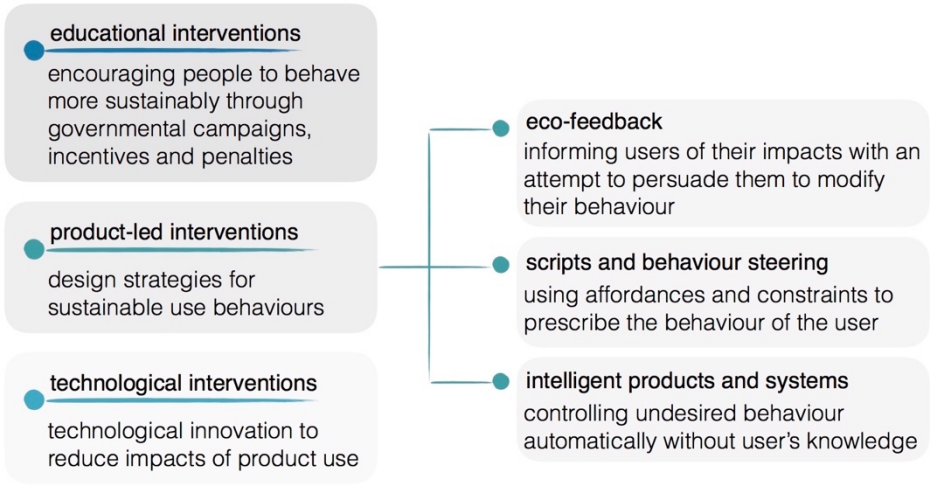


Figure 2.10: *Interventions to change behaviour* categorization (reproduced from Lilley et al., 2005)

Froehlich, Findlater and Landay (2010) categorized six strategies for influencing pro-environmental behaviors that are "*information, feedback, incentive/disincentives and rewards/penalties, goal setting, comparison, and commitment"* through reviewing research studies within the fields of HCI and environmental psychology. The proposed strategies are suggested to be used in conjunction with each other such as combining feedback and incentives to effectively guide intended behaviors. This categorization excludes strategies about technological improvements where the user has little influence on the intended behavior but rather focuses on motivational strategies that may support users to adopt sustainable use behaviors.

Yun, Scupelli, Aziz and Loftness (2013) proposed nine design intervention strategies through the review of existing studies within the areas of persuasive technology, environmental psychology and HCI. Through suggesting a distinctive categorization, the strategies are gathered under three main categories;

"*instructional, motivational* and *supportive intervention"* (Figure 2.11). The instructional level makes people realize their environmentally irresponsible habits through adopting strategies, including "*education, advice,* and *self-monitoring"*. The motivational level encourages and inspires people to make pro-environmental changes through "*goal-setting, comparison* and *engagement"* which are often criticized for being temporary. The supportive level aims to sustain the desired behaviors for a longer time through incorporating strategies namely "*communication, control,* and *reward"*. In this categorization, self-monitoring, for instance, matches with the eco-feedback strategy highlighted by previous researchers. Engagement, however, has been proposed for the first time aiming to motivate users to perform pro-environmental use behaviors through appealing to their emotions.

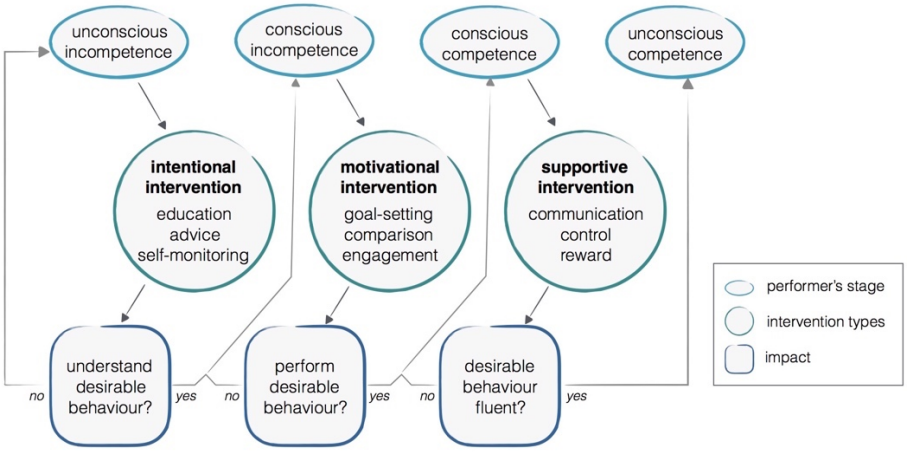


Figure 2.11: Three levels of interventions for sustainable behavior change (reproduced from Yun et al., 2013)

In his doctoral study, Coşkun (2015) proposed another categorization of strategies for influencing sustainable behaviors which includes four distinctive strategies "*inform, enable/disable, support,* and *automate"* (Figure 2.12). He transformed the proposed categorization into an ideation tool called strategy cards which are utilized during design workshops to support the ideation process for promoting pro-environmental driving behaviors. Even the proposed strategies were adopted to

stimulate ideas for a specific behavior, they hold opportunities to be transferred to diverse target behaviors related to sustainability for inspiring change.

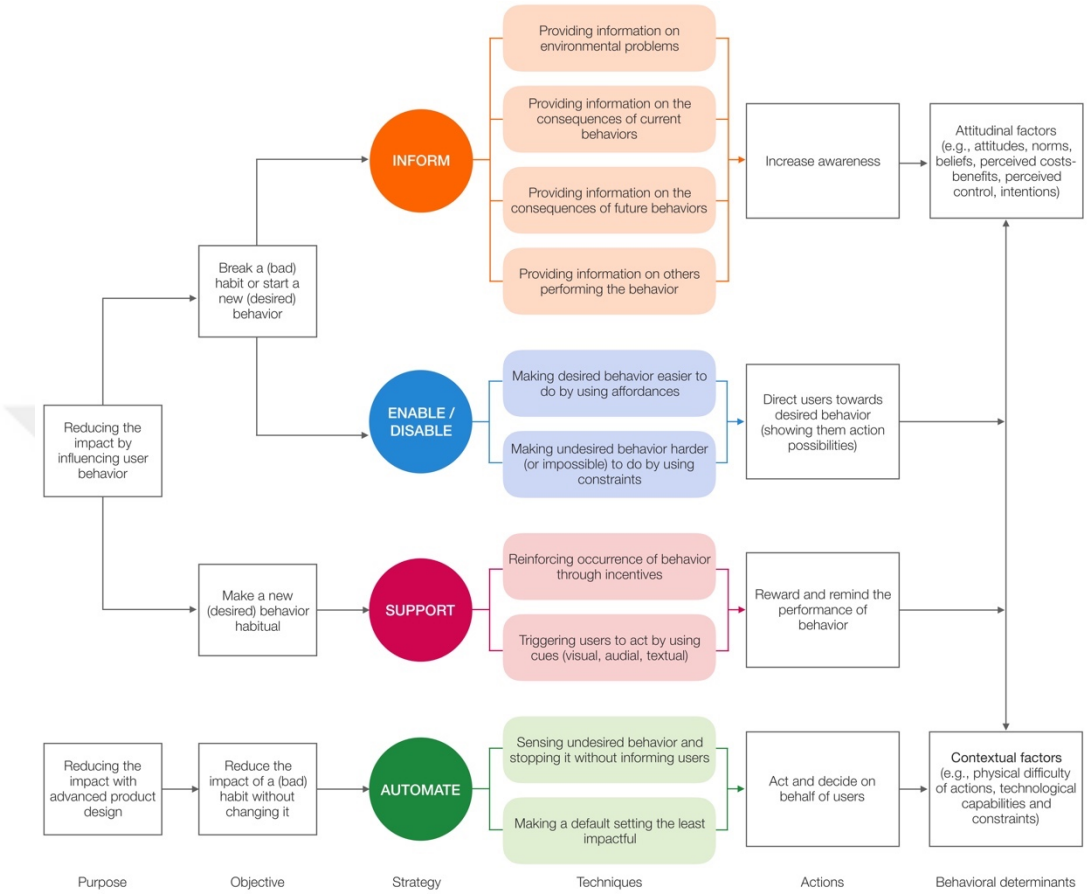


Figure 2.12: Four levels of design strategies for promoting sustainable behaviors (Coşkun, 2015)

2.5.2 Strategies Supported by Field Research and Design Interventions

While some design strategies and their categorization were developed through reviewing the related literature, some have been supported by field research. In this section, the design strategies that were explored through design interventions (Lilley, 2009) and evaluated with users (Lidman & Renström, 2011; Tang, 2010; Wever, 2008; Elias et al., 2007) to assess the effectiveness of the incorporated strategies for promoting sustainable behaviors will be shared.

An early categorization of design strategies focusing on energy consumption, proposed by Elias, Dekoninck and Culley (2007), suggests two main causes of intensive energy use; intrinsic losses directly related to the built-in features of the products, including materials and technology, and the user-related loses associated with use behaviors. It recommends that these two should be considered in combination for the aim of reducing energy consumption, otherwise the solution areas would be insufficient. For user-related losses, three strategies are offered which are improving *"consumer education"*, providing *"feedback"*, and *"user-centred eco-design"* (Figure 2.13). The first two strategies have been previously mentioned by Lilley et al. (2005); however, user-centred eco-design adopts a new approach and suggests developing a new product which either matches with the old behavior or designed for a new behavior. It aims to design highly efficient products through which the most intuitive way of engaging with them is also the most environmentally responsible choice.

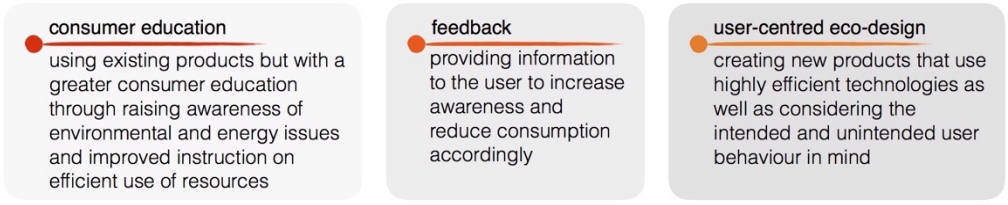


Figure 2.13: Three strategies to reduce user-related energy losses (reproduced from Elias et al., 2007)

In his doctoral research, Elias (2011) further explored the proposed strategies with a case study on refrigerators. Through video recording and observations in two households for 9 and 18 days, problem areas for intensive electricity consumption were defined. Later, a prototype refrigerator (Figure 2.14) including internal self-closing glass door, a separate area for frequently used items and a timer switch for the light was developed to reduce energy losses resulting from opening and closing of the refrigerator doors. The prototype was tested in a household for ten days, and a decrease in user-related energy losses was measured by 43%.



Figure 2.14: A prototype refrigerator developed by Elias (2011)

Wever, Kuijk and Boks (2008) proposed a categorization namely "*inducing sustainable use"* through clearly defining the distinction between the product and the user related strategies as *"functionality matching* and *behavioural adaption"* (Figure 2.15). Functionality matching seeks to better adapt products to the real use behaviors while attempting to minimize harmful impacts of use, such as developing a remote control with a switch-off function to reduce energy losses on the standby mode. In a similar approach to Lilley et al. (2005), behaviour adaption is divided into three categories that are "*eco-feedback, scripting* and *forced functionality"*. In this categorization, the strategies have been categorized for the first time in line with the distribution of power in decision making between the user and product.

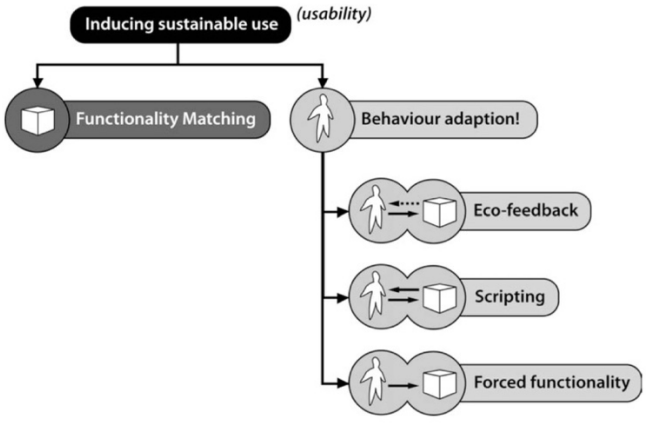


Figure 2.15: *Inducing sustainable use* categorization (reproduced from Wever et al., 2008)

In this research study, one of the reviewed strategies (i.e., eco-feedback) have been evaluated through a case study focusing on re-designing of an energy meter to clearly inform users about domestic energy consumption. Through adopting a user-centered approach, *Greeny Energy Meter* (Figure 2.16) was developed, which provides real time feedback through changing light intensity and information on financial cost. Then, user tests were carried out comparing the original energy meter and the proposed redesign which have been found more effective in terms of the clarity of the provided information and the ease of use.



Figure 2.16: The final design of the *Greeny energy meter* providing real time feedback through changing light intensity and information on financial cost

Lilley (2009) suggests a categorization that mainly focuses on product-led intervention strategies and maps them on a spectrum to demonstrate who has the control while deciding upon the performance of responsible behaviors (Figure 2.17). While *eco-feedback* empowers the user to behave responsibly through providing information, the user is often unaware of the choice of behavior with *persuasive technologies.* She also defines three intervention levels: "*guiding, maintaining* and *ensuring"* the change.

The effectiveness of the proposed strategies was evaluated through a case study focusing on social impacts of mobile phones. Through identifying social problems related to mobile phone use (e.g., speaking loudly, improper subjects and language, intrusion of privacy), master students are expected to choose a design strategy among

the proposed categorization and integrate it into the design process for inspiring ideation. It appeared that most of the students preferred to integrate two or more design strategies to enhance the effectiveness of the developed design interventions, yet their implications have not been evaluated.

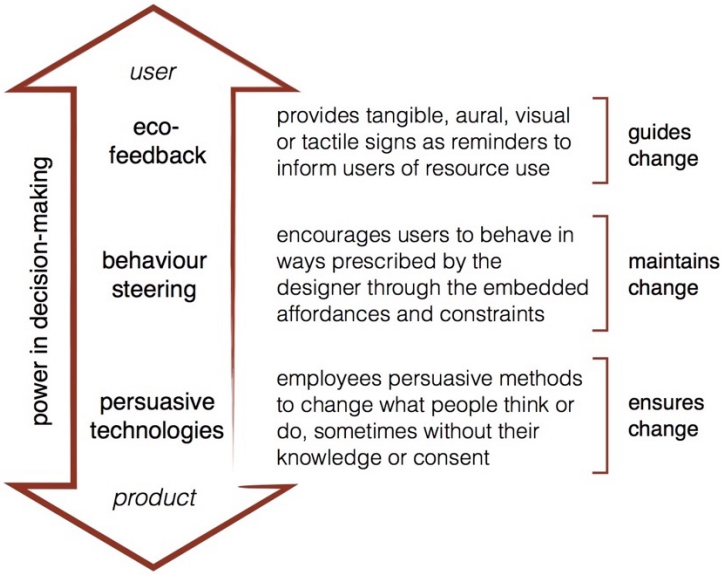


Figure 2.17: Design intervention strategies (reproduced from Lilley, 2009)

Extending the previously suggested strategies from three to seven through an iterative process, Tang (2010) offered a more comprehensive model named *Design Behavior Intervention Model* (DBIM) (Figure 2.18). The proposed model offers seven strategies in three "levels of interventions" *(i.e., informing, maintaining and ensuring change)* and relates them with three "determinants of behavior" *(i.e., intention, habits and contextual factors)* and three "stages of habit formation" *(i.e., declarative, knowledge compilation and procedural stage)*. Despite the detailed content, the definitions of the strategies and the boundaries between them are blurry which makes it difficult to incorporate into the design process effectively.

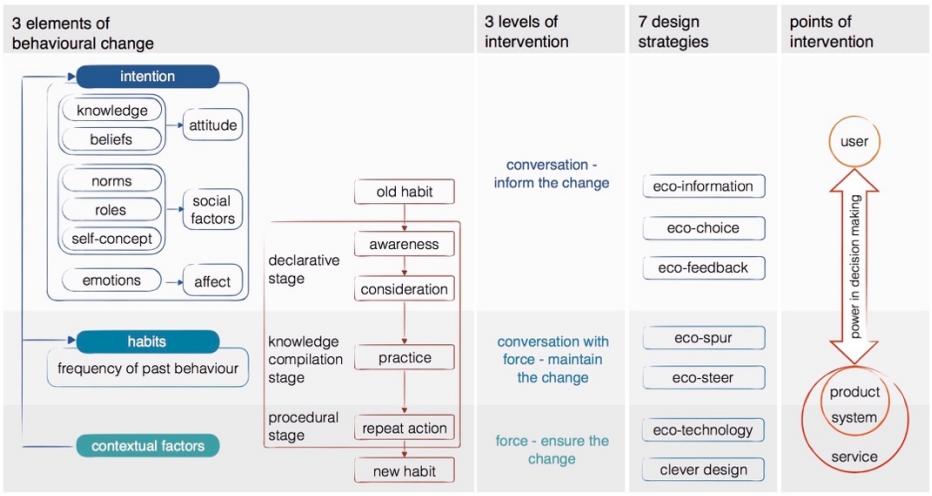


Figure 2.18: Design Behavior Intervention Model (DBIM) (reproduced from Tang, 2010)

To evaluate the implications of the proposed categorization for supporting sustainable behavior change, a case study on environmental impacts of household refrigerators and freezers were conducted (Tang, 2010). Through facilitating a comprehensive exploratory user research phase, the existing use behaviors and habits, user needs, and problems as interacting with the refrigerators and freezers that lead to intensive energy use have been detected (Tang, 2010). Then, the proposed design intervention strategies were applied in the ideation processes, and a range of design solutions was generated for the identified problems, which were further evaluated through focus group sessions (Figure 2.19).

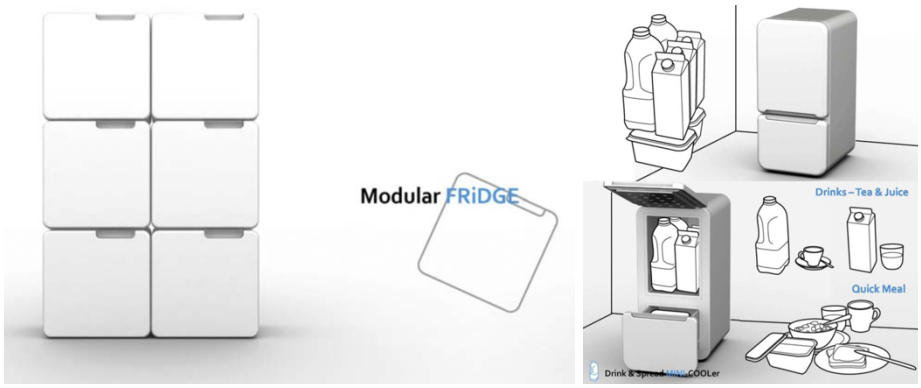


Figure 2.19: Examples from integration of DBIM in the design process; (left) Modular fridge, (right) Drink and spread mini cooler (Tang, 2010)

Lidman and Renström (2011) with a different categorization identified five strategies called *enlighten, spur* (user in control), *steer, force* (designer in control) and *match* (product in control) and evaluate four of these (excluding match) to explore their long term acceptability and effectiveness in inducing sustainable behaviors (Figure 2.20). Four prototypes (i) measurement cup with a plastic frog (enlighten), (ii) dosing kit (spur), (iii) detergent package (steer) and (iv) detergent tablets (force) have been evaluated through the participation of 16 households for the duration of four months (Figure 2.21). The findings from the detergent use and usage experience revealed that the DfSB strategies have varying impacts in terms of acceptability and effectiveness of the design interventions. For instance, the measuring cup have been found highly effective in the long run, yet fairly well accepted, while the detergent tablets have been considered as both very effective and highly acceptable.

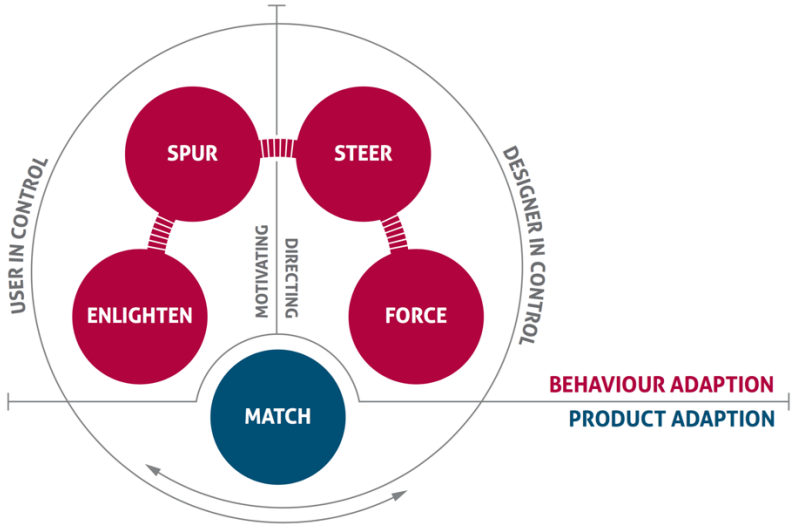


Figure 2.20: A model for categorization of five design strategies (Lidman & Renström, 2011)



Figure 2.21: Four design intervention prototypes; (from left to right) measurement cup, dosing kit, detergent package, and detergent tablets (Lidman & Renström, 2011)

2.5.3 Proposed Categorization for Design Strategies

Within the reviewed literature, researchers have proposed a range of strategies and their diverse categorizations that can be used by designers to influence sustainable behaviors. Though, the lack of common terminology among the proposed strategies make it quite challenging to integrate these into ideation to inspire design interventions aiming to influence sustainable behaviors. For instance, strategies aiming to constrain the users' possibilities to perform an undesired behavior through making it difficult or impossible is named as *steering* (Lilley et al., 2005), *scripting* (Wever et al., 2008), and *control* (Yun et al., 2013) by different researchers. Similarly, within diverse categorizations, information with the aim of influencing environmentally responsible behaviors were defined as *information* (Froehlich et al., 2010), *education* (Yun et al., 2013), and *enlighten* (Lidman & Renström, 2011). This diverse categorization of strategies sharing similar meanings and adopting similar techniques to alter behaviors reveals the need to better communicate the aim and distinctive emphasis of strategies for sustainable behavior change and provide a guidance for their integration into ideation.

In this doctoral study, a new categorization of design strategies was proposed through reviewing and comparing a range of strategies aiming to promote sustainable behaviors. The proposed categorization aims to support and inspire designers as generating ideas for promoting sustainable behaviors through introducing them diverse techniques that they can adopt to alter behaviors. Inspiring from the reviewed

studies, five diverse design strategies were identified which are *informing, engaging, motivating, guiding* and *determining.* Figure 2.22 presents the comparison of the nine diverse categorizations of design strategies for behavior change that mainly intend to promote sustainable behaviors. The comparison relates the existing design strategies with each other through placing them on an axis representing the distribution of power between the user and product during the decision-making process as influencing behavior. This comparison should not be seen as a strict categorization but rather a representation of how existing strategies relate to each other.

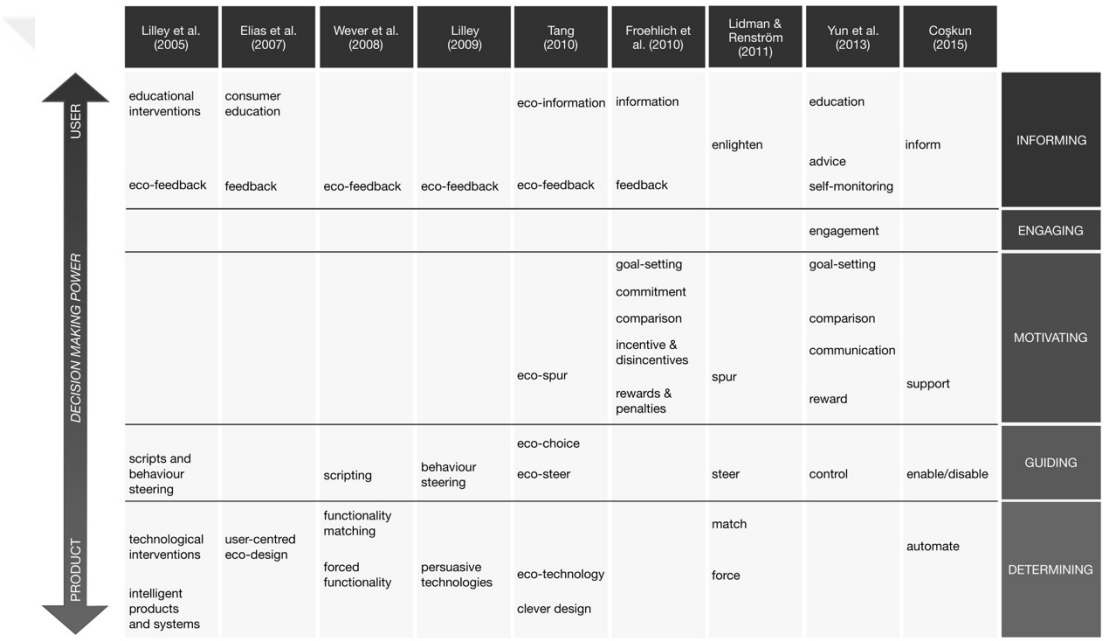


Figure 2.22: Cross comparison of design strategies for influencing behaviors

While stimulating change, both the individual and the environment (product, system and service) are critical factors. Considering this, the proposed categorization of the design strategies empowers the individual and the environment at different scales to encourage sustainable behavior change (Figure 2.23). The power of the user in the decision-making process regarding the adoption of sustainable behaviors gradually decreases from the *informing* to the *determining* strategy. At one end of the spectrum, the design intervention simply provides information for the user to act responsibly,

while at the other end, it automatically behaves responsibly without interfering with the user. The proposed strategies are suggested to be combined to enrich the possibilities of influencing behaviors toward sustainable directions. The details about the proposed categorization of the design strategies will be discussed in the following sections through elaborating on the potential techniques for their implementation and discussing their possible implications for influencing sustainable behaviors.

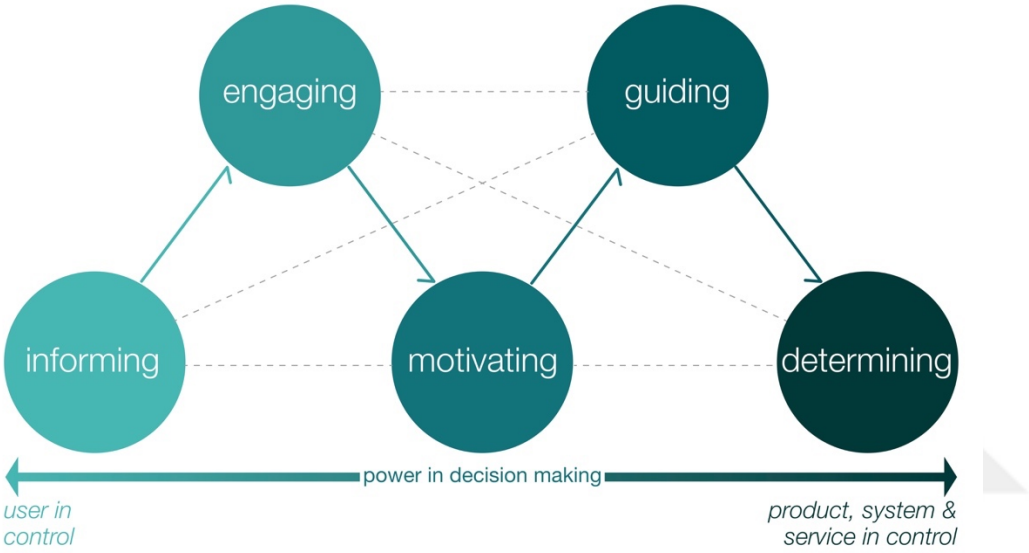


Figure 2.23: The proposed categorization of the design strategies

2.5.3.1 Informing

Informing as a broad category involves strategies for providing information or feedback related to the environmental issues, and past, present and future consequences of a behavior. It aims to raise awareness and inspire sustainable use behaviors through affecting individual's cognitive thinking processes including their attitudes, intentions, personal norms, habits and perceived behavioral control. Informing includes strategies focusing on sharing information on environmental issues, providing feedback about users' past, present and future behaviors and offering suggestions to reduce the environmental impacts of behaviors. Figure 2.24

presents the particular aim of the design strategies that are grouped under this category.

Even informing strategies are frequently adopted to influence behavior, there is a potential that the user may ignore the provided information and continue performing unsustainable behaviors.

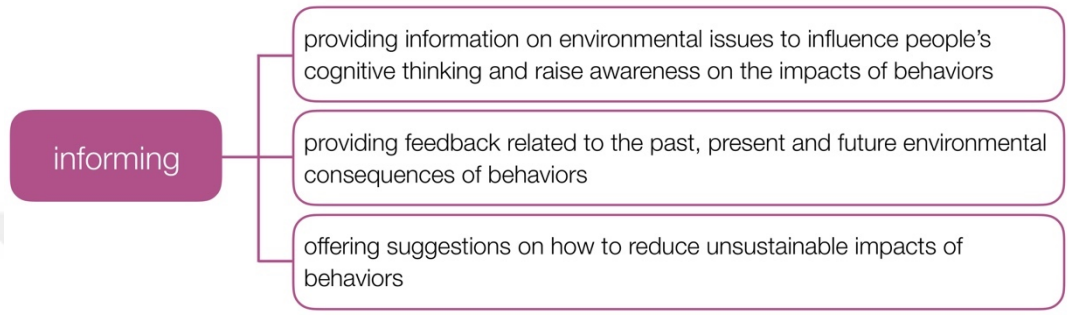


Figure 2.24: Strategies for informing sustainable behaviors through design

2.5.3.2 Engaging

Engaging category includes strategies aiming to inspire individuals to adopt environmentally responsible behaviors through appealing to their interests and emotions and enhance their involvement to personalize and adapt design interventions in line with their needs and preferences. The significance of empowering users to adapt and personalize design interventions is often neglected in the related literature, though it has a considerable power to support individuals to adopt responsible behaviors. Along with that, emotions, that are instinctive responses to particular situations, are also influential in the construction of behaviors. Considering these, engaging strategy adopts strategies that are personally appealing and adaptable for individuals' diverse needs and expectation with the aim of creating a bond between the individual and a desired behavior and making it habitual. It mainly focuses on attitudinal determinants of behaviors through influencing individuals' emotions, motivations, habits, intentions, attitudes and subjective

constraints. Figure 2.25 presents the strategies for engaging individuals' in the intended behaviors.

Design strategies for influencing behavior are often ephemeral in nature, however there is a need for longer lasting alterations in behaviors. Engaging strategies, in that sense, aims to inspire the user to make a desired behavior habitual through enabling their active involvement in the decision-making process to perform a desired behavior.

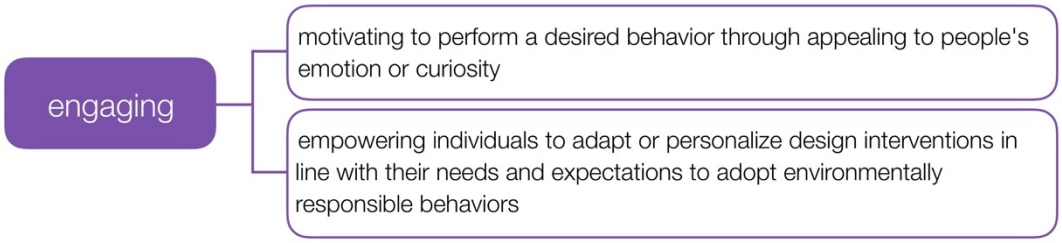


Figure 2.25: Strategies for engaging sustainable behaviors through design

2.5.3.3 Motivating

In this proposed categorization, *motivating* encompasses design strategies that aim to influence environmentally responsible behaviors through triggering or provoking them with motivational techniques. People are more likely to alter their behaviors when they are motivated and appreciate the consequences of their behaviors. Rewarding a desired behavior, making individuals feel competent while performing a behavior, providing incentives, determining goals to pursue an intended behavior, comparing the environmental impacts of past and present behaviors are prominent strategies adopted to influence behaviors towards desired directions. Through influencing individuals' motivations, habits, intentions, attitudes and subjective constraints, this category mainly focuses on attitudinal determinants of behavior. Figure 2.26 demonstrates various motivational strategies suggested for supporting intended behaviors.

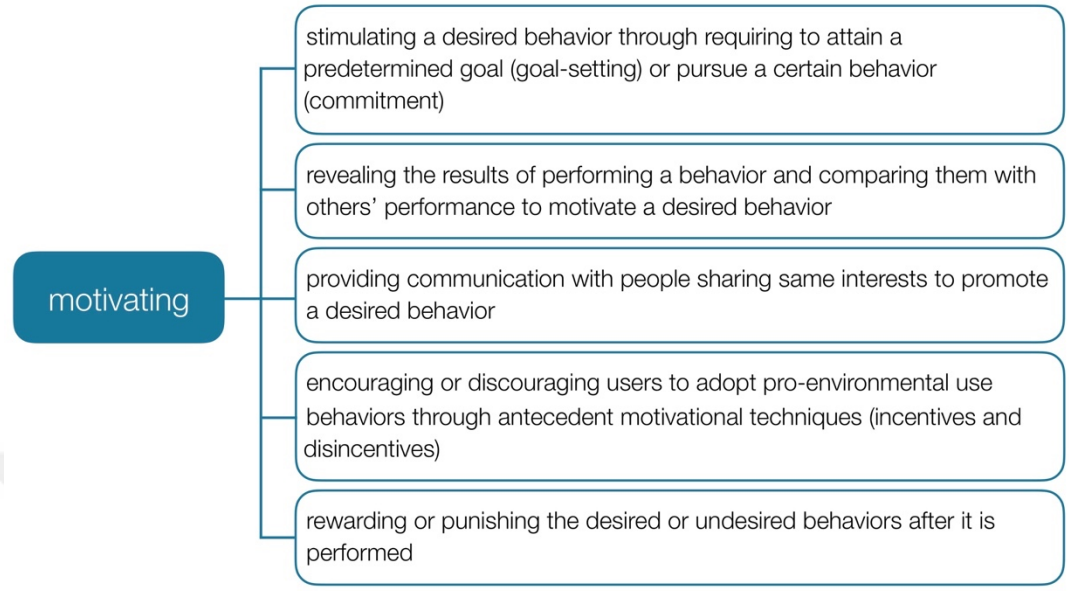


Figure 2.26: Strategies for motivating sustainable behaviors through design

2.5.3.4 Guiding

Guiding focuses on leading individuals towards intended use behaviors through affordances and constraints that either enable or limit them to perform a behavior. It influences both contextual and attitudinal determinants of behaviors through including strategies that either physically steer a behavior or influence individuals' perception of ease or difficulty to perform a desired behavior. The design strategies enabling or constraining a behavior can be embedded in the environments or related products' features. Making a particular behavior intuitive or easier to perform, obstructing the undesired behaviors and providing individuals with responsible choices are suggested strategies to control and lead behaviors towards desired directions. Figure 2.27 below presents the particular aim of the strategies recommended for guiding individuals' towards intended behaviors.

Physically or cognitively guiding individuals towards a behavior is a commonly adopted strategy to influence intended behaviors. Even if it provides individuals to

decide on their behaviors, it often lacks affecting their attitudes or raising awareness. In that sense, the alterations in behaviors heavily depend on the design intervention, thus the individuals may return to their past behaviors in the absence of the intervention.

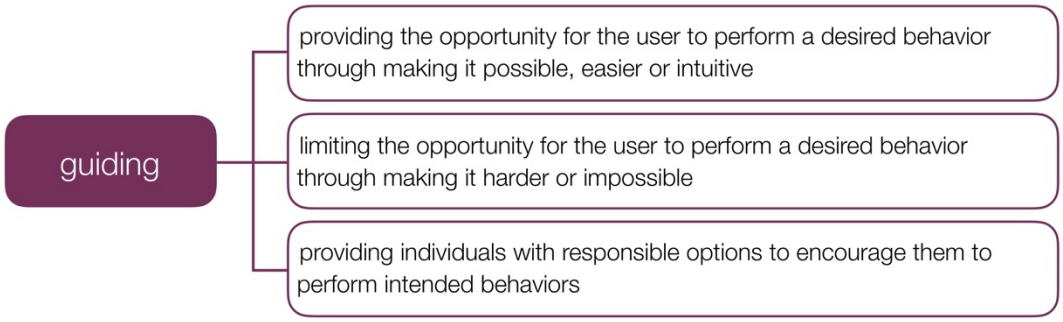


Figure 2.27: Strategies for guiding sustainable behaviors through design

2.5.3.5 Determining

Unlike previously mentioned strategies, *determining* does not have any intention to motivate or direct individuals to alter their behaviors. The particular aim of the determining category is to restrain undesired behaviors or minimize the consequences of them through advanced technology without increasing awareness or changing the individual's behavior. It mainly focuses on contextual factors of behavior rather than the attitudinal ones. There exist different strategies for determining a behavior: (i) adapting to an individual's existing behavior for reducing the impacts of behaviors (ii) limiting or restraining the undesired behavior, (iii) reducing the impacts through technological improvements, and (iv) automatically performing an intended behavior. The particular aim of the strategies that are grouped under the determining category are provided in Figure 2.28.

As determining a behavior, the distribution of control between the individual and related design intervention may be a concern. Even the impacts can be reduced significantly through forcing a desired behavior, since it does not raise any awareness

when the intervention is removed or replaced, the individual would possibly return to the old and undesired behavior.

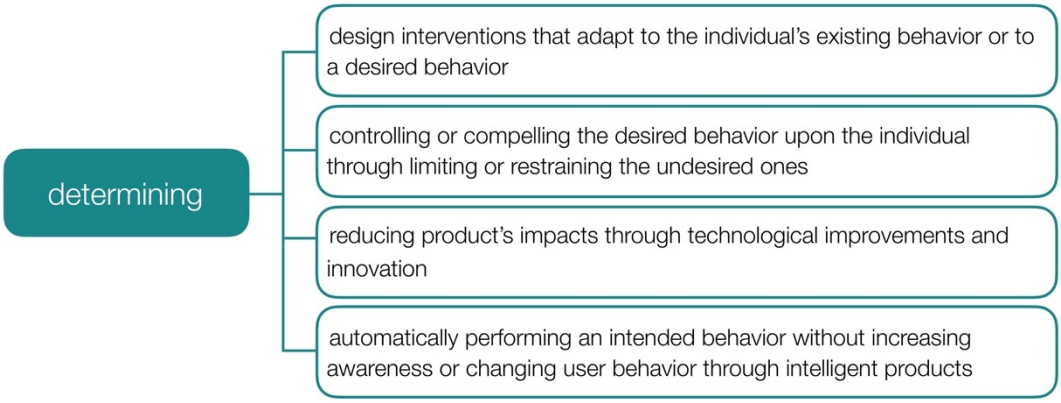


Figure 2.28: Strategies for determining sustainable behaviors through design

The proposed categorization of the design strategies intends to support designers as developing ideas aiming to promote sustainable behaviors. Though, selecting an appropriate strategy to trigger change is still quite challenging (Lilley & Wilson, 2017). Adopting a design strategy that forces an intended behavior might be rejected by the user. On the contrary, informing the environmental consequences of a behavior might motive the user who is already enthusiastic about change. This demonstrates the significance of recognizing individual differences towards adopting change which will be discussed in the following section.

2.6 Significance of User Diversity for Influencing Sustainable Behaviors

The reviewed approaches so far revealed that there are various strategies available to promote sustainable use behaviors. What they have in common is that most of these make different assumptions about the users and how they will respond to behavioral interventions. They basically assume that the user would perform pre-determined behaviors if the design intervention enables or constraints them (Lockton et al., 2012). However, users may have different interests and attitudes towards environmental issues which directly influence their intentions to adopt behaviors.

There are a number of studies focusing on the exploration and identification of user types for sustainable behavior change with varying emphasizes (Coşkun, 2020; Coşkun, 2015; Coşkun & Erbuğ, 2014; Lilley et al., 2013; Lockton et al., 2012).

Lockton et al. (2012) developed a categorization through exploring experience and interaction designers' interpretation of personas from their professional experiences and suggested three user types including *thoughtful users, shortcut users* and *pinball users* (Table 2.2). These user types were further incorporated into a Design with Intent toolkit as an idea generation medium (Lockton, 2013). *The thoughtful users* are described to be concerned about their use behaviors. They are open to persuasion through reasoned arguments and can be motivated to alter their attitudes. They can also learn from their or other people's mistakes and change their behaviors accordingly. Information and feedback are suggested strategies for this user type as these allow them to explore the consequences of their behaviors. *The shortcut users* are concerned with doing things in the easiest way possible rather than thinking over the problems and potential ways to solve them. They tend to take shortcuts and often make decisions intuitively. Considering that, defaults and shortcuts are suggested to influence the behavior of these users. *The pinball users* are assumed as users who do not think of the consequences as performing a behavior but rather can be pushed and pulled around through the design interventions. Forcing and controlling are considered to be effective strategies to influence sustainable behaviors for them since the behavior is performed without the user being necessarily aware of it.

Table 2.2: Three user types (reproduced from Lockton et al., 2012)

user types	definitions	suggested strategies
the 'thoughtful' user	users who think about what they are doing and why they are behaving in a particular way	*education and feedback*
the 'shortcut' user	users who are interested in doing things in the easiest way possible	*defaults and shortcuts*
the 'pinball' user	users who only react simply to inputs, doing the same thing each time the same stimulus is applied, and do not think about any decisions	*forcing and controlling*

Through conducting an online survey focusing on users' diverse demographics, lifestyles, attitudes towards and enabler and barriers for repair, Lilley et al. (2013) suggested three personas *(i.e., fixers, sometimers and non-fixers)* associated with different mending behaviors (Table 2.3). Unlike Lockton et al.'s (2012) inclusive user types, these user typologies represent particularly the mending behavior of the users. *Fixers* are the most motivated users who always attempt repairing that is similar to the thoughtful users. *Sometimers* are the ones who try repairing some products. Non-fixers are the least motivated ones who do not attempt repairing in the past. They further combined these personas with DfSB strategies to develop design interventions aiming at influencing behaviors for repairing small electrical household appliances. They carried out design workshops through which designers adopted the behavior change strategies to develop design solutions for influencing repair behaviors for these three user typologies. It appeared that fixers require products providing information whereas non-fixers require persuasive methods and technologies to alter their behavior as they lack the motivation for repairing. Sometimers are placed in between these two in terms of motivation towards repairing and they require products with embedded affordances and constraints to encourage mending behavior.

Table 2.3: Three user personas associated with mending behaviors (reproduced from Lilley et al., 2013)

user types	definitions	suggested strategies
fixer	users who always attempted repairs	*information*
sometimers	users who attempted repairs on some but not all products	*behaviour steering (affordances and constraints)*
non-fixers	users who had not attempted repairs in the past	*persuasive technologies*

Through a comprehensive study aiming to explore individuals' environmental concerns, perceived behavioral control, attitudes, intentions and subjective norms in relation to adopting eco-friendly driving behaviors, Coşkun (2015) suggested five user orientations namely *ready, feel peer pressure, don't care, see no benefit* and *see no difference.* Similar to the Lilley et al.'s (2013) user typologies, these personas

represent individuals' orientations towards adopting a particular behavior which is eco-friendly driving behavior (Table 2.4). *Ready* users are the ones who are eager to drive environmentally friendly which is similar to Lockton's thoughtful user. Considering their willingness to change their behaviors, it was suggested to inform and support them with incentives. *Feel peer pressure* users have an intuition to drive responsibly, yet they hesitate for the people's approval. In that sense, informing them about the behaviors of others was suggested to encourage intended behaviors. For altering the behaviors of *don't care users*, who believe that changing their behaviors would not make a significant difference, informing the consequences of behaviors and enabling easier use were considered as effective. *See no benefit* users believe that they would not gain any personal benefit for driving environmentally friendly, thus informing and supporting them with incentives is suggested. For the fifth orientation, *see no difference*, automating behavior change is considered useful as they care little about the environment.

Table 2.4: Five user personas for eco-friendly driving (reproduced from Coşkun, 2015)

user types	definitions	suggested strategies
ready	users who have strong concern, intention, perceived behavioral control and social support, and positive attitude towards environment	*informing and supporting (feedback, incentives)*
feel peer pressure	users who have strong concern, intention, perceived behavioral control and positive attitudes, but low levels of perceived social support towards environment	*informing (comparison)*
don't care	users who have strong concern, intention and perceived social support, but a negative attitude and a low level of perceived behavioral control towards environment	*informing and enabling (feedback, affordances)*
see no benefit	users who have strong concern, intention and perceived social support and positive attitudes, but low levels of perceived behavioral control towards environment	*informing and supporting (feedback and triggers)*
see no difference	users who have low concern, intention, perceived behaviural control and perceived social support, and negative attitude towards environment	*automating*

In a recent study on reducing household food waste, four diverse user categories namely *conservers, considerates, reluctants* and *prodigals* were revealed (Coşkun,

2020) (Table 2.5). The study also received the participants' attitudes towards different design interventions developed to reduce food waste. *Conserver*s are the ones with the least amount of food waste and high responsibility while the *prodigals* have the highest amount of food waste and lowest concern for reducing food waste. Even *considerates* have an intention for mitigating food waste they do not adopt necessary behaviors. *Reluctants* waste considerable amounts of food and have low intention to alter their behaviors.

Table 2.5: Four user types suggested by Coşkun (2020) for reducing household food waste (reproduced from Coşkun, 2020)

user types	definitions
conservers	individuals producing the least amount of food waste and possess the most responsibility for reducing food waste
considerates	individuals with the highest intention to reduce food waste, yet can not translate this attitude into their behavior
reluctants	individuals wasting large amount of food due to poor planning, and have low intention and negative attitudes towards reducing food waste
prodigals	individuals with the highest amount of food waste and have lowest positive attitudes, behavioral control and concern over reducing food waste

These diverse user typologies developed by researchers focusing on sustainable behavior change revealed that users' attitudes towards adopting sustainable behaviors may differ in line with varying attitudinal and contextual determinants. It also appears that diverse target behaviors (i.e., mending behaviors, eco-friendly driving, reducing food waste) may reveal different user types. In that sense, within the scope of this doctoral study to be able to guide designers as developing interventions for influencing sustainable behavior, diversity of users in terms of their intentions, attitudes, norms and constraints need to be thoroughly understood and transferred to be able to adopt design strategies that have greater potentials for altering behaviors of different user types.

2.7 Idea Generation Tools for Influencing Sustainable Behaviors

Previously mentioned research studies mainly focused on developing and categorizing strategies for influencing sustainable behaviors, though there are also a number of idea generation tools aiming to support the ideation process for inducing behavior change for sustainability (Hoolahan & Browne, 2020; Artefactgroup, 2018; Toxboe, 2016; Coşkun, 2015; Daae, 2014; Lockton et al., 2010). *Design with Intent (DwI)* toolkit developed by Lockton, Harrison and Stanton (2010) suggests techniques along with simple examples that are applicable to particular target behaviors. The toolkit is developed and refined through a series of iterations and it includes 101 *patterns of principles* for influencing behavior (e.g., tailoring, simplicity, peer feedback, etc.). The patterns are arranged into eight lenses, and each pattern is presented on a separate card with a title, a question highlighting the pattern's purpose, and an exemplary case demonstrating its application (Figure 2.29). The card deck also recognizes the significance of user models through pinball, shortcut and thoughtful cards to be implemented into the ideation. Toolkit's being extensive and inclusive as it encompasses various examples from diverse disciplines including architecture, psychology, interaction design, human factors, games design and behavioral economics would be considered as one of its strengths in terms of its adaptation to diverse problem spaces.



Figure 2.29: Examples from Design with Intent toolkit (Lockton et al., 2010)

The utilization of this comprehensive toolkit has been evaluated through a range of workshops. In a workshop focusing on redesigning four household products (i.e., electric kettles, curtains, printers and sinks/taps), design students used both conventional brainstorming techniques and the toolkit. The findings from the workshop revealed that the proposed ideation tool supported the participants to develop more ideas when compared to the traditional ideation techniques. This shows the value of equipping designers with strategies for behavior change as it contributes significantly to the development of variety of ideas.

While Design with Intent tool intends to inspire designers to generate a multitude of ideas for altering behavior through design, *Dimensions of Behaviour Change (DBC)* cards developed by Daae (2014) focuses on helping designers decide on the behavior change strategies to be applied to the ideas. The tool involves 16 different *design principles* and 9 *dimensions* (i.e., control, obstructiveness, encouragement, meaning, direction, empathy, importance, timing, exposure) which are gathered through a literature review (Figure 2.30). Unlike the DwI cards, the DBC cards do not include the characteristics and needs of different user types. The implications of the DBC cards have been evaluated through a study comparing the environmental impacts of a conventional wood stove and a stove prototype that is designed with the incorporation of the principles and strategies proposed by the DBC cards. The findings from this longitudinal study, including user research, design phase and developing and testing of a woodstove prototype, revealed that employing the proposed tool during the ideation results in the intended behavior change and considerable reductions in environmental impacts of use. The long-term implications of the study on behavior change show the significance of including design strategies in the early design phases for promoting pro-environmental behaviors.

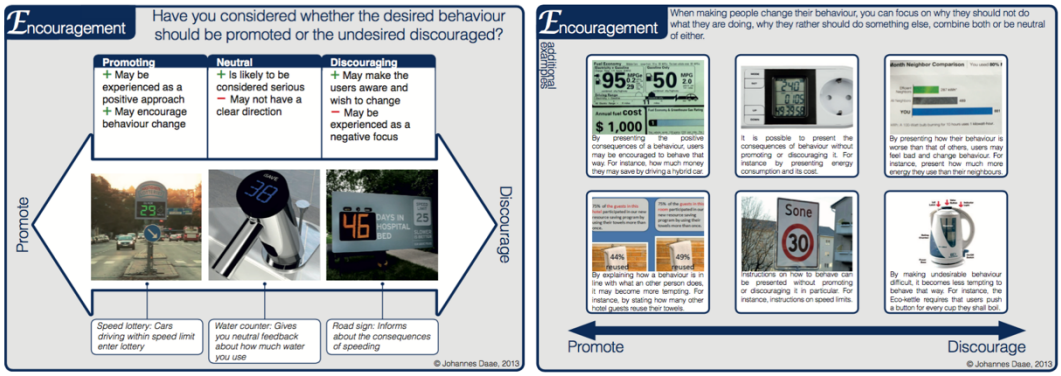


Figure 2.30: An example from DBC cards (Daae, 2014)

Behavior Change Strategy cards look at the issue of behavior change from a broader perspective and includes diverse *dimensions* to be considered as designing for behavior change (Artefactgroup, 2018). It consists of 23 cards and aims to inspire designers and researchers to be mindful about their decisions as influencing behaviors through providing a medium for brainstorming (Figure 2.31). The card set includes five thematic sections that involve strategies, their explanations and examples to support users as developing ideas. The strategies involved in the card set are quite inclusive in terms of their focus for guiding behavior change, yet they hold potentials to be adapted in diverse research areas including sustainability.



Figure 2.31: Examples from Behavior Change Strategy cards (Artefactgroup, 2018)

Focusing on the diversity in users' orientations towards sustainable behaviors which has been often neglected in previous research studies, Coşkun (2015) developed an

ideation tool aiming to help design researchers, practitioners and students generate solutions areas for influencing pro-environmental behaviors. The proposed tool consists of *strategy cards* including a range of behavior change strategies (i.e., inform, enable/disable, support and automate) and *user orientation cards* (i.e., ready, feel peer pressure, don't care, see no benefit and see no difference) to inform designers about the diversity of users regarding eco-friendly driving behaviors (Figure 2.32). To evaluate the tool's impact on the development of ideas, four design workshops on eco-friendly driving have been carried out. The findings from and insights into the workshops supported that the incorporation of the tool enables the participants to explore a range of strategies and increases the number of ideas generated. It also allowed them to consider diverse user orientations in the early phases of idea generation.



Figure 2.32: An example from (left) strategy cards and (right) user orientation cards (Coşkun, 2015)

The Persuasive Patterns card deck is another brainstorming tool that was developed to guide users to design with intent and purpose (Toxboe, 2016). It mainly focuses on human behavior and each card includes *psychological insights* (e.g., rewards) and suggests *potential ways* (e.g., use rewards to encourage continuation of wanted behavior) to incorporate it into the design process through text-based instructions enriched with illustrations to ease comprehension. The card deck was developed

through several iterations through workshops and evaluations and includes 54 diverse cards to inspire ideation (Figure 2.33). Even though the main intention was to integrate it into UX design, it has been adapted in diverse research areas as an idea generation tool including design for sustainable behavior change (Kälviäinen, 2019). The card deck, however, is not available as open access, which limits its adoption by a wide range of designers and design researchers for influencing behavior.



Figure 2.33: The Persuasive Patterns card deck (Toxboe, 2016)

Change Points toolkit (Hoolohan, 2020) is another open source ideation tool that includes a range of exercises to enable users (e.g., practitioners, designers, design researchers, etc.) engage with tasks to experience practice-based research and create practice-oriented design interventions for sustainable practices. Even the particular emphasis of the toolkit is to develop solution spaces for resource consuming practices (e.g., energy, water, food, etc.), it is also suggested to be applied in other societal challenges where a behavior change is required. Unlike previously reviewed ideation tools which provide theoretical information and strategies for inspiring change, the proposed toolkit mainly consists of *a range of instructions* designed to guide a workshop process and to trigger ideation (Figure 2.34). It involves six exercises including various questions that empower participants to explore the

everyday life and routines, their resource implications and develop interventions through building on the understanding received through this exploration. The adopted approach shows the importance of a well-constructed process for guiding individuals to think about behavior change.

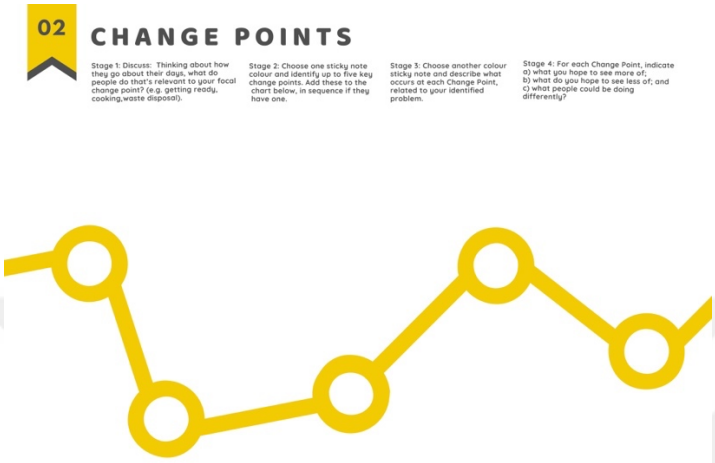


Figure 2.34: An example from the Change Points toolkit (Hoolahan, 2020)

The reviewed ideation tools adopt diverse approaches and incorporate a range of strategies, examples and exercises to develop ideas for guiding behaviors, most of which derived from the literature review (Hoolahan, 2020; Artefactgroup, 2018; Toxboe, 2016; Lockton et al., 2010; Daae, 2014) while one includes findings from a user research study (Coşkun; 2015). Whilst some of the reviewed ideation tools are specific to a particular problem area (Hoolahan, 2020; Coşkun, 2015), others take a more inclusive approach to behavior change, yet provide opportunities to be adapted into diverse problem areas related to sustainability. Apart from the differences, their integration into various design projects with the inclusion of participants from diverse disciplines showed the significance of providing individuals with the appropriate tools, procedures and information in generating diverse ideas for behavior change.

As previously discussed, promoting sustainable use behaviors requires a comprehensive understanding of the intended behaviors as well as the targeted users'

intentions for adopting change to be able to influence their behaviors through adopting behavior change strategies. Based upon this problem, within the scope of this doctoral research an ideation tool and a procedure for its implementation in the design process is proposed aiming to support designers for generating ideas for influencing behaviors for the effective use of water. The proposed tool differs from the previous examples in terms of its *scope* (i.e., effective use of water), *content* (i.e., behavior types, attitudinal and contextual determinants of behaviors, a new classification of user intentions for adopting change and a new categorization of design strategies) and *origins of the content* (i.e., including examples and statements from a user research study and literature review).

2.8 A Review of User Research Methods for Influencing Sustainable Behaviors

"Understanding (mainstream) consumer behaviour is a pre-requisite for understanding how to motivate or encourage pro-environmental consumer behaviour. But it is also a daunting task."

Jackson, 2005, p.9

Acquiring individuals' behaviors, experiences, intentions and insights on specific topics and investigating their interactions with products within different use contexts are quite challenging. In this section, a review of user research methods and techniques (e.g., interviews, focus group, card sorting, cultural probes, observations, video ethnography, shadowing, etc.) from User Centred Design literature will be presented through discussing their potentials for receiving particular aspects of behavior. Along with these, various generative tools and techniques incorporated into research studies focusing on design for sustainable behavior will be briefly reviewed to demonstrate diverse possibilities to capture users' insights and perspectives.

As it has been previously mentioned, both internal and external factors are influential for a behavior to occur. Yet, as exploring particular behavioral factors (e.g., intentions, habits, attitudes, etc.), some user research methods may hold various limitations to capture them. In a review study, Daae and Boks (2015) investigate the diverse types of insights that the design practitioners and researchers should anticipate to acquire related to user behavior through applying different user research methods. Table 2.6 presents how diverse user research methods may serve to investigate various behavioral determinants.

Table 2.6: User research methods recommended for diverse behavioral determinants (reproduced from Daae & Boks, 2015)

Research methods \ Behavioral factors	habits	beliefs	attitude	intention	objective constraints	subjective constraints	social norms	personal norms	values	
Interview		•	•	•		•	•	•	•	Methods for communicating with the user
Focus group		•	•	•		•	•	•	•	
Survey		•	•	•		•	•	•	•	
Verbal protocol		•	•	•		•	•	•	•	
Conjoint technique			•					•	•	
Want and needs analysis			•					•	•	
Card sorting		•								
Group task analysis		•								
Probes / diary study		•	•	•		•	•	•	•	
Observation					•					Methods for investigating what users do
Studying documentation							•			
Video ethnography					•					
Shadowing					•					
User testing					•					
Emphatic design					•					
Cultural focused research							•			
Applied ethnography	•	•	•	•	•	•	•	•	•	Methods for what users do including communicating with the user
Contextual enquiry	•	•	•	•	•	•	•	•	•	

Internal factors (e.g., attitudes, values, habits) exist within the user that are almost impossible to observe; thus, it is suggested to acquire this kind of data directly from the user for a thorough understanding (Daae & Boks, 2015). Methods for communicating with the users (e.g., interviews, probes, focus groups) are dependent

on the information that the user delivers, yet they are not suitable to understand the behavioral factors that the user is unaware of, such as habits.

The external factors (i.e., objective constraints and social norms) can be explored without interacting with the user, yet communication with the user may provide valuable insights as well. Methods for exploring what people do (e.g., observation, shadowing, user testing) allow researchers to collect data about the user and the context indirectly. Even though this approach enables the acquisition of data that the user may not be consciously aware of, it is limited to gain insights into the behavioral factors that emerge through the user's thinking processes (e.g., beliefs, attitudes, intention).

It is inevitable that what people say they believe or do may be slightly different from the actual situation. They may state things that they believe to be interesting or significant for the researcher or socially acceptable to share (Courage & Baxter, 2005). In that sense, observational studies often lack these biases in comparison to the research methods through which people directly share their experiences. Though, they are limited to the context and the available interactions and provide little about the attitudinal aspects of behaviors. The existence of the researcher in the observational settings or controlled environments may also affect product-user interactions and make it challenging to acquire actual use behaviors.

Data triangulation employs a combination of diverse research methods and approaches to have a thorough understanding of the research problem (Robson, 2002). In that sense, as studying behavior, combining multiple methods may result in investigating diverse behavioral determinants even though none of the methods alone might be anticipated to receive. Methods within the final categorization (i.e., applied ethnography, contextual inquiry) adopt this approach and combine observational techniques with the methods for communicating with the user to receive a wide range of behavioral determinants. They are suggested to be appropriate for exploring any external and internal behavioral determinants. In a

research study aiming to receive diverse determinants of behaviors, combining diverse methods from the matrix would be effective for comprehensive understanding of the behaviors (Lilley & Wilson, 2017). Even this analysis by Daae and Boks (2015) is mostly based on the researchers' understandings and reflections on the research methods that need further evaluations; it serves as an initial guideline for deciding upon the suitable research methods and techniques that would provide opportunities while facilitating research on behavior change.

As studying with people, individuals' diverse interests, skills, backgrounds, and limitations need to be recognized since these differences may make it a challenge to engage them into research activities and tasks (Hanington & Martin, 2012; Levitt & Richards, 2010). The incorporation of complementary generative tools (e.g., cards, timelines, diaries) and techniques (e.g., scenario building, storytelling, card sorting) into user research studies enables people to communicate their insights, experiences, needs, perceptions and expectations about the research problem easily and effectively.

Diaries are frequently utilized as a complementary tool in user research studies. *Workbook* (Figure 2.35), for example, developed to enable participants to deconstruct their bathing practices, share their needs and understandings about what is normal related to bathing patterns (Scott et al., 2012). In this study on exploring sustainable patterns of bathing, each participant was provided with an individual workbook involving guiding questions to document and analyze their bathing practices and do some experiments as bathing. The incorporation of the tool engaged participants in the analysis of the targeted practices and experimentations through the developed creative tasks.



Figure 2.35: (left) Workbooks as participatory tools and (right) a section from a workbook (Scott et al., 2012)

In another study focusing on exploring everyday interactions with energy in different contexts, participants were given arrow-shaped cards (Figure 2.36) and asked to label items that they engage with during their everyday interactions and practices (e.g., appliances, environments, products), and include their insights, problems, and ideas concerning energy consumption (Lockton et al., 2014b). The incorporation of the arrow comment labels and the related exploratory task made it easier for participants to recognize their surroundings, tell stories and express how the artefacts fitted into their everyday life.

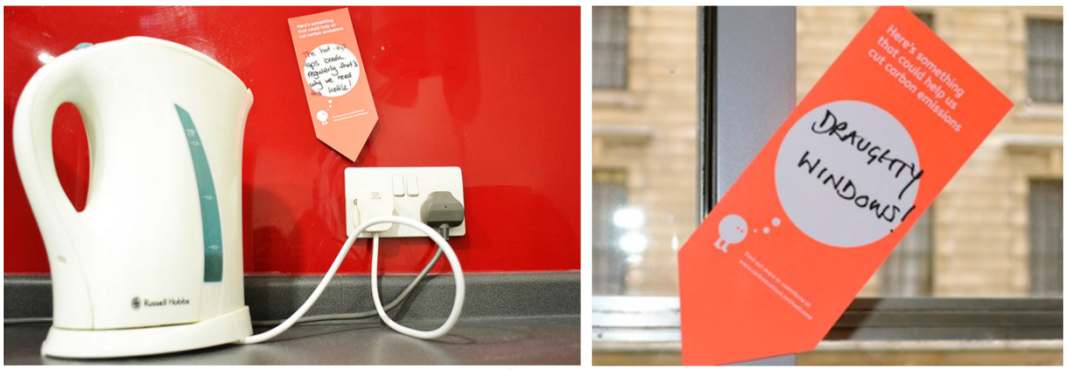


Figure 2.36: Arrow comment labels as exploratory research tools (Lockton et al., 2014b)

Drawing energy (Figure 2.37) is developed as a participatory research activity through which people visualize their ideas, mental models, experiences and notions of energy (Bowden et al., 2015). It aims to explore energy in new ways and uncover the perceptions people hold and the associations they make with this immaterial entity. The adopted technique revealed diverse and conflicting personal descriptions of and perceptions about the energy that is difficult to receive solely through interviews.

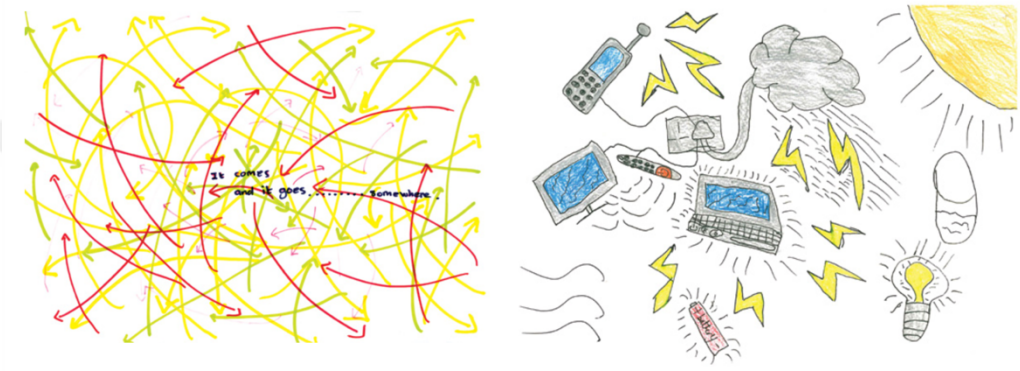


Figure 2.37: Examples of interpretation of energy from drawing energy exercise (Bowden et al., 2015)

The overview of various user research methods, their limitations and expected behavioral insights inspires that within this doctoral research, triangulation of methods would have greater possibilities to explore individuals' behaviors and experiences that are shaped through a range of attitudinal and contextual factors. Considering the different backgrounds, interests and abilities of participants, selected user research methods will be further supported with generative tools and techniques to engage participants in the data collection process and receive information (i.e., particularly about their understandings about water consumption) that is difficult to express through words *(see Section 3.1 Research Design: Generative Research).*

2.9 Summary and Discussion

As reviewed studies suggest, increasing demand for the household water consumption is a significant problem at the global and local scales. Limited number of studies focusing on the water consumption practices in the bathroom area, which is often associated with behaviors considered as private, make this area and related behaviors worth exploring. Household water consumption is affected and shaped by various individual, attitudinal, social, contextual and demographic factors. This supports the importance of investigating the personal care and hygiene practices as a whole and *gaining insights into the behaviors as well as the factors* affecting them *(see Section 2.4.1 Practice Oriented Design)*. This understanding is believed to reveal individuals' both existing and future needs and expectations in relation to water consumption and develop design interventions accordingly.

Besides the exploration of the nature of household water consumption, it is necessary to understand the individuals' diverse attitudes, concerns, norms and constraints towards adopting water-effective behaviors. Reviewed studies support that diverse target behaviors reveal different user types, thus *practice-specific intentions of individuals* should be captured to develop design interventions for altering behaviors of different users *(see Section 2.6 Significance of User Diversity for Influencing Sustainable Behaviors).*

Investigating individuals' behaviors, experiences, intentions and interactions with their surroundings is quite a challenging process, especially in the bathroom environment. Existing studies propose valuable insights related to the diverse user research methods and their expected outcomes for revealing various behavioral determinants *(see Section 2.8 A Review of User Research Methods for Influencing Sustainable Behaviors).* Considering these, as exploring personal care and hygiene practices and concerns about water consumption, a combination of diverse user research methods and generative techniques will be considered for an in-depth understanding.

The literature review showed a growing interest in design to encourage pro-environmental behaviors among individuals. Researchers in the field adopted diverse approaches and a range of design strategies for guiding sustainable behaviors. The lack of common vocabulary on the existing strategies encouraged me to propose *a new categorization of the design strategies (see Section 2.5.3 Proposed Categorization for Design Strategies)*. This comprehensive categorization will be utilized to inform designers as generating ideas for influencing sustainable behaviors.

For informing the diverse strategies and approaches to designers, researchers also developed a range of ideation tools with varying emphasizes. Considering the potentials and limitations of the existing tools, within the scope of this doctoral study, *new ways of communicating research findings to designers and design researchers* will be explored with a particular focus on influencing water effective use behaviors as performing personal care and hygiene practices.

The next chapters will present the adopted methodology, facilitation and findings from the *user research study* focusing on the exploration of the water-consuming personal care and hygiene practices and the users' intentions for adopting change and *design workshops* adopting research through designing approach that incorporate the research findings into the ideation phase of the design process and evaluate their implications for designing for influencing sustainable behaviors.

CHAPTER 3

EXPLORING DIVERSITY IN WATER CONSUMING BEHAVIORS AND USERS' INTENTIONS TOWARDS ADOPTING WATER EFFECTIVE BEHAVIORS

This step of the doctoral research aims to (i) gain insights into individuals' diverse behaviors that are responsible for water consumption as performing personal care and hygiene practices in the bathroom. Through enabling individuals to convey details about their behaviors, experiences and needs, and share their concerns and understandings about water consumption, it is believed (ii) to understand attitudinal and contextual determinants of the behaviors that are linked to intensive water consumption. This step also aims to (iii) understand individuals' diverse intentions towards adopting water effective use behaviors through supporting them to reconstruct their existing behaviors and suggest new paths for using water effectively.

In line with these intended outcomes, this first step of the research includes two complementary stages; *a diary study* and *generative interview sessions.* Diary study collects individuals use behaviors through time while generative interview sessions explore their experiences, insights, concerns and understandings about water consumption through generative tools and techniques (e.g., visualization, card sorting, etc.). The analysis of this user research study revealed diverse *behaviors types* that results in intensive use of water as performing activities of interest and a variety of *attitudinal and contextual* determinants that leads to performing these behaviors. Through evaluating the participants' existing behaviors, speculations about and attitudes toward potential paths for effective use of water, a range of *user intentions* was also proposed related to adopting water effective use behaviors. This

chapter of the doctoral study presents the details of the study, including the adopted methodology, facilitation of the research through reflecting on the development and incorporation of the generative tools and tasks, findings, and the limitations of and reflection on the study.

3.1 Research Design: Generative Research

Gaining an in depth understanding of the individuals' behaviors, experiences, needs and intentions and exploring their interactions with their surroundings that are shaped through a range of factors are quite a challenging process. Besides the difficulty of capturing behaviors and rationale behind their occurrence, bathroom environment also possesses several challenges to access and enable people to share their experiences due to the highly personal, sensitive and intimate nature of the activities that take place there. In this stage of the doctoral study, to overcome these difficulties, exploratory research methods (i.e., diary study and semi-structured interviews) are utilized through adopting a *generative research approach*.

Generative research aims to engage participants in creative processes to think about, assess and effectively express their insights, feelings, experiences, needs and desires related to a research topic (Hanington & Martin, 2012). The generative research approach is further separated as projective and constructive methods (Hanington, 2007). *Projective methods* involve activities through which participants reveal their needs and insights that are difficult to communicate through conventional means. They include collages, diagramming, drawing, daily logs, image and text- based cards and their sorting that are often adopted in the earlier stages of the research. *Constructive methods*, on the other hand, are utilized in the later stages of the design research, in which the particular aim is to enable individuals' share their insights, needs and expectations through making tangible things such as Velcro modelling (Hanington & Martin, 2012). In this stage of the doctoral research, incorporating *projective methods* (i.e., diaries, card sorting, mapping and drawing) are decided to

be valuable to support participants to share their behaviors and rationale behind them along with their tendencies to adopt behaviors for the effective use of water.

Diaries provide possibilities for the individuals to track, record and share the details of their everyday life and insights on a specific topic. They are preferable particularly to record information across time or at key moments throughout the day (Hanington & Martin, 2012). They provide the opportunity to capture interactions, reflections and emotions that are closer to the time of the execution which are difficult to recall otherwise. Based upon the scope of the research, diaries may require recordings in the form of texts, drawings or photographs either through digital or conventional mediums to enable participants to effectively convey their experiences. The purposes of the diaries may include *exploring* the participants for design inspiration, *sensitizing* the participants to a research topic or they can be utilized for *evaluating* purposes to receive feedback from the participants.

In this research, *diary study* is adopted to sensitize participants to the research topic and prepare them for the generative interview sessions. Facilitating a diary study is also considered as effective to overcome the potential difficulties of receiving information related to the behaviors performed in a sensitive environment like bathroom which is difficult to observe and access. In this study, it is mainly intended to enable participants to explore and engage with their personal care and hygiene activities, and record and convey the details about their personal experiences and understandings about water consumption. This exploration is believed to allow them to get familiar with their use behaviors and overall attitudes about water consumption in the bathroom environment and support them to recall and share these during the generative interview sessions. Diary study included two self-recording stages *(i) tracking* and *(ii) revealing* which will be shared in detail through the following sections *(See Section 3.3 Diary Study)*.

The knowledge received from the diary study leave space for the researchers' interpretations. (i) To further explore the individuals' water consuming behaviors

and experiences documented through the diary study and reveal the reasons for their performance, (ii) to gain insights into their understandings, beliefs, attitudes and concerns about water consumption, and (iii) to reveal their intentions for adopting behaviors for the effective use of water, the diary study is decided to be complemented with *semi-structured interviews* with the incorporation of a range of *generative tools and techniques*.

Interview is a fundamental research method that seeks first-hand knowledge and understanding of experiences, opinions and attitudes through a conversation (Hanington & Martin, 2012; Mills et al., 2010). Semi-structured interviews follow a predetermined script, but the questions largely evolve as the interviews progress. In this study, to probe into the participants' unique experiences, understandings, intentions, attitudes and concerns about water consumption, *semi-structured interviews* were adopted. Though, the difficulty of sharing insights related to water consumption revealed the need for incorporating creative techniques to support participants to effectively express their thoughts through diverse means. Advancing on this problem, a range of generative tools and tasks with diverse purposes were designed and developed to be included in the interview sessions. (i) *Two-dimensional representational bathroom components* and *mapping sheet* that support discussing the constraints and possibilities in the bathroom environment in relation to water consumption; (ii) *statement cards* and *a timeline* to support participants to enact and share their experiences and behaviors; (iii) *visualization task* allowing individuals to express their understandings about water consumption, and (iv) *probing cards* to inspire them to reconsider and reconstruct their existing behaviors for the effective use of water are among the generative tools and tasks incorporated into the interview sessions.

Considering its main approach (i.e., generative research) and the adopted methodology (i.e., semi-structured interviews), this step is named as *generative interview sessions*. Generative interview sessions include four complementary phases; *(i) mapping, (ii) sharing, (iii) reflecting* and *(iv) speculating* which will be

shared through the following sections along with the details of the adopted tools and techniques *(see Section 3.4 Generative Interview Sessions)*.

In this user research step of the doctoral study, diary study and generative interview sessions, that are planned as complementary to each other, with the inclusion of well-considered generative tools and tasks contribute significantly to reveal individuals' experiences, behaviors, belief, attitudes and intentions in relation to water consumption as performing personal care and hygiene activities that are difficult to express solely through acts or words. Figure 3.1 illustrates the research stages along with the incorporated tools and tasks and their intended outcomes.

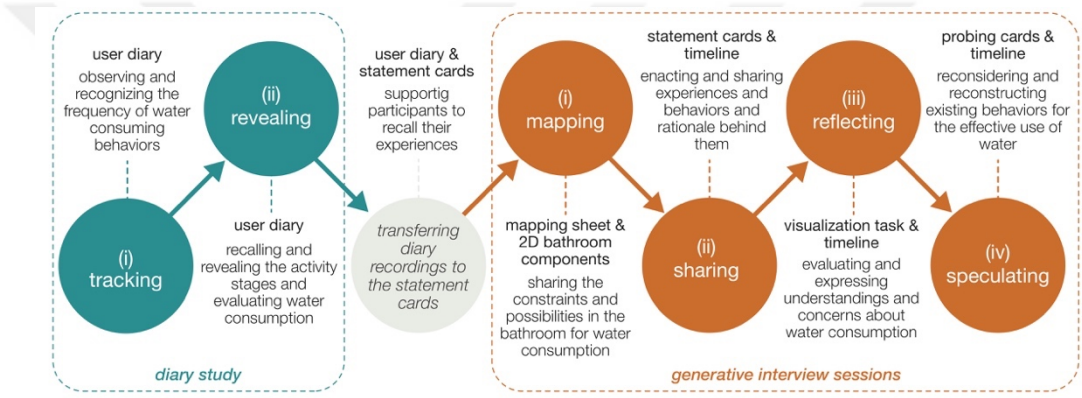


Figure 3.1: The user research stages, incorporated generative tools and tasks and their intended outcomes

3.2 Participants

Through the diary study and generative interview sessions, particular emphasis has been on receiving individuals' diverse behaviors, attitudes, and concerns related to water consumption and varying intentions for adopting water effective use behaviors. Considering this, *maximum variation sampling*, which is a kind of *purposive sampling strategy*, has been used to reach a wide range of individuals and capture diverse perspectives related to the research topic (Palys, 2008). The choice of the *purposive selection criteria* was defined considering the factors that have been highlighted through the existing research findings and insights focusing on water

consumption. *Occupancy type of households, age, gender,* and *neighborhoods* were among the prioritized criteria to recruit participants for receiving a variety of perspectives related to problem areas and concerns about water consumption. The number of people sharing the same dwelling may have an effect on the ways that individuals consume water. In shared bathrooms (e.g., families, student homes, etc.), the limited time allocated for individual use might lead individuals to develop diverse behaviors as performing water-consuming activities. The presence of children may also influence the frequency and duration of individuals' bathroom practices and their behaviors. In that sense, participants from *different types of households* (i.e., single, couple/non-family, and family with the kid[s]) were recruited to gain insights into diverse practices. As previously discussed, people from *different age groups* might possess various concerns about hygiene, which contributes to embracing diverse behaviors for cleaning *(see Section 2.2 Personal Care and Hygiene Practices in the Bathroom Environment)*. For example, elderly people might not be agile enough, and the duration and frequency of the water-consuming activities and the behaviors they adopt might differ from the younger generations. In that sense, reaching participants from various age groups was considered to reveal diverse use behaviors and concerns about water consumption. Considering the diverse personal care and hygiene practices performed in the bathroom environment, a balanced number of female and male participants tried to be reached to reveal diverse behaviors of people from *different genders* that could be responsible for intensive use of water. Participants were recruited among dwellings in Ankara which have proper water infrastructure. However, reaching diverse neighborhoods, for instance, ones experiencing frequent water cuts or buildings with a storage water heater or central heating system, is believed to increase the variety in behaviors as consuming water. The *diverse neighborhoods* also have an indirect effect on recruiting participants from different *income levels,* which may influence their concerns about water consumption.

User-centered studies adopting qualitative research methods often tend to receive an in-depth understanding of the preferences and needs of people through reaching a specific cohort rather than a larger population (Lilley & Wilson, 2017). In line with the considerations mentioned above, twelve participants were recruited for this step of the doctoral study to acquire a detailed understanding of the problem area.

As recruiting participants, rather than making comparisons between diverse groups, the main intention was to reach as diverse behaviors, intentions, beliefs, and experiences of various people as possible. Considering this, within each criterion that is regarded as significant for this study, enough diversity is included so that the implications of diverse characteristics can be explored in relation to water consumption behaviors. For instance, the occupancy type of household can be considered as a commonly used recruitment criterion to receive different perspectives. However, diverse representations within the same household type group are tried to be included in this research to see how other factors enrich the diversity of the data. To achieve this, I adopted a deliberate strategy to include cases that vary widely from each other. For example, one of the participants among family households with kids had a two-year-old baby while the other had an adolescent, and one other living in an extended family including all three generations. This *diversity in the composition of the families* supported to receive diverse behavior patterns and attitudes in relation to water consumption. Similarly, among elderly participants, even they were all physically active, they have various health problems (i.e., arthritis, chronic pains) that shape how they perform their personal care and hygiene activities. All participants were able to perform their self-care activities independently while one was occasionally receiving help from a family member while showering for safety concerns (i.e., fear of fall). *The physical and mental constraints of participants* also enriched acquiring diverse behaviors concerning intensive use of water.

For reaching participants, an announcement explaining the aim of the user research study and its stages has been published through social media sites. Since personal care and hygiene practices are mundane activities performed by every individual,

any particular skill or competence was not required to participate in the study. Among the potential participants who returned to the announcement, those who met the prioritized recruitment criteria and supported the diversity within these criteria were contacted. During the first contact with the potential participants, questions about to the secondary recruitment criteria were addressed including the composition of the households, the existence of a pet, physical constraints, number of bathrooms, water heating system, monthly water bills, etc. The final selection of participants was performed carefully to ensure that they fulfill the quota requirements and diversity as much as possible. Considering the populations who may be less likely to access to the internet, recruited participants were also used as gatekeepers to suggest potential participants fulfilling the selection criteria.

The participants of this research took part in both the diary study and generative interview sessions. Table 3.1 presents participants' distribution among diverse recruitment criteria. At the beginning of this user research study, as distributing the diaries, participants' approval to take part in both stages of the study was asked through a consent form (Appendix A). It briefly explains the main focus of the study, intended outcomes, and what is expected from the participants, along with the voluntary nature of the research and their rights to support participants to reach a consensual decision to take part in the study. Participants were also provided with incentives to motivate their active involvement in the study as well as to reward their valuable contributions.

Table 3.1: Participants' distribution among diverse recruitment criteria

		Occupancy type of households / Gender					
		Single		Multiple			
		Single		Couple / Non-family		Family with kid(s)	
		F	M	F	M	F	M
Age	18-24	P6		P5			
	25-34		P1		P2	P4	
	35-44		P3				P11
	45-54			P9	P7		
	+55	P10				P12	P8

3.3 Diary Study

3.3.1 Diary stages

Diary study, including two self-recording stages *(i.e., tracking and revealing)* aims to enable participants to explore and engage with their water consuming activities prior to the interview sessions and support them to the recall their experiences, use behaviors and interactions with their surroundings (Figure 3.2). This section will present the details of the diary study, its facilitation, and reflections on its contributions and limitations for this research.

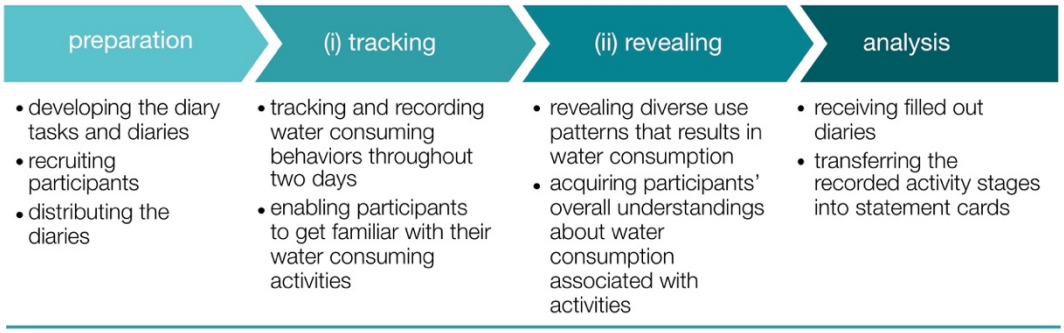


Figure 3.2: Diary study stages

The diary, consisting of 16 pages, starts with the brief explanation of the research aim and includes questions about the participants' personal information (i.e., age, gender, occupation, household size, billing type and monthly water consumption). Explaining what is expected from the participants is quite important as the diary will be completed in the absence of the researcher. Thus, it continues with the explanation of the diary stages and how participants are required to contribute to this study. The diary proceeds with *tracking* and *revealing* stages developed for various personal care and hygiene practices.

Tracking

The tracking task aims to enable participants to observe and recognize the frequency of their water consuming use patterns. It requires them to track and record their personal care and hygiene activities *(i.e., showering, bathing, washing body, washing feet, washing hair, washing hands, washing face, brushing teeth and performing an ablution)* in the bathroom across two days. It includes a timetable through which participants are asked to check the boxes with the corresponding time slots as they perform the activities of interest (Figure 3.3). Through this task, prior to the generative interview sessions, participants would have thought about their activities and become relatively aware of their routinized and habitual behaviors (e.g., repetitive hand washing, etc.) that they often carry out without conscious deliberation. Participants were asked to complete this task during two days through which they spend the most part of the day at home as the particular focus of the research is household water consumption. The duration of the tracking task decided considering the diversity of the recorded activities in terms of their duration and frequency. The seasonal, contextual or psychological factors affecting the frequency of these water consuming activities were further probed through the generative interview sessions.

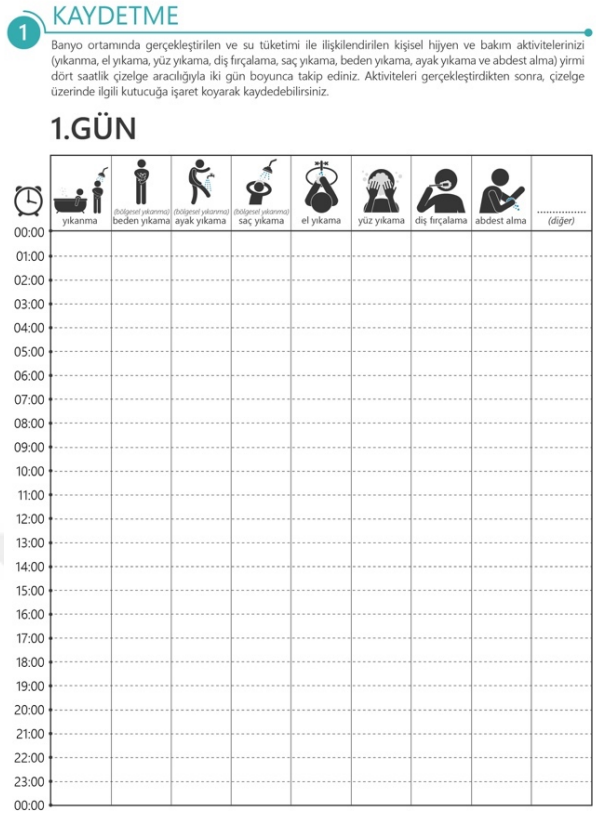


Figure 3.3: Tracking step of the diary study

Revealing

The aim of the revealing stage is to enable participants to think over their personal care and hygiene activities and observe and get familiar with the stages of the activities they perform. In this stage, participants are required to complete four complementary tasks. Initial step is to *select an activity scenario* that they perform the activities they record. They are provided with a list of activity scenarios (e.g., showering to freshen up in a warm day, removing odor and sweat after gym, etc.) through which they can select the one that they found relevant or they may include a new scenario to better describe their use experience.

In the second task, they are asked to *convey the stages of their experience* through ordering provided activity stages (e.g., turning on the tap, adjusting the flow rate of water, soaping hands, etc.) on an empty timeline. The participants are also expected

to add new stages to share their experiences in a detailed way. These recordings are further used in generative interview sessions as a probe to gain insights into the participants' diverse use patterns and the reasoning behind their performance to reveal potential problem areas for intensive water use. Lastly, noting down *the approximate duration* of the recorded activities, they are also asked to express their *overall understandings about water consumption* resulting from their use patterns. The participants were provided with a five-point Likert scale question ranging from *very little, little, normal, intensive* and *very intensive* to evaluate the water consumption in relation to the behaviors they adopt in each activity. It also included a *"not sure"* scale to prevent respondents delivering their opinions when they are uncertain about them. The reasons of their understandings are probed further through the generative interview sessions. Figure 3.4 shows a section from the revealing stage for the showering activity along with the explanation page.

Throughout this revealing task, participants are allowed to recall a previous experience or simply elaborate on the one that they have already performed and recorded in the tracking task. Even the diary study includes a range of water consuming personal care and hygiene practices that are at the focus of the research, participants are expected to fill in the activities that they perform. As completing the diary stages, participants returned the diaries to the researcher. Participants' responses were transferred into *statement cards* to be probed during the generative interview sessions.

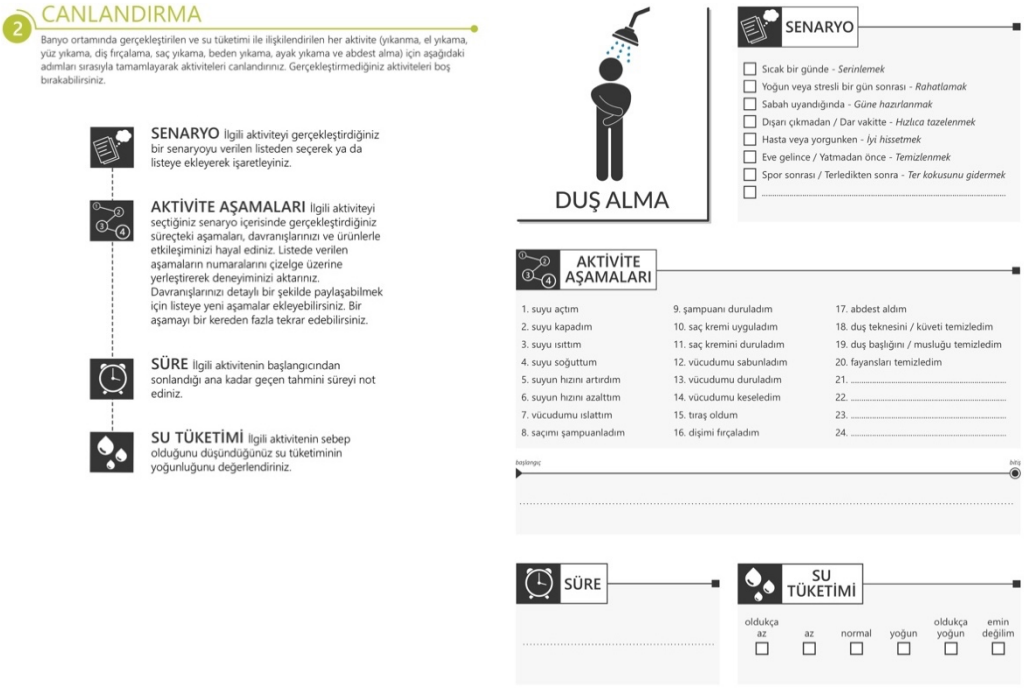


Figure 3.4: An explanation page for the revealing stage (left); empty revealing page for the showering activity (right)

3.3.2 Reflections on the Diary Study Stages

The diary study and the incorporated tasks holds some limitations and possibilities for this step of the doctoral research. This section will present the reflections on the diary study and its stages. During the *tracking stage*, there might have been a gap between the actual time the activity was carried out and the time it was recorded. This might lead to miss out some of the activities performed. However, as the main intention is not to map the behavioral patterns of the participants but rather to make participants become more familiar with their use patterns and more conscious about their water consuming behaviors, it can be inferred that the tracking stage fulfilled its expected outcomes.

Another limitation is related to *the duration of the tracking stage*. Since more comprehensive activities such as bathing might be performed more rarely when compared to others (e.g., washing hands and face), the duration of the tracking task

(two successive days) might be found limited. However, due to the its level of detail, the bathing activity is often planned in advance, and performed with conscious deliberation which makes its frequency easier to recall. Considering this, even if the participants would not have had a bath throughout the recorded days, it would still be easy for them to talk about the frequency of their bathing patterns.

The tracking stage enabled participants to observe and recognize the frequency of their water consuming use patterns some of which are realized to be performed habitually (e.g., washing hands after touching food, etc.). As they become relatively more aware of their routinized and habitual behaviors, it enabled them to reflect on the details of their water consuming behaviors during the generative interview sessions and allow me to probe into them to reveal the reasons for their performance.

In the *revealing stage*, the provided *list of activity stages* (e.g., turning on the tap, rinsing soap, etc.) mentioned to be triggering to give more detail about their activities and enabled participants to recall activity stages that are performed without conscious deliberation (e.g., cleaning the tap). As participants started to record their activity stages, they also remembered additional steps that were not in the list and they included them as well which enriched the detail of the documented experiences.

In the revealing stage, as evaluating their understandings about water consumption in relation to the recorded activities, participants mentioned to have difficulties to understand the criteria through which they would evaluate their understandings. For instance, it was not clear whether they would compare their use behaviors with other people, compare diverse activities (e.g., comparing water consumption in bathing with hand washing, etc.), or evaluate the activities within the recorded scenario. In fact, the aim of this evaluation was to enable participants to question their overall perception of and attitudes towards water consumption before the interview sessions, and it achieved its purpose. When the participants attend the interview sessions, they had already thought over water consumption through elaborating on diverse dimensions, and this supported discussions in a positive way. Overall, it can be stated

that the combination of tracking and revealing stages primed the participants for the following stage of the research and supported them to share the details of their experiences in relation to water consumption resulting from personal care and hygiene practices.

3.4 Generative Interview Sessions

3.4.1 Generative Interview Stages

In this stage of the doctoral study, aiming to explore the individuals' behaviors responsible for intensive use of water documented through the diary study and reveal the factors affecting them, gaining insights into their understandings about water consumption, and revealing their intentions for adopting behaviors for the effective use of water, generative interview sessions were facilitated. The duration of the generative interview sessions changed between 55 to 102 minutes in line with the number of personal care and hygiene activities discussed. The study includes four complementary phases; *(i) mapping, (ii) sharing, (iii) reflecting* and *(iv) speculating* along with the comprehensive preparation and analysis phases (Figure 3.5). This section will present the stages of the generative interview sessions through introducing the developed and adopted tools and techniques and discuss the reflections on the stages in terms of their implementation, and contributions and limitations they offer for the study.

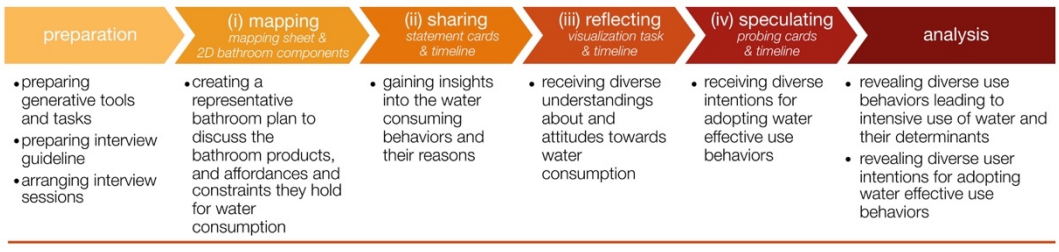


Figure 3.5: The generative interview stages

Preparation

Prior to the interview sessions, a comprehensive preparation phase is carried out to develop the tools to be incorporated into the study to stimulate discussions. These tools include *mapping sheets* (i.e., bathroom plan template) and *two-dimensional laser-cut bathroom components* (i.e., shower trays, bathtubs, washbasins, bathroom counters, toilets, bathroom cabinets, doors, and windows), *statement cards, timelines* and *probing cards* that were carefully designed to support the expected outcomes of the interview stages. During the preparation stage, as receiving filled-out diaries from the participants, the interview sessions were scheduled and participants' recordings on the diaries were transferred into the statement cards to inspire and guide discussions during the generative interview sessions (Figure 3.6).

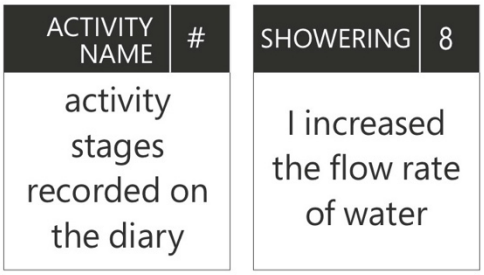


Figure 3.6: Statement card template and filled-in example

To be able to guide the discussions and cover all the issues that are essential for this phase of the study, *an interview guideline* was prepared and categorized in four parts based on the content and intended aim of the questions: (i) preparing the bathroom environment, (ii) sharing the use patterns leading to water consumption, (iii) reflecting on the understandings and concerns about water consumption and (iv) speculating over potential behaviors for the effective use of water. The comprehensive list of the interview questions can be found in Appendix B. Throughout the interviews, the main structure of the interview guideline was followed, though based upon the flow of the conversation, the order of the questions were changed and probing questions were included to reveal diverse aspects related to water consumption.

Mapping

The contextual factors such as the affordances and constraints designed into the products and environments may influence adopting pro-environmental behaviors. Since the generative interview sessions were not facilitated in the participants' bathrooms, creating a representative plan of their existing bathrooms is considered to be supportive as *sharing the details about the bathroom products and environment along with the constraints and affordances they create for water consumption*.

For creating a bathroom plan, a variety of two-dimensional bathroom components have been created through a laser cutter (Figure 3.7). A template has been developed for the participants to create their bathroom plan through attaching these components on it. The template also includes a list of diverse types of washbasin and shower mixer taps (i.e., two-handle, single handle, sensor-operated, and others), shower heads (i.e., hand shower, sliding shower head, rain shower, and others), and water heating systems (e.g., central heating system, boiler, solar water heaters, etc.) to explore the details of the participants' bathroom environment and support them to share their experiences with the existing products and systems which can be directly responsible for adopting water intensive use behaviors (Figure 3.8).

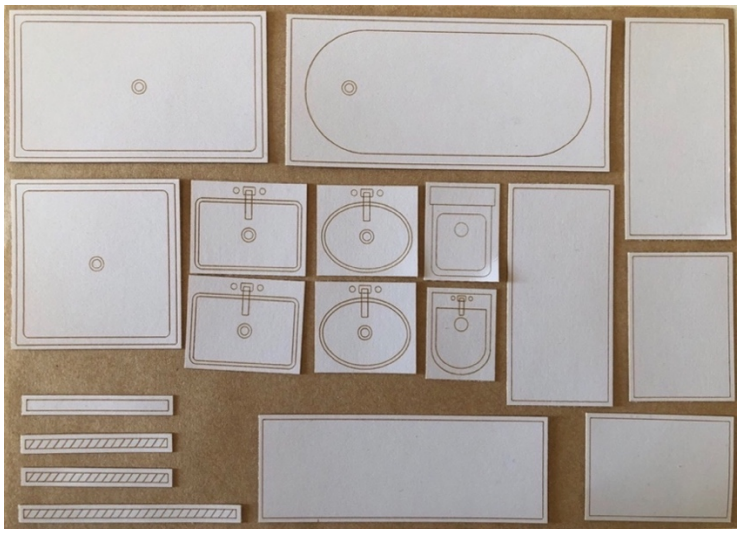


Figure 3.7: Two-dimensional representative bathroom components and furniture for bathroom plan

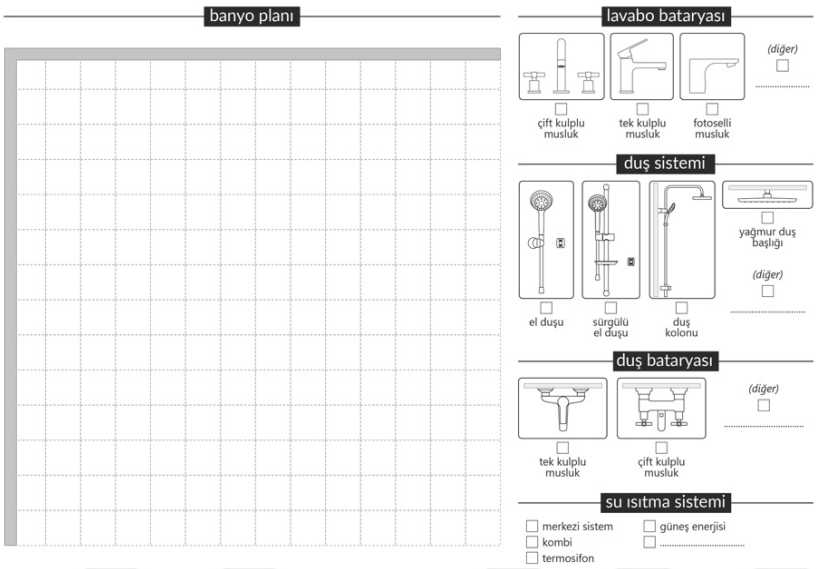


Figure 3.8: Mapping sheet including a representative bathroom plan and accessories

As conducting sessions, creating a representative bathroom plan and directed interview questions supported participants to share their experiences with and concerns about their existing bathroom products and environment, and water heating system that are associated with water consumption. The inclusion of this stage in the sessions, particularly for the ones that are facilitated outside the home during the pandemic, has been very effective for the participants to recall the environment and talk over the problems they experience in relation to intensive use of water. The participants' responses during the mapping stage directly served to understand contextual determinants of adopting water intensive behaviors. Through this warm up task, participants were also engaged into the generative interview sessions, creative tasks and the research topic. Figure 3.9 below present a filled in mapping sheet by Participant 4.

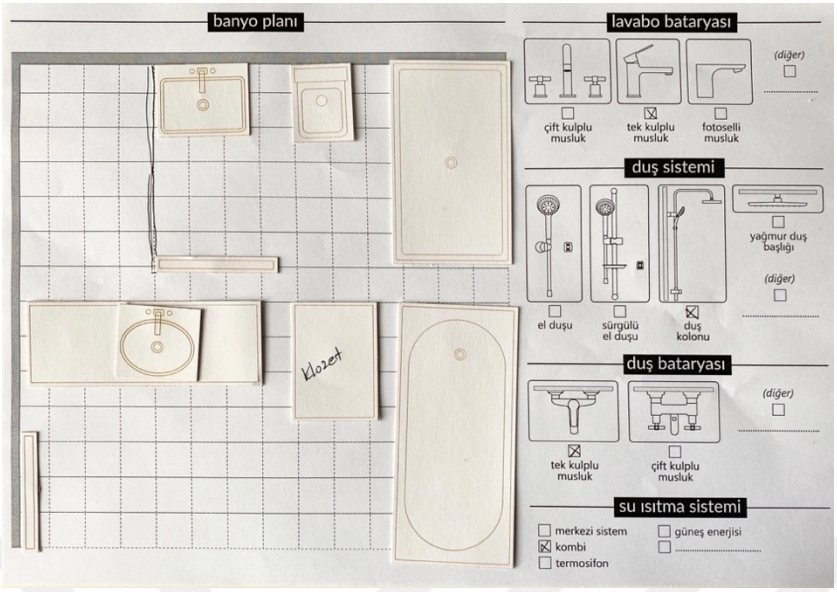


Figure 3.9: Filled in mapping sheet by Participant 4

Sharing

The particular aim of this stage is to enable participants to (i) *share the details of their water consuming behaviors* that they have recorded during the diary study and (ii) *reveal the reasoning behind their performance* The acquired data is aimed to inform the understanding of diverse behaviors responsible for the intensive use of water and their attitudinal and contextual determinants.

To remind participants their behaviors and enable them to share their experiences in detail, *statement cards* are prepared which includes the activity stages that the participants documented in the revealing task of the diary study. In this stage, participants first sort out the statement cards on *an empty timeline* created separately for each activity (Figure 3.10) and describe their experiences in detail through the addressed probing questions. In this stage, they are also provided with *empty statement cards* that they may fill and attach on the timeline, if they recall an additional activity stage or a behavior.

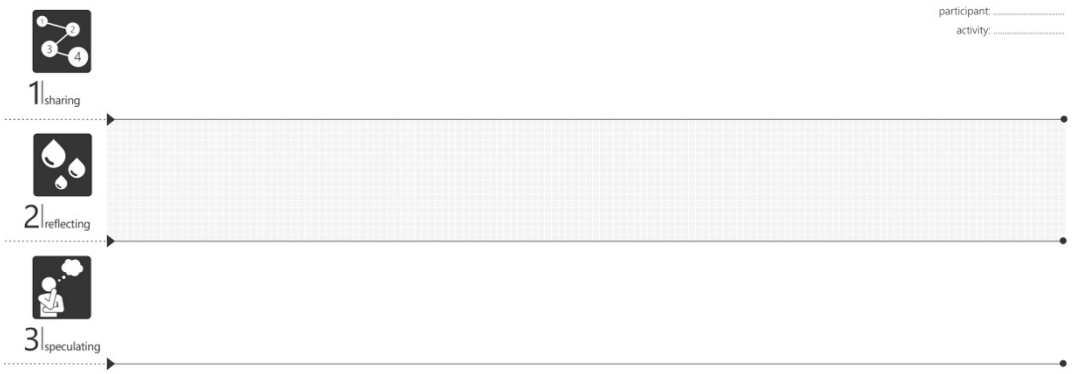


Figure 3.10: Empty timeline template for sharing & reflecting and speculating stages

As carrying out this stage, through the integration of statement cards, participants recalled and shared the details of their water consuming activities and activity stages that they have recorded during the diary study. They often extended the detail of the activities through incorporating diverse stages that they occasionally perform (e.g., shaving body, applying mask, etc.) and attached these new stages on the timeline. Figure 3.11 demonstrates a filled-out sharing stage by Participant 4.

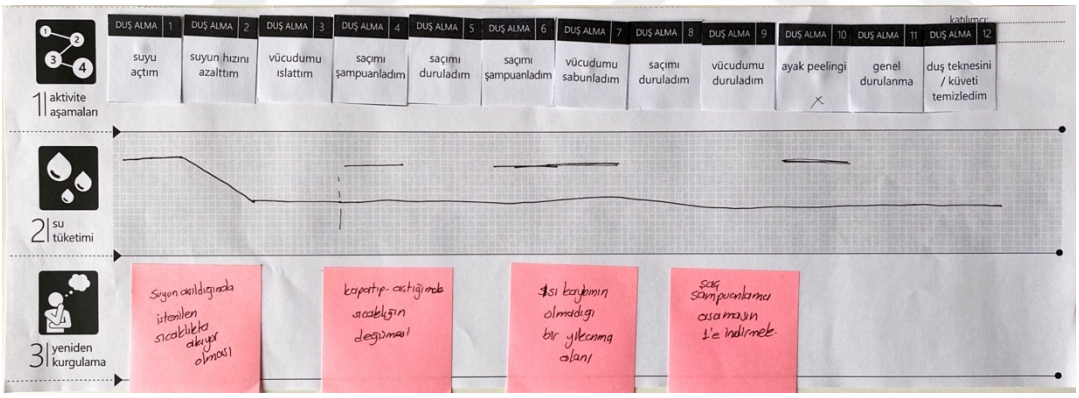


Figure 3.11: Filled in timeline for the showering activity by Participant 4

Some of the personal care and hygiene activities were mentioned to be combined as performing them. For instance, brushing teeth, washing hands and washing face activities are carried out in sequence through which some activity stages overlap. Considering this, during the sessions, the timeline template was extended through attaching templates to each other, and participants were encouraged to share these

combined activities in a single activity scenario. During this stage, addressed interview questions enabled to understand various contextual and attitudinal reasons behind the performance of water consuming behaviors and revealed various problem areas, and diverse intentions of users for adopting water effective use behaviors.

Reflecting

After sharing their experiences as performing an activity, participants were asked to *visualize their perceptions and overall understandings about alterations in water consumption* (e.g., increase, decrease, stability, etc.) referring to the activity stages described during the sharing stage. Through this exercise, it is aimed to enable participants to *consider, evaluate and share their understanding of water consumption* which may be difficult to express solely through words. To better reflect their understandings, participants were encouraged to use a variety of means including charts, graphs, colors and lines while describing their insights. As they visualize their understandings about water consumption, the rationale behind their perception was explored through probing questions.

In this stage, the visualization exercise was adopted as a means to enable participants better communicate their insights related to water consumption (Figure 3.12). The developed task worked quite effectively to acquire the participant's understandings about water consumption and relate their concerns with diverse use stages that they have shared through the previous stage. Addressed questions enabled me to understand how they link their existing behaviors with water consumption which served to reveal diverse intentions towards adopting water effective use behaviors. It also informed diverse behaviors responsible for intensive use of water and factors affecting their performance.

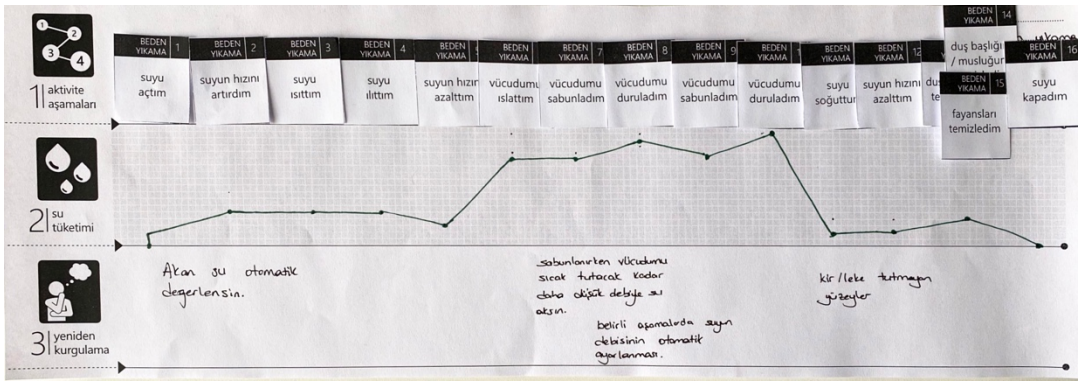


Figure 3.12: Filled in reflecting stage by Participant 7

Speculating

While previous stages mainly focus on the existing behaviors, experiences and understandings related to water consumption, speculating stage allows participants to *reconsider and reconstruct their existing personal care and hygiene behaviors* to identify opportunities for change to reduce water consumption. Through enabling participants to *share their suggestions for and attitudes towards effective use of water*, this stage aims to reveal their diverse intentions for adopting responsible behaviors for water consumption.

In this stage, participants are first asked to share the strategies they develop or adopt for reducing water consumption as performing activities of inquiry. Then, the barriers or enablers for reducing water consumption or altering their behaviors are questioned. Following that, to stimulate discussions further and support participants to rethink and reconstruct their water consuming behaviors in the bathroom environment, probing cards are provided (Figure 3.13). Probing cards include triggering facts about water scarcity and intensive water consumption resulting from products and users' behaviors. As making the problem area more visible for the participants through these cards, they are asked to reconsider their existing use patterns and suggest potential behaviors to be adopted for the effective use of water. In this stage, rather than generating design ideas, the particular focus is to receive the potential paths for change to understand their intentions and attitudes towards

adopting water effective use behaviors. Participants transferred their insights and suggestions into the sticky notes and then added them on the timeline (Figure 3.14). Throughout the generative interview sessions, sharing, reflecting and speculating stages were repeated for each activity that the participants recorded during the diary study.



Figure 3.13: Probing cards incorporated during the speculating stage

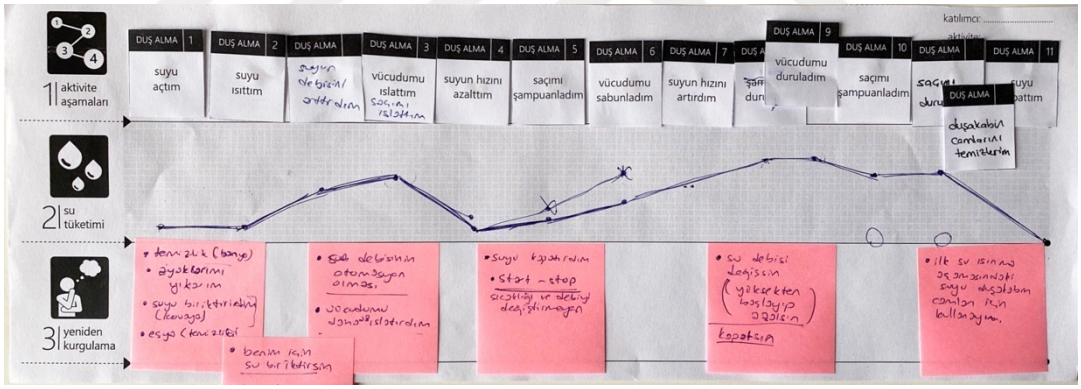


Figure 3.14: Filled in speculating stage by Participant 3

In this stage, the provided information on the probing cards was often new for the participants. Even they somehow knew that the water resources have been depleting, they were not aware of the impacts of their use behaviors on the environment. For instance, representing water consumption through the showering activity through more tangible means (i.e., water bottles) made them realize the amount of consumption. In that sense, probing cards made the consequences of individuals' use

behaviors clearer and encouraged participants to reconsider their use behaviors and to propose paths for effective use of water. This awareness also helped me to understand their attitudes towards adopting more sustainable ways of consuming water. For example, throughout the interview session one participant was quite hesitant to alter the way he showers, believing that he/she spiritually needs that routine. After reviewing the probing cards and realizing the significance of the issue, he/she stilled showed a hesitation to adopt water effective use behaviors, and even to use more efficient products. This showed that the participant is quite conservative about his/her showering practice and very resistant to change his behavior.

While speculating over potential paths for change, participants reviewed the use stages documented on the timeline and their overall reflections on the sharing and reflecting stages and tried to offer suggestions accordingly. In that sense, combining sharing, reflecting and speculating stages on the same timeline was effective. Throughout this stage, I address several questions to better explore their attitudes for change and reasons behind them. Asking participants to reconsider and reconstruct their existing behaviors enabled me to understand how they relate their existing behaviors to water consumption and their intentions towards adopting water effective use behaviors. This stage also enabled me to reveal some other behavior types and their determinants through projecting on the potential solutions they mentioned.

3.5 Data Analysis

The expected outcomes of this step of the doctoral study was to reveal *diverse behaviors* that are responsible for intensive use of water and understand *the factors affecting their performance*. It was also aimed to capture *diverse intentions* of users for adopting water effective use behaviors. Considering the particular aim of this stage of the doctoral study, the received qualitative data was analyzed through adopting *inductive content analysis and grounded theory* approaches.

Content analysis is a method through which the received data is categorized and coded to achieve replicable interpretations and identify consistent patterns and relationships between them (Julien, 2008). Considering the sources of the themes and categories, the content analysis method suggests two diverse approaches: deductive and inductive. In *deductive approach* codes and categories are based on a theoretical framework or literature whereas *in inductive approach* they are grounded in the data itself and revealed through systematically reviewing (Hanington & Martin, 2012).

Grounded Theory is a methodology through which theories are derived inductively from the rigorous analysis of the qualitative data (Corbin & Strauss, 2014). In the analysis of the collected data, codes are developed and assigned to repetitive insights and statements. As the analysis proceeds, through revisiting and re-evaluating the collected data, higher-level of categories emerge to group the codes into concepts and categories. Then, these categories become the grounding of new theories which directly derives from the collected data (Corbin & Strauss, 2014).

The transcription of the generative interview sessions, which were voice and video recorded, was the first step of the data analysis process. Since the participants' behaviors, concerns, attitudes, intentions and understandings in relation to water consumption were grounded within the received data, to be able to preserve its richness, the sessions were verbatim transcribed through a web platform named otranscribe. As the transcriptions completed, the participants' statements with the corresponding time slots were transferred to an Excel Sheet and labeled in relation to the *interview stages* (i.e., mapping, sharing, reflecting and speculating), *personal care and hygiene activities* (e.g., showering, brushing teeth, etc.) and *products* (e.g., washbasin, tap, etc.) that the statements are associated with. In total 1532 meaningful statements were analyzed. Carefully reading through and interpreting these statements, codes started to emerge. As the analysis proceeds, the codes were further grouped under sub-themes and themes. Meanwhile, these emerging codes, themes and sub-themes were simultaneously defined in a glossary of terms table in order to

preserve the consistency and reliability of the analysis process. While the new codes were appearing, these definitions were reviewed and revised many times. During this process, the wording of the codes revised and refined while some codes merged with the similar ones. Below figure demonstrates the iterative nature of the followed analysis process (Figure 3.15). A template for the analysis phase is shared in Table 3.2 demonstrating examples from the interpretation of the data and the development of the codes.

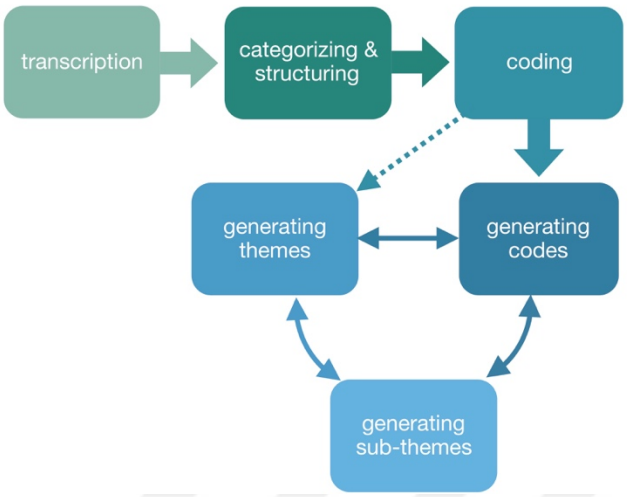


Figure 3.15: Data analysis process

The following section will present the findings from this research through highlighting significant examples and participants' statements from the diary study and generative interview sessions.

Table 3.2: Examples from the interpretation of the qualitative data and the development of the codes

						Determinants of Behaviors			Strategies & Suggestions	
#P	Interview Stage	Activity	Related product	Statements	Reflections	Behavior types	Attitudinal determinants	Contextual determinants	User intentions	Behavioral strategies	Speculative solution areas
1	speculating	washing hands	washbasin tap	(1:11:54) If I turn off the water when my hand is soapy, tap will be soaped too because I have to touch it. This time I will spend more water to clean the tap. Instead of thinking whether to turn it off or not for seconds, I don't want to have that much workload, I optimize the process in my head and do not turn it off.	Finds it unpractical to turn off the water while it is not used while soaping hands. Needs to clean the tap to remove soap stains and uses more water in the cleaning stage	running water without any purpose	perception of hygiene for bathroom components need for comfort	difficulty in controlling the tap	reluctant		
5	speculating	showering	overall	(20:51) I don't have any strategies to reduce water consumption. I see it as a comfort activity that is why it took a while. I am aware that my consumption is excessive, but I am not quite worried about it. If someone requests me to do so, I would be a little more careful and take shorter showers, but I have no inner motivation.	Has low intention to adopt responsible behaviors, as showering considered as a comfort activity. However external factors might be useful to change their behaviors	performing activities and activity stages for long durations	need for comfort		reluctant	reducing the duration of activities and activity stages	peer pressure
7	speculating	showering	overall	(40:24) If I could see the amount of water I am using during the shower, I would reduce the duration of the stages like rinsing or simply skip some unnecessary stages.	Being informed about the water consumption is effective to adopt responsible behaviors	performing activities frequently and repeating activity stages performing activities and activity stages for long durations	visibility and clarity of water consumption		willing	reducing the frequency of activities and activity stages	clear feedback on water consumption

3.6 Findings from the User Research Study

In this step of the research, enabling individuals to share details about their personal care and hygiene practices in the bathroom environment through the incorporation of generative tools and techniques revealed diverse *behaviors types* that results in intensive use of water as performing activities of interest. Exploring the factors that affect the individuals' needs, beliefs, constraints, attitudes and concerns in relation to water consumption, revealed a variety of determinants that shape these water-intensive behaviors. The emerging determinants have been categorized under two sub-themes: *(i) attitudinal determinants of behaviors* and *(ii) contextual determinants of behaviors* which are interrelated to each other. Through investigating existing behaviors, discussing how individuals relate these to water consumption and speculating over potential paths for reducing water consumption, a variety of *user intentions* has been revealed related to adopting water effective use behaviors. Even though it was not the main intention, this exploration also uncovered various *behavioral strategies* and *speculative solution areas* for the effective use of water. Table 3.3 presents the generated *behavior types*, *determinants of behaviors* and *user intentions* along with their short descriptions. The details about the findings from this user research stage of the doctoral study will be shared through the following sections.

Table 3.3: The short descriptions of the findings from Step I

Behavior Types	Definitions
running water without any purpose	continuous flow of water with diverse intentions during different stages of the activities where the water is not directly used such as warming up the water or brushing teeth
using water for different purposes	using water to meet diverse physical and psychological needs rather than cleaning purposes such as keeping the body warm or feeling relaxed
performing activities frequently and repeating activity stages	repetition of the activities or activity stages with diverse reasons including not feeling oneself clean or to effectively remove the residuals of personal care products and cleaning supplies
performing activities and activity stages for long durations	increase in the length of the activity time resulting from the individuals' diverse preferences, perception about time and changing needs
ineffective scaling of water	difficulty in adjusting the amount of water for diverse needs arising throughout the different stages of the activity or preferring to run water with high flow rates for various reasons which in turn leads to intensive and unnecessary use of water
performing habitual behaviors	performing learned behaviors that are carried out with little or no conscious deliberation such as leaving the tap on as brushing teeth or repeating hand washing activity

Attitudinal Determinants of Behaviors	Definitions
feeling oneself clean and refreshed	performing or repeating the activities and their stages or extend their duration as feeling dirty or to be able feel relaxed and refreshed
need for disinfecting body and body parts	diverse understandings about personal hygiene which lead to repeating activities and their stages, increasing their duration or scaling water ineffectively to clean and sterilize the body parts
perception of hygiene for bathroom components	considering the residues of soap, cleaning supplies and lime scale as dirty which reveals the need to clean the surfaces of bathroom components and accessories leading to intensive use of water
visibility and clarity of water consumption	adopting behaviors responsible for intensive use of water due to the difficulty in relating the consequences of behaviors to water consumption throughout the different activities and activity stages
perception of time	individual's sense of the duration of personal care and hygiene activities and activity stages that is responsible for adopting unsustainable behaviors
need for rinsing body and body parts	adopting water intensive use behaviors in relation to the need to effectively remove personal care products from the body parts and to be convinced that they are properly rinsed
need for comfort	performing behaviors responsible for intensive water use to satisfy the sense of comfort as performing personal care and hygiene activities

Table 3.3: The short descriptions of the findings from Step I (continued)

Contextual Determinants of Behaviors	Definitions
difficulty in controlling the tap	consuming water intensively resulting from products' constraints to enable precise adjustment of temperature and flow rate of water in line with individuals' diverse needs and preferences and insufficient feedback related to them, and difficulty in accessing and interacting with the tap
difficulty in cleaning bathroom components	intensive use of water as cleaning lime scale and residuals of personal care products from the surfaces of bathroom components and accessories
difficulty in accessing hot water	water heating system and infrastructure related issues that are responsible for wasting water because of the late arrival of the hot water to the bathroom environment
ineffective spraying of water	intensive use of water in relation to the bathroom products to spray water efficiently
difficulty in personalizing bathroom components	intensive use of water resulting from the bathroom products' constraints in terms of adaptation, adjustment and personalization in line with the diverse needs and preferences of individuals
deterioration of bathroom components and their replacement	intensive use of water resulting from the deterioration or wearing off the bathroom components and accessories, and difficulty in their replacement due to the affordability of newer or more efficient bathroom products and required knowledge and effort in their installation

User Intentions	Definitions
mindful	mindful individuals are aware and concerned about the consequences of their water consuming behaviors. Since they are sensitive towards environmental issues, they already adopt responsible behaviors for effective use of water
willing	willing individuals are aware and worried about the consequences of their water consuming behaviors and possess positive attitudes towards adopting behaviors for effective use of water
doubtful	doubtful individuals have lower awareness about the consequences of their water consuming behaviors but worried about them which makes them uncertain about adopting water effective behaviors and their expected outcomes
reluctant	reluctant individuals have low awareness and low or no concern about the consequences of their water consuming behaviors. They find it difficult to alter their existing behaviors leading to intensive use of water or think that these are efficient or necessary and consequently have low intention to adopt water effective use behaviors
unconcerned	unconcerned individuals have low or no awareness about the consequences of their water consuming behaviors, unconcerned about them, and thus have no intention to adopt water effective behaviors.

3.6.1 Behavior Types Leading to Intensive Water Consumption

Individuals adopt diverse behaviors leading to intensive use of water while performing activities and interacting with their surroundings which are influenced from multitude of factors. In this research, six behavior types *(running water without any purpose, using water for different purposes, performing activities frequently and repeating activity stages, performing activities and activity stages for long durations, ineffective scaling of water,* and *performing habitual behaviors)* have been identified as responsible for intensive use of water while performing personal care and hygiene practices. Below the definitions of these behavior types will be presented along with the examples from participants' responses for further clarification.

Running water without any purpose

Throughout the diverse stages of the activities (e.g., warming up the water, shampooing hair) in which the water is not directly used, individuals prefer to flow water continuously with different intentions such as avoiding contact with cold water or finding it difficult to readjust the water temperature. These use patterns through which the water is not directly used and flows unnecessarily are named as *running water without any purpose.*

Participants have mentioned a variety of reasons for adopting behaviors that leads to wasting water. For instance, as soaping their hands or splashing water to their faces, they do *not want to touch the washbasin tap* to turn off the water thinking that either they would stain the tap, or their hands would get dirty. In such a case, it is believed that cleaning the tap or repeating the hand washing activity thinking their hand is contaminated would create a rebound effect and result in higher water consumption. Another reason for wasting water is related to the *perception about the duration of the activity stages* and its *overall impact on water consumption*. Thinking the certain activity stages (e.g., soaping hands and body, rinsing mouth, etc.), through which the water flows unnecessarily, are performed quite quickly and believing this short period of time would not have a considerable effect on water consumption,

individuals hesitate to turn off the tap. Adopting such behaviors is often related to desire to *have a comfortable experience* without interrupting the flow of the activity stages. *Allowing water to heat up before stepping in the shower* is another use pattern adopted frequently by the participants that result in considerable amount of water to be lost from the drain while still clean. *Difficulty in reaching the tap and adjusting the temperature and flow rate of water, infrastructure related problems for accessing hot water* and *water leakage* resulting from the deterioration of product parts are also revealed as the potential reasons for wasting water throughout the diverse stages of the activities.

Using water for different purposes

As performing personal care and hygiene practices, individuals tend to use water to meet diverse physical and psychological needs rather than cleaning purposes such as keeping their body or the bathroom environment warm or feeling refreshed and relaxed. The use patterns where the water is not utilized for cleaning the body or its parts but rather used for answering different needs are called as *using water for different purposes*.

One frequently mentioned reason for using water for different purposes is related to *the temperature of the bathroom environment*. Since this environment often lacks a separate control over the temperature, individuals hesitate the turn off the water as showering worrying that they would get cold. Instead, water is used to *keep the body warm* as shampooing hair or soaping body. Particularly during winter, the duration of showers extends just to warm the body up rather than to clean it. Parents have diverse concerns and use water with various purposes while giving their babies a bath. As being very sensitive about the temperature of the environment, water is both utilized to keep the baby's body and the bathing area warm, and to enable the baby play with it as the parents clean the baby.

Another reason that is mainly mentioned by the elderly participants is related to *relieving pain*. It is often believed that water has a healing power. Depending on the

origins of the pain, people spray hot or cold water to the body parts (e.g., knee, neck, elbow, etc.) for long durations to feel better, and in turn consume considerable amount of water. One other reason is linked to the *emotional and psychological meanings* attached to water. Believing that the water purifies the soul as well as the body, individuals tend to carry out activities such as washing face and bathing to *calm down, feel relaxed and refreshed* even when they do not actually need to clean themselves.

Performing activities frequently and repeating activity stages

Desire to effectively remove the residuals of personal care products, perceived social standards of personal hygiene, changing seasonal needs or not feeling oneself clean were among the highlighted reasons driving the frequency of activities and repeating certain activity stages. During the analysis of the data, such repetitive behaviors leading to intensive use of water are named as *performing activities frequently and repeating activity stages*.

The frequency of activities and activity stages is affected by various *physical and psychological needs and habits* of individuals. One of the reasons is related to the need to *remove the residuals of personal care products* from the body and *rinse the cleaning materials* from the bathroom components (e.g., washbasin, shower cabinet). As washing face, for instance, to be convinced that the face is free off soap, individuals may repeat splashing water. Similarly, as rinsing shampoo or toothpaste, the activity stages are performed repetitively to ensure that the personal care products are effectively removed from the hair and the teeth.

Repeating the activities and activity stages believing that the body or its parts are not clean, is also quite common among participants. The reason behind performing these water consuming behaviors is often related to individuals' unique *perception about personal hygiene*.

The frequency of activities may also differ related to the *needs and preferences emerging in different seasons and situations*. For example, participants showed a

tendency to have more *frequent showers during warm days* not to simply clean their body but to feel refreshed and relaxed. *Sweating in warm days* is also mentioned to be a factor effecting the frequency of washing face and feet. The need to repeat the activities differs, if the user stays home or goes out. As entering home, for example, activities such as washing hands and face are repeated for the *purposes of disinfection.*

Performing activities and activity stages for long durations

In line with the individuals' diverse preferences, perceptions about time and changing needs in different seasons and circumstances, the length of the activity time may change and lead to intensive water consumption. Considering that, the behaviors causing the activity to last longer are called as *performing activities and activity stages for long durations*.

Individuals are often unaware of how long they perform the activities and what it means for water consumption. *Being uninformed and unaware about the duration of use and its consequences* cause individuals to maintain their existing behaviors leading to intensive water use.

Another factor affecting the duration of use is individuals' *changing needs in diverse seasons and situations*. For example, in winter the duration of showers mentioned to be increased to warm up the body while quick showers are preferred to feel refreshed in summer. Duration of activities are also driven by the *periodic needs* such as shaving, hair and skin care activities.

The duration of soaping hands after toilet use, soaping the body after gym, or shampooing hair after a long day outside increase just to *ensure effective cleaning*. The activity stages may also proceed until the individuals are convinced that the hair, body, face or the mount is completely *free of applied personal care products*. However, duration of use is not only related to cleaning purposes but also linked to *individuals' hedonic needs* (e.g., pleasure, comfort, etc.). They may extend the

duration of showers, for instance, just to feel relaxed, or spend hours in the bathtub for pleasure.

The duration of activities is also affected from several contextual factors including *the infrastructure and the bathroom products*. The water heating system can directly influence the duration that the hot water reaches to the user. Households with storage water heaters through which the heating system warms up and stores a certain amount of water, it was mentioned that the capacity of the hot water tank could create a rebound affect and increase overall water consumption. This is related to the individuals' tendency to extend the duration of showers until the hot water is completely consumed. *The difficulty as controlling the tap* also influences the duration of use while trying to precisely adjust the temperature and flow rate of water. Both in the showering and the washbasin area, *products' constraints to effectively spraying water* is also considered as an issue that increases the duration of use particularly for rinsing personal care products and cleaning materials. *Difficulty in cleaning lime stains and cleaning supplies* from the surfaces such as sinks, and showers cabinets is also responsible for extending the use duration.

Ineffective scaling of water

Individuals often experience difficulty in adjusting the amount of water for diverse needs arising throughout the different stages of the activities or prefer to run water with high flow rates for various reasons, which in turn leads to intensive and unnecessary use of water. Behaviors that are associated with flowing more water than needed are named as *ineffective scaling of water*.

Increasing the flow rate of water in various activity stages is quite common believing that it would enable to *successfully remove the personal care products* and contribute to *achieving proper cleaning*. The very same behavior is also adopted as cleaning the residuals accumulated on the surfaces of bathroom components for *detailed and fast cleaning*. To *quickly warm up the water*, particularly during winter, the flow rate is also increased, even though it does not guarantee such a result.

Difficulty in adjusting the flow rate of water in line with diverse needs emerging in different stages of the activity is also responsible for ineffective scaling of water. For instance, taps often do not *enable precise adjustment* nor *provide feedback related to the flow rate of water* which leads individuals to run water with high pressures than preferred. In taps with double valves, when the water flow is decreased, the water temperature is also affected. Therefore, to be able to reach a desired temperature, water is unintentionally run with a high flow rate.

The *technical incompetence of the showerheads or washbasin taps* to spray less water with high pressures and *the conventional ways of interacting with the taps* are also considered as potential reasons to use water with high flow rates. As carrying out activities such as soaping hands, splashing water to face, or shampooing hair, considerable amount of water is wasted due to the difficulty in interacting with the tap since the hands are occupied. This reveals the need to engage with the tap through different techniques (e.g., voice-based and gestural controls, etc.). In relation to sensor taps, on the other hand, participants have concerns about not having *full control over the duration* through which the water flows and relate these products with intensive use of water.

Participants often showed little concern about the flow rate, as they are uncertain about its *impacts on overall water consumption*. Some others simply do not want to *interrupt their experience* to access the tap and adjust the flow rate. However, some participants revealed adopting different *methods to effectively scale water* while performing personal care and hygiene practices such as using a cup of water for rinsing tooth paste, or collecting water in a bucket during bathing. Though, when the activities are completed if there is a residual water, participants mentioned to try to finish it even they do not need to. In that sense, a behavior with an intention to effectively scale water can create a rebound effect and lead to unnecessary water use due to the *difficulty in foreseeing the amount of water that would be needed*.

Performing habitual behaviors

Individuals may perform some behaviors regularly, or with little or no conscious deliberation such as leaving the tap on as brushing teeth or repeating hand washing activity. Understanding such routines and habits requires longitudinal studies through repeated assessment of individuals behaviors over a period of time. Though, in this study the behaviors that has been mentioned as being performed with little cognitive effort or performed regularly and responsible for intensive use of water are named as *performing habitual behaviors.*

Individuals may perform certain behaviors regularly as an automatic response to specific cues. For instance, behaviors such as showering as waking up, washing hands after entering home from outside and shampooing hair twice during shower are *performed intuitively.* Even if individuals do not need to perform these behaviors, they *occur automatically as rituals*. *Following a sequence of behaviors* as showering, soaping the body and hands more than once, splashing water to face multiple times, increasing the flow rate of water as cleaning the washbasin are some behaviors that have been mentioned as performed without any conscious deliberation.

One other behavior which is under the control of habit and responsible for intensive use of water is *leaving the tap on* during activities. Even individuals may know that leaving the tap on as soaping hands, brushing teeth or shampooing can lead to considerable amount of water use, they adopt these behaviors without thinking thoroughly the expected outcomes associated with that behavior.

Some habitual behaviors which extend the duration of use such as brushing hair under running water or wetting the toothbrush are also linked to intensive use of water. Since these behaviors are once learned and has been performed many times, it becomes difficult for the users to change it over time.

3.6.2 Determinants of Behaviors

There is not a single definition of what motivates behaviors that are responsible for intensive use of water since they are influenced from a variety of factors. Through the analysis of this study, determinants of water consuming behaviors have been grouped under two main categories namely *attitudinal determinants* and *contextual determinants*. Attitudinal determinants are related to human cognition and involve seven different factors in relation to individuals' attitudes, norms, habits and beliefs that lead to adopting unsustainable behaviors for water consumption. Contextual determinants are external sources and include six diverse factors that are related to individuals' physical capabilities, environmental constraints and monetary incentives for the occurrence of behaviors responsible for intensive use of water. The definitions of the determinants of behaviors will be described through the following sections together with the examples from participants' responses.

3.6.2.1 Attitudinal Determinants of Behaviors

Individuals hold different perceptions and make diverse associations which are strongly linked to performing unsustainable behaviors as carrying out personal care and hygiene practices. In this study, internal variables including individuals' attitudes, norms, habits and beliefs that determine the decision-making process for adopting and maintaining behaviors for intensive use of water are named as *attitudinal determinants of behaviors.* Through the analysis of the data seven diverse attitudinal determinants have been identified namely *feeling oneself clean and refreshed, need for disinfecting body and body parts, perception of hygiene for bathroom components, visibility and clarity of water consumption, perception of time, need for rinsing body and body parts,* and *need for comfort.* The below sections will present the detailed descriptions of the attitudinal determinants through reflecting on the participants' experiences.

Feeling oneself clean and refreshed

Apart from the actual need for cleaning, individuals may perform or repeat the activities and their stages or extend their duration as they feel dirty or to be able feel relaxed and refreshed. The factors affecting individuals' perception of cleanliness and need for refreshment which lead them to consume water intensively have been named as *feeling oneself clean and refreshed.*

Water is believed to have therapeutic effects which makes it valuable to feel revived and refreshed. Showering or washing face in the morning to revive and start a day, taking a long bath after an exhausting day at work to relieve stress, short but frequent showers during warm days to feel refreshed and washing feet to freshen up can be considered as significant contributors to intensive use of water that emerge from *individuals' emotional needs*. The way these activities are performed, however, is directly related to individuals' unique *perception of hygiene*. For example, there are certain attitudes towards bathing during which individuals are expected to immerse their body in an accumulated water. It has been mentioned that the act of bathing often followed by showering with constantly running water to feel clean which leads to intensive water consumption.

Feeling clean requires more time and effort and result in repeating the activity stages until individuals are convinced about being properly cleaned. When individuals skip their routines, they may also feel dirty and feel obliged to perform the certain activities. For instance, a participant mentioned that it was impossible for him/her to sleep without taking a shower since he/she feels the need to rinse the dirt of the day off himself. The feeling of being clean is also affected from diverse situations. For example, the nutrition and health status influence the repetition of tooth brushing activity to be sure about the smell of the breath.

Need for disinfecting body and body parts

Individuals may perform unsustainable behaviors to effectively clean and sterilize themselves. Factors affecting individuals' diverse understandings about personal

hygiene leading to repeating activities and their stages, increasing their duration or scaling water ineffectively have been called as *need for disinfecting body and body parts*.

Being dirty is one of the main factors responsible for the emergence of the need for disinfecting body parts. For different activities, there appears diverse motives for cleaning. For instance, sweating particularly during warm days would be responsible for the frequency of showers and washing feet while the duration and repetition of tooth brushing would influence from the coffee consumption and smell of the breath in sickness. In families with babies, as the baby's mobility increases, the baby gets dirty more often and the frequency of bathing increases.

To be assured that the body is completely free of dirt, smell, bacteria and germs, the activity stages including soaping face, body or hands, shampooing hair, and tooth brushing are repeated. Within the *period of pandemic*, individuals' personal care and hygiene activities, particularly as entering home from outside, are reshaped in relation to the changing perceptions about personal hygiene. For instance, the duration of hand washing, mainly the rubbing hands with soap, is increased along with its frequency where the social norms played a significant role. As performing personal care and hygiene activities, individuals have a tendency to *use water with high flow* rates believing that it would ensure effective cleaning.

Disinfecting body is often considered as a *necessity* through which water consuming activities are performed as a functional need. Activity scenarios like washing hands after using the toilet or before touching the food, showering after gym, washing face as waking up, and brushing teeth after consuming food or drinks are carried out simply to clean and disinfect the related body parts. Considering the performance of this activities purely as a need may lead to perform water intensive use behaviors with little or no concern and result in maintaining these behaviors.

Perception of hygiene for bathroom components

The residues of soap, personal care products, cleaning supplies, and lime scales accumulated on the surfaces of bathroom components and accessories are often considered as dirty. This understanding leading to repeating activity stages or increasing the flow rate of water to effectively clean the surfaces have been coded as *perception of hygiene for bathroom components.*

In the showering area, individuals adopt diverse behaviors to *clean the residues* on the shower basin, bathtub, shower mixer tap and shower cabinet. They often clean these surfaces with *high pressured water* believing that it is necessary for effectively removing the residues. As the *visibility of the stains* disturbs the users, the duration and the frequency of the cleaning phase and therefore the water consumption are also affected.

Around the washbasin area, there appears to be similar problems. To avoid creating lime scales on the washbasin tap, individuals often *hesitate to turn off the tap* as soaping hands or washing face and run water without any purpose. As carrying out these activities, dripping water on the counter and creating a lime scale also constraint the users to interact with the tap. One other concern is about the water used during the cleaning phase, which also creates scales on the surfaces unless dried properly. Since cleaning the surfaces is considered as a need, individuals may not be concerned about the amount of water consumed throughout this stage. This understanding contributes significantly to pursuing water-intensive use behaviors.

Visibility and clarity of water consumption

Adopting behaviors responsible for intensive use of water due to the difficulty in relating the consequences of behaviors to water consumption throughout the different activities and activity stages have been named as *visibility and clarity of water consumption*.

The unclarity about how performing personal care and hygiene behaviors and interactions with bathroom products affect water consumption can lead individuals to pursue their existing behaviors which are responsible for intensive water use. For instance, in terms of overall water consumption, participants mentioned not being sure about the difference between bathing and showering or cleaning their body with constantly running water and pouring water from a bucket. As performing activities, they also have hesitations about turning off the tap thinking that they might consume more water as readjusting the temperature and flow rate of water. They are often aware about the wasted water as rinsing mouth, soaping hands and feet but the uncertainty about the amount of wasted water leads them to maintain their unsustainable behaviors. This unclarity may also be responsible for misinterpretations. For example, pressured water is believed to clean surfaces with less water through carrying out the activity more quickly and enabling effective cleaning.

The most common indicator of water consumption is the *monthly water bills* which *provide insufficient information* related to the impacts of individuals' behaviors. Even though water bills provide cues about the amount of overall water consumption and its corresponding fee, it is almost impossible to relate these with the responsible activities and activity stages. Individuals believe that being informed about the consequences of their behaviors in a meaningful way during the course of action would increase their awareness and enable them to adopt certain precautions such as reducing the flow rate of water, turning off the tap, skipping stages and reducing duration.

As participants evaluate their water consumption, variables including duration of use, frequency and flow rate of water are taken into consideration. While some participants conceive the duration of use alone during this evaluation, others make an evaluation by considering these variables together. However, it is stated that since these evaluations are based on personal perceptions, they most probably would not reflect the real situation. Considering that, it is suggested to provide real time

information on consumption during the activities to inspire sustainable behaviors through increasing individuals' awareness and preventing water from being perceived as an infinite resource.

Perception of time

Individuals' unawareness about the duration of personal care and hygiene activities and activity stages, that is considered as responsible for adopting unsustainable behaviors, is called as *perception of time.*

The *subjective predictions and evaluations about the time* spent as performing activities is directly related to individuals' understandings about water consumption and lead them to maintain their habitual behaviors leading to intensive water consumption. For instance, thinking that the duration of behaviors like soaping hands, face and body or rinsing mouth are quite short, individuals are not concerned about turning the tap off and waste considerable amount of water. Activity stages that endures longer such as rinsing body is associated with intensive water consumption whereas soaping body which relatively takes shorter time is considered as responsible for less water consumption. However as comparing the duration of activities or activity stages, individuals' unique perception of time might be misleading. For example, believing that the duration of showering and partial body cleaning is the same, one may prefer showering over partial body cleaning.

Individuals may *lose their sense of time* especially as showering which proceeds relatively longer than other personal care and hygiene activities. Some participants developed their own strategies to keep track of time including calculating the numbers of songs they listen as showering. Yet, increasing the awareness about the duration of activities and how it affects consumption is believed to enable people to realize their unsustainable behaviors and trigger them to alter their behaviors. It has also been stated that even the participants were clueless about the duration of personal care and hygiene activities, they became aware through the diary study where they were asked to record the duration of their activities.

Need for rinsing body and body parts

To effectively remove the personal care products from the body parts and to be convinced that they are properly rinsed, individuals tend to extend the duration of use, increase the flow rate of water and repeat the activity stages. Adopting water consuming behaviors resulting from the individuals' perception of proper rinsing has been named as *need for rinsing body and body parts*.

The residues of personal care products (e.g., soap, shampoo, facial masks, cleansing gel, etc.) harms the skin and hair. In case of contact with eye or food, the soap residues on hands might be dangerous. Considering these, individuals pay great attention to effectively rinse off the body parts. One of the prominent behaviors for an effective rinsing is to *increase the flow rate of water*. As rinsing off the body and hair in the showering area, and the hands and face around the washbasin area, using high pressured water is believed to effectively rinse the residues of personal care products that is responsible for intensive use of water.

Repeating the activity stages and *extending their duration* to ensure that the residues are effectively rinsed are other behavior patterns leading to intensive use of water. Repeating the steps to remove soap from the body, and shampoo and conditioner from the hair, repetitively splashing water to make sure that the face is cleansed from the soap and rinsing mouth to remove toothpaste are among the prominent behaviors resulting from the need for effective rinsing. Even though these activity stages are recognized to be responsible for intensive water use regarding the duration and the flow rate of water, participants also consider these stages as a necessity which may create a barrier to influence these behaviors.

Need for comfort

Individuals may perform behaviors responsible for intensive water use to have a comfortable experience. Adopting behaviors to satisfy the sense of comfort as performing personal care and hygiene activities has been coded as *need for comfort.*

Human nature guides us to seek for comfort in our physical and social everyday interactions. In the case of water consuming activities, *to support our wellbeing*, *relax, regenerate ourselves* or simply for *practical reasons* we may look for comfort. Taking long showers in cold days to warm the body or to relax at the end of an exhausted day, running water unnecessarily to keep the body and the environment warm in the shower, and increasing the temperature and flow rate of water to warm up the water faster are some of the behaviors associated with the perception of comfort and causing intensive use of water.

Some water consuming behaviors are performed thinking that *adopting responsible ones would take too much effort and time*. For instance, it is often considered difficult to interact with the tap as performing activities. Even if the tap is turned off, when it is turned back on, it does not flow at the desired temperature and flow rate and disrupts the practice. Therefore, to maintain a comfortable experience, individuals *hesitate to interrupt the flow of events* and let the water flow constantly during activities such as shampooing hair, soaping hands, rinsing mouth, and soaping face and waste water.

3.6.2.2 Contextual Determinants of Behaviors

There appear several external variables related to individuals' physical capabilities, environmental constraints and costs that influence the decision-making process for adopting and maintaining behaviors for intensive use of water. Through the analysis of this research, these extrinsic factors responsible for the occurrence of water intensive behaviors are named as *contextual determinants of behaviors*. The findings from this study revealed six diverse contextual determinants of behaviors which are *difficulty in cleaning bathroom components, difficulty in controlling the tap, difficulty in accessing hot water, ineffective spraying of water, difficulty in personalizing bathroom components,* and *deterioration of bathroom components and*

their replacement. Below these factors will be defined through providing examples from the participants' statements for further clarification.

Difficulty in controlling the tap

Consuming water intensively resulting from the products' constraints to enable precise adjustment of temperature and flow rate of water in line with individuals' diverse needs and preferences, insufficient feedback related to them, and difficulty in accessing and interacting with the tap have been called as *difficulty in controlling the tap*.

The design and position of the taps are considered as one of the main constraints affecting the performance of water intensive behaviors. Difficulty in precisely sliding and rotating taps' handles or adjusting water pressure modes on the shower heads are some examples mentioned by the participants that are found responsible for using water excessively. Difficulty in reaching the tap constraints individuals to adjust the flow rate and temperature in line with the emerging needs throughout the activities. It is also found quite difficult to control the tap while washing baby since the parent is often occupied with caring the baby. These concerns revealed the need to control the temperature and flow of water through different methods. Rather than conventional interactions, participants prefer to control water through alternative methods including voice-based and touch-free controls in order not to interrupt the flow of the activity. Sensor-operated taps, which are suggested to be more responsive to movements, are linked to intensive water consumption as the duration of water flow is not in the user's control.

Products' constraints to *precisely adjust the flow rate and temperature of water* also lead to extending the duration of use while engaging with these settings. During the period that the water reaches the intended temperature, participants often cannot make use of the flowing water effectively and waste it. Readjusting the temperature and flow rate of water during use is also difficult, which causes reluctance to turn the water off in diverse stages of the activities. Participants stated to have difficulties

in precise adjustment, particularly in double handle taps where the temperature adjustment automatically affects the flow rate. Similarly, when the water flow is decreased, the temperature also decreases. This leads to running water with high intensity just for accessing warm water.

Throughout the different stages of water consuming personal care and hygiene activities individuals may need or prefer to be exposed to water with different intensities. For example, in the shampooing stage water is sprayed with low flow rate while this preference changes in the rinsing phase through which the flow rate of water is increased. *Difficulty in precisely adjusting the flow rate* can lead to utilize water with the same intensity throughout the activities and result in excessive use of water.

Lack of clear feedback on the temperature and flow rate of water is also associated with intensive water consumption. Products often provide very little guidance to adjust the water temperature and almost no indicator about the reached temperature. During showering, for instance, participants often let the water run for a while, then control the temperature with their hands or decide the warming up duration intuitively. The unclarity of the temperature may result in wasting water during the warming up process. Similarly, the flow rate is adjusted intuitively and may lead to flow water intensively. Not being informed about whether the water is properly turned off or not is one other problem, especially in cases where the shower head or tap drips water.

Difficulty in cleaning bathroom components

Factors responsible for the intensive use of water in the cleaning stage of the bathroom components and accessories such as removing lime scales, and the residues of cleaning supplies and personal care products have been coded as *difficulty in cleaning bathroom components.*

The form of the products (e.g., sharp corners, size, etc.) and the properties of the *adopted materials* (e.g., texture, color, etc.) are closely related to the *visibility of*

stains and *their difficulty in cleaning*. The accumulation of lime scale, and the residues of cleaning supplies and personal care products on the shower tray, bathtub, shower cabin, washbasin and taps are the most common problems leading to the need of cleaning them with large amounts of water and result in intensive use of water throughout the cleaning stage. The size of the washbasin, for instance, may cause splashing water around as engaging with the activities and create stains on the bathroom counter. Due to the adopted materials on the counter (e.g., glass, marble, etc.), lime scales become visible which leads to repeating cleaning activity and leads to excessive use of water. These problems also guide users to adopt various behaviors as performing their personal care and hygiene practices such as avoiding touching the tap to turn it off throughout the activities in order not to create stains on the tap and the counter which leads to consume water unnecessarily. Molding resulting from the lack of proper ventilation of the bathroom environment is another problem leading to excessive use of water as cleaning bathroom components.

The accessibility of the bathroom components is one other factor affecting the cleaning process and related water consumption. For example, the height of the rain shower head makes it difficult to clean the accumulated lime which in turn may result in clogging. *The placement of the bathroom components* is also important for ease of cleaning. The water flowing from the shower head, for instance, may directly touch the shower mixer tap and create lime scales which is found quite difficult to remove. Similarly, the positioning of the washbasin and the tap can cause splashing and create water stains.

Difficulty in accessing hot water

Water heating system and infrastructure related issues that are responsible for wasting water because of the late arrival of the hot water to the bathroom environment have been coded as *difficulty in accessing to hot water.*

Duration of access to hot water differs in relation to the *water heating systems* utilized in homes (e.g., centralized hot water, storage water heaters, etc.). This

infrastructure related problem may result in running water without any purpose until hot water reaches to the tap. *The distance between the water heater and the bathroom* is also mentioned to be effective as reaching hot water. Even participants do not have a particular tendency to carry out activities around washbasin with hot water, it is considered as a necessity as performing activities around the showering area. As showering, to avoid contact with cold water, individuals often wait until water warms up, let it run unnecessarily from the drain and waste a great amount of water. Likewise, during activity stages where the water is not directly used, they often avoid turning off the tap in intervals as it takes a while to reheat the water. Since the available system does not enable them to adjust the temperature precisely and access hot water immediately, they pursue their existing unsustainable behaviors.

One essential constraint in relation to the water heating system is the *capacity of the storage water heaters*. These heaters warm up a certain amount of water as their capacity allows, though it may occasionally be insufficient for a whole shower. When the heated water is consumed, it may take a while to reheat the cold water entering into the tank. Meanwhile, as waiting for the water to warm up, the cold water runs without any purpose and is wasted.

During the generative interview sessions, it has been realized that the participants have developed several strategies to utilize water effectively, including collecting water as it warms up, trying to utilize cold water for cleaning the surfaces, or reducing its flow rate. In this regard, along with enhancing the existing water heating systems, inspiring water effective behaviors with the existing system is quite valuable for mitigating water consumption.

Ineffective spraying of water

The reasons for intensive use of water in relation to the bathroom products' constraints to spray water efficiently have been named as *ineffective spraying of water.*

Bathroom products are getting water efficient through their embedded features. For instance, low-flow taps and shower heads mix air into the water and give the impression of high-pressured water, even though the amount of water consumed is greatly reduced. However, the adoption of these water efficient appliances and fixtures may not be widespread with varying reasons (e.g., affordability, accessibility, etc.)

Problems related to the *products' constraints to adjust the water pressure* for the diverse needs emerging during showering and as cleaning surfaces are considered as potential contributors to intensive and unnecessary water use. During rinsing body parts which is often associated with intensive water use, participants prefer shower heads to spray water with high pressure for an effective rinsing with less water.

The dimensions of the surfaces where the water flows (e.g., tap aerator, shower head surface) are also linked to intensive use of water. The narrow shower heads are found ineffective to spray enough water to wet the body properly which is responsible for extending the duration of shower for an effective cleaning experience. Some participants believe that wider shower heads might be responsible for consuming water more than needed while others think wider tap aerators and shower heads would enable to perform activities (e.g., hand washing, showering) more effectively and quickly through using less water.

Difficulty in personalizing bathroom components

Intensive use of water resulting from the bathroom products' constraints in terms of adaptation, adjustment and personalization in line with the diverse needs and preferences of individuals are labeled as *difficulty in personalizing bathroom components*.

The environmental constraints that limit flexible use in line with the individuals' diverse needs and preferences for performing personal care and hygiene activities is considerable contributor to intensive use of water. In the showering area, the technical incompetence of the shower heads to adjust its angle makes it difficult to

effectively wet and rinse the body parts which in turn result in extending the duration of use or increasing the flow rate of water. In that sense, handheld shower heads are preferred over rain shower heads which enable the participants to rinse the desired area more effectively. For consuming water effectively, shower heads offering various modes for adjusting pressure in line with diverse needs are preferred which is mentioned to be often unavailable in rain shower heads. Rather than a specific water source, spraying water from different parts of the bathing area is desired for an effective rinsing with less water.

Around washbasin area, similarly products' constraints in terms of flexible use are associated with intensive use of water. For instance, not being able to move the nozzle of the tap leads to clean the washbasin with excessive amount of water due to the difficulty as reaching certain parts of the washbasin. Activities including washing feet and hair in the washbasin are found difficult due to the tap's position which determine the duration of the activities and related water consumption.

One other constraint is related to *adjusting the temperature of the bathroom environment*. It is stated that due to not being able to properly warm up the bathroom in line with different needs and preferences, water is used intensively during shower simply to warm up the body. Besides that, water temperature preferences show differences for diverse household members and for different activities. Adjusting these settings in each use is also considered responsible for extending the duration of activities, while personalized water temperature settings are preferred to be able to use water effectively.

Deterioration of bathroom components and their replacement

Intensive use of water resulting from the deterioration or wearing off the bathroom components and accessories, and difficulty in their replacement due to the affordability of newer or more efficient bathroom products and required knowledge and effort in their installation have been coded as *deterioration of bathroom components and their replacement*.

The wearing off or deterioration of water consuming bathroom products may lead to intensive use of water over time. For instance, the corrosion in the valve seat or worn out cartridge may be responsible for the taps to leak water, even after they are properly turned off. The hose of the shower head may detach from where it is connected to the shower head and the tap or puncture which result in leaking water and unnecessary water consumption. The calcification on the shower head and washbasin tap is believed to be responsible for ineffective use of water, yet participants mentioned to have little knowledge about how to maintain these parts properly. Due to the *difficulty of accessing spare parts, their cost* and *required knowledge and skills for their replacement*, the damaged parts are used without replacing or repairing them, causing intensive or unnecessary consumption of water.

One other constraint responsible for the intensive use water is related to the *accessibility of water efficient products*. Even there are a variety of water efficient bathroom products (e.g., low flow shower heads and taps.) that inherently use water effectively, the affordability of and awareness about these products makes it difficult to replace conventional ones that are associated with intensive water use.

3.6.3 User Intentions

As previously discussed, individuals' intentions towards adopting sustainable behaviors may differ in line with various factors and these intentions shows differences across diverse target behaviors *(see Section 2.6 Significance of User Diversity for Influencing Sustainable Behaviors)*. In this user research study, through investigating existing behaviors, discussing how individuals relate these behaviors to water consumption and speculating over potential paths for change, a variety of intentions have been revealed related to adopting water effective use behaviors. This variety in intentions are affected from a range of factors which include individuals' attitudes, awareness, beliefs and perceived behavioral control related to water consumption behaviors within the diverse stages of the activities.

Through the analysis of this study, five diverse user intentions for adopting water effective use behaviors were identified. In line with the level of eagerness to adopt sustainable behaviors, they are listed as *mindful, willing, doubtful, reluctant* and *unconcerned* users. This section will introduce the user intentions along with the participants' statements from the interview sessions.

Mindful

"The water warms up so slowly that I feel very bad for the flowing water. Thus, I fill the water into a bucket and use it later for cleaning or something else."

Participant 11 (27:32)

Mindful individuals are aware and concerned about the consequences of their water consuming behaviors. Since they are sensitive towards environmental issues, they already adopt responsible behaviors for the effective use of water.

As performing personal care and hygiene activities, mindful users develop or adopt several strategies to consume water responsibly. *Repurposing flowing water*, for instance, is one of the commonly adopted strategies particularly during showering. As the water warms up, collecting it in a bucket and utilizing it for cleaning purposes or flushing are quite common use patterns among mindful users. They also prefer to *scale water effectively* through reducing the flow rate in line with their needs during the activity stages. *Turning off the tap* is another strategy they adopt during the activity stages where the water is not directly used such as soaping face and hands, and brushing teeth. They also have a tendency to *combine diverse activity stages together* (e.g., cleaning the washbasin as washing hands, rinsing hair as soaping body) to *reduce the overall duration of the activities* and in turn the water consumption. Some mindful users occasionally adopt *alternative cleaning methods* that enables personal hygiene practices to be performed without the use of water such as dry shampoo, dental floss and mouthwash.

Willing

"As splashing water to my face, water flows in the background without any purpose, I can turn it off intermittently."

Participant 10 (32:22)

"While brushing teeth, I consume at least four or five glasses of water as rinsing my mouth. I could pour water in a glass, turn off the tap and rinse my mouth with it to save water."

Participant 8 (11:35)

Willing individuals are aware and worried about the consequences of their water consuming behaviors and possess positive attitudes towards adopting behaviors for effective use of water.

Even willing users may not be frequently adopting strategies to use water responsibly as mindful users do, their motivation to alter their existing behaviors is quite high. They have an *intrinsic motivation to adopt responsible behaviors*, yet they also *prefer these behaviors to be enabled, guided or determined by the contextual factors*. As an intrinsic motivation, for instance, they mentioned that they might collect the water as it warms up and repurpose it for cleaning. They are also eager to use alternative methods for cleaning and disinfecting hands which would not consume any water. Considering the use stages like shampooing and soaping, where a considerable amount of water is lost, they indicate that they would turn off the tap to prevent wasting water. They also tend to *reduce the duration of activities* through combining or skipping activity stages and *reduce their frequency* to consume water responsibly. However, it was stated that *changing habitual behaviors might be quite challenging unless products and systems support this transition*. Enhancing the visibility of the water consumption, utilizing water efficient products, effective heat control in the bathroom environment, precise temperature and water flow adjustments, ease of access to hot water, integrated solutions for reutilizing water, alternative methods for interacting with the tap, and products adopting materials for

ease of cleaning are some of the contextual facilitators proposed by the participants for adopting responsible behaviors.

Doubtful

> *"As showering, I could turn off the water at some stages. Yet, I suppose this means that I would spend more time to readjust the water temperature, wait for it to warm up and consume more water in the end."*
>
> Participant 3 (27:01)

Doubtful individuals have lower awareness about the consequences of their water consuming behaviors, but they are worried about them. Their conflicting beliefs about the implications of adopting responsible behaviors on environment affect their attitudes and intentions towards change.

Although doubtful users have an overall idea about the water consumption resulting from their existing personal care and hygiene behaviors, they are *unsure about what to do* and *how performing responsible behaviors would affect overall water consumption*. For instance, how short-term interventions, such as turning off the water during soaping hands or mouth rinsing, would have an impact on the overall water consumption is unknown for these users. They are also confused about the impacts of turning off the water during the activity stages when the water is not directly in use. Even it contributes to considerable water savings, due to the difficulty in readjusting the temperature and flow rate, they believe that it may create a rebound effect and may cause intensive use of water. The difference between cleaning the bathroom components in a short time with high flow water or in a longer time with low flow rate is not clear for these users. Similarly, the differences in the amount of water consumed while bathing and showering or partial body cleaning and showering are unknown for them. These issues resulting from the unawareness about the outcomes of water consuming behaviors may lead doubtful users to maintain their existing unsustainable behaviors.

The hesitations that these users experience may result from the *internal contradictions*. For example, even they have a tendency to reduce the frequency of shampooing hair, not being convinced about whether the hair is properly cleaned or not, prevents them to behave responsibly. Similarly, even they believe that reducing the frequency of washing hands is necessary and possible, they hesitate to alter their existing behaviors in order not to compromise their sense of cleanliness. Doubtful users often suggest receiving effective and clear feedback on water consumption to be able to know the exact implications of their personal care and hygiene behaviors in order to alter those towards sustainable directions.

Reluctant

> *"I want to feel clean while showering and there is a necessary amount of water to achieve this feeling. So, I am using that amount of water and doing the things that have to be done, nothing more nothing less.*
>
> Participant 1 (33:28)

Reluctant individuals have low awareness and low concern about the consequences of their water consuming behaviors. They find it difficult to alter their existing behaviors leading to intensive use of water, or think that these are efficient or necessary, and consequently have low intention to adopt water effective use behaviors.

Reluctant users often *seek for comfort* as performing personal care and hygiene activities. *Perceived difficulty to enact a water efficient behavior* prevent them from adopting that behavior. For example, interrupting the activities as soaping hands or body to turn off the tap is often found difficult which leads to pursue their existing unsustainable behaviors. Difficulty in accessing and controlling the tap, readjusting the temperature or creating lime scales on the tap are some other disincentives for the reluctant users. Flowing water continuously to warm up the body during showers or increasing flow rate to effectively rinse the body are some other behavior patterns that are adopted by the reluctant users for a comfortable experience. Even they are

aware about the implications of these behaviors, their intrinsic motivation to change these are quite low. One other factor affecting their intention is the *perception of need*. Behaviors that are linked to intensive use of water including rinsing body and soaping hands for long durations and repetitive splashing water to face are considered as a need to feel clean, therefore they need incentives to alter these.

Perception of time and *diverse understandings about water consumption* affect their intentions as well. Due the invisibility and unclarity of water consumption, they may assume their existing behaviors are already efficient and cannot be enhanced. Even a considerable amount of water is wasted during rinsing mouth or soaping hands, considering the duration of these activity stages, reluctant users may not care about the water consumption that these stages are responsible for and continue performing their unsustainable behaviors.

Unconcerned

> *"I turn on the water to wet the toothpaste. In the meanwhile, water continues to flow at a low flow rate as I brush my teeth. Sometimes I turn it off, it changes. However, I have no worry about the flowing water."*
>
> Participant 2 (53:51)

Unconcerned individuals have low or no awareness about the consequences of their water consuming behaviors, unconcerned about them, and thus have no intention to adopt water effective behaviors.

Unconcerned individuals' resistance to change is determined by various factors. The *need for comfort*, particularly during showering, is one of the main factors determining the adopted behaviors. Flowing water continuously, for instance, is considered as a necessity to feel relaxed and warm the body up and unconcerned users do not worry about the water consumption that this behavior is responsible for.

They also have *no concern about the wasted water*. For instance, while water flows constantly during the toothbrushing activity, unconcerned users are not disturbed by

the amount of wasted water. Their *unawareness about the implications of their unsustainable behaviors* may also be responsible for pursuing these behaviors. For instance, some participants think that turning the water off when not in use would not have any significant effect on the overall water consumption, thus they maintain their existing behaviors. Some habitual behaviors are performed without any conscious deliberation (e.g., repetitive hand washing, frequency of showers) which makes it difficult to relate these behaviors with intensive water consumption and alter them.

Unconcerned users may adopt responsible behaviors as well, however these are not performed with the purpose of reducing water consumption. For example, individuals utilizing a storage water heater may have shorter showers as they run out of water due to the capacity of the water tank. This example that enables users to unintentionally adopt a water effective behavior, in fact, highlights the significance of automation for the unconcerned users.

3.6.4 Behavioral Strategies and Speculative Solution Areas for Effective Use of Water

During the speculating stage of the generative interview sessions, the particular emphasis was on the understanding of how people relate their existing behaviors to water consumption and what are their intentions towards adopting water effective use behaviors. As sharing their insights, participants highlighted a variety of determinants of behaviors linked to intensive use of water that were not mentioned throughout the previous stages of the interviews. It also enabled me to understand the individuals' diverse intentions for adopting water effective use behavior, as they reconsider their existing behaviors, think about potential paths for change and reflect on their attitudes towards adopting these for reducing water consumption.

As participants rethinking and reconstructing their existing behaviors during the speculating stage, various behavioral strategies and speculative design solution areas

for effective use of water have been revealed. *Behavioral strategies* are the patterns of use that the participants adopt or willing to adopt to save water during the diverse stages of the activities. Collecting wasted water to use throughout the activities or to repurpose later in cleaning or flushing, reducing the duration of use through skipping activity stages and combining diverse activities, and turning off the tap as shampooing hair and soaping hands are among the prominent behavioral strategies to use water effectively. *Speculative solution areas*, on the other hand, include the participants' attitudinal or product and system-related suggestions to adopt responsible behaviors for the effective use of water. Raising awareness through providing clear and visible description of the duration of the activities, enabling clear communication of the water consumption in relation to activity stages, influencing people to adopt water effective use behaviors through sharing the responsible behaviors their peers adopt, developing alternatives to conventional cleaning methods (e.g., steam room) and waterless solutions for personal hygiene, using built-in systems that automatically accumulate water that is otherwise wasted, and utilize it for diverse purposes, enabling precise adjustment for the flow rate of water or automatically scaling the flowing water through learning from individuals' behaviors were some of the proposed solution areas by the participants for the effective use of water.

Even acquiring behavioral strategies and speculative solution areas were not the particular aim of this research phase, they provided a valuable inspiration source for generating design interventions for design researchers and practitioners. Table 3.4 demonstrates the revealed behavioral strategies and speculative solution areas through relating them with the behavior types, determinants of behavior and user intentions.

Table 3.4: Suggestions and strategies for effective use of water and their relations with the behavior types, determinants of behaviors and user intentions

		Related behavior types						Related cognitive determinants of behavior							Related contextual determinants of behavior						Related user intentions				
		running water with no purpose	using water for different purposes	performing activities frequently and repeating activity stages	performing activities and activity stages for long durations	ineffective scaling of water	performing habitual behaviors	feeling oneself clean and refreshed	need for disinfecting body or body parts	perception of hygiene for bathroom components and accessories	visibility and clarity of water consumption	perception of time	need for rinsing body and body parts	need for comfort	difficulty in cleaning bathroom components	difficulty in controlling the tap	difficulty in accessing hot water	ineffective spraying of water	difficulty in personalizing bathroom components	deterioration of bathroom components and their replacement	mindful	willing	doubtful	reluctant	unconcerned
Behavioral strategies	**Definitions**	**BT1**	**BT2**	**BT3**	**BT4**	**BT5**	**BT6**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**	**C13**	**UI1**	**UI2**	**UI3**	**UI4**	**UI5**
repurposing flowing water	collecting wasted water to use throughout the activities or to repurpose later in diverse activities (e.g. collecting water as it warms up and repurpose it for cleaning, cleaning the washbasin as rinsing hands)	●				●										●	●				●	●			
turning off the tap in diverse stages	turning off the water in activity stages where it is not directly used (e.g. shampooing hair, brushing teeth, soaping body, hands or face)	●	●		●	●		●		●	●			●	●	●	●				●	●	●	●	
reducing the frequency of activities and activity stages	avoiding performing activities or activity stages to reduce water consumption (e.g. reducing the frequency of shampooing, rather than repetitively washing hands cleaning them through alternative cleaning supplies)			●			●	●	●	●	●		●		●						●	●	●	●	
reducing the duration of activities and activity stages	reducing the activity duration through various methods (e.g. skipping activity stages, combining diverse activities)	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●			●	●	●	●	●
effective scaling of water for diverse needs	adjusting the amount of water by scaling it according to changing needs and preferences in the activity or activity stages (e.g. reducing the flow rate of water while cleaning the washbasin)	●				●	●			●	●		●	●		●	●	●	●		●	●	●	●	

Table 3.4: Suggestions and strategies for effective use of water and their relations with the behavior types, determinants of behaviors and user intentions (continued)

Speculative solution areas	Definitions	BT1	BT2	BT3	BT4	BT5	BT6	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	UI1	UI2	UI3	UI4	UI5
make oneself feel clean	enabling individuals to feel themselves clean to reduce the frequency of activities (preventing odor, preventing hair oil, etc.)			●				●														●			
visibility of the duration of activities	raise awareness through providing clear and visible description of the duration of activities				●							●					●					●			
peer pressure	influencing people to adopt water effective use behaviors through sharing the responsible behaviors their peers adopt	●			●	●	●							●		●								●	
ease of accessing and interacting with the controls	enabling easy access to and interaction with the controls to adjust the flow rate and temperature of water according to different needs and preferences during the activity stages (e.g. voice based interaction with the tap)	●			●	●				●				●	●	●						●			
clear feedback on water consumption	providing visible and clear communication of the water consumption and its implications resulting from the activities and their diverse stages (e.g. smart meters, providing real-time feedback)	●		●	●		●				●											●	●		
alternative cleaning methods	developing alternatives to conventional cleaning methods or to perform cleaning without using water at all (e.g. steam room, solutions for cleaning body)	●		●	●		●	●	●				●								●	●		●	
rinsing without water	being able to rinse the personal care products (toothpaste, facial cleansing gel, shampoo, etc.) without the need of water			●									●									●			
ease of cleaning	enabling easy cleaning for the surfaces of bathroom components and accessories through products' forms and adopted materials			●	●	●				●					●							●			

Table 3.4: Suggestions and strategies for effective use of water and their relations with the behavior types, determinants of behaviors and user intentions (continued)

Speculative solution areas (cont.)	Definitions	BT1	BT2	BT3	BT4	BT5	BT6	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	UI1	UI2	UI3	UI4	UI5
automatically and precisely scaling the water	enabling precise adjustment of the flow rate according to changing needs throughout the activities or automatically scaling the flowing water (e.g. automatically reducing the flow rate during shampooing, diverse flow rate modes for pre-adjusting and providing relevant feedback)	●			●	●							●	●		●			●			●			
automatically and precisely adjusting the temperature of the water	enabling automatic or precise adjustment of the temperature of water in line with the varying needs and preferences of users (e.g. diverse temperature modes for pre-adjusting, clear feedback about the temperature of water)	●			●	●								●		●			●			●		●	
spraying water efficiently	spraying water efficiently through the built-in features of bathroom components (e.g. low-flow taps, shower panels enabling water to flow from diverse positions for effective rinsing)				●	●			●				●					●				●			
automatically collecting water for repurposing	automatically accumulating water that is otherwise wasted and utilize it for diverse purposes (e.g. a built-in system that collects water in the shower as it warms up and repurpose it for flushing)	●														●	●					●			
instant access to hot water	providing instant access to hot water to support effective use of water through preventing wasted water during heating.	●			●						●			●			●					●		●	●
heat control in the bathroom environment	enabling temperature control for the bathroom environment to be adjusted in line with the personal needs and preferences in order to prevent unnecessary use of water for heating the environment and the body	●	●											●					●			●		●	●
providing certain amount of water for diverse activities	Providing predetermined amounts of water for diverse activities and enforcing the behaviors for effective use of water	●			●		●	●				●										●			●

3.7 Limitations of the User Research Study

Related to the focus of the study

Considering the particular scope of this research, the main limitation is related to the practice-specific findings of the study that are not applicable to other activities responsible for intensive water consumption. However, it should be noted that this step focuses on exposing the diverse behaviors leading to water consumption, their reasons, and individuals' diverse intentions for adopting water effective use behavior to be used as an inspirational source for the development of ideas aiming to influence water effective behaviors among personal care and hygiene activities. In that sense, practice-specific outcomes of this study provide an in depth understanding of the problem area as well as the user. The outcomes of this study also reveal the behaviors, determinants, intentions, strategies and suggestions of the participants; thus, generalizations can be made only for the specific sample of the study.

Another limitation is related to the focused activities. Since bathroom environment along with the activities that take place there are considered as private, the access to the use context and actual use behaviors created a constraint. The diary study, however, enabled participants to explore and engage with their activities prior to the generative interview sessions and support them to the recall their experiences, behaviors and interactions with the products during the sessions. Even most of the interviews were conducted in the participants' homes, carrying out the generative sessions in the bathroom environment was not possible. Mapping stage, in that sense, eased to talk about the product and infrastructure related problems leading to intensive use of water.

Related to the adopted tools and methods

One of the limitations of this research stage is related to the duration between the diary study and interview sessions. As it occasionally became difficult to arrange

interview sessions, particularly during the pandemic, participants might have difficulties as recalling the activities that they have performed and recorded during the diary study. Considering the potential gap between these two sessions, statement cards supported them to recall their experiences.

The tracking stage holds some limitations as well. Participants mentioned to adopt diverse approaches as filling out the diaries. Some of them noted down the activities as soon as they performed them. While the others occasionally experienced a gap between the actual time the activity was carried out and the time it was recorded. This might have led to miss out some of the activities carried out. However, in this study the main intention was not to map the behavioral patterns of the participants but rather to make them become more familiar with their use patterns and more conscious about their water consuming behaviors to prime them for the interviews and ease sharing the details of their experiences.

One other limitation that this research stage holds is related to the preparation phase both for the diary study and the generative interview sessions. Preparation phase for the development of generative tools and tasks requires quite time from the researcher. Though, receiving users' tacit knowledge is a challenging process through which conventional research techniques might provide limited information. It should be noted that the generative interview sessions were also relatively demanding for the participants considering the tasks to be completed.

In this phase of the research, participants are required to take part both in the diary study and interview sessions. As participants were filling out the diaries, I occasionally contacted them to ask if they were having any troubles considering the clarity of the stages and expectations from them. However, they mentioned carrying out the stages of the diary study without experiencing any difficulties. The generative interview sessions, on the other hand, as there were a number of activities to be probed and several tasks to be completed, were relatively more demanding for the participants. However, unlike the diary study, my presence in the research setting

helped to overcome emerging difficulties. For instance, while facilitating sessions with older participants, some tasks (i.e., mapping and sharing) were completed with my support. Without guiding and inferring into the participants' responses, I tried to help them attach 2D bathroom components on the bathroom plan and order the statement cards on the timeline. While participants sharing their personal care and hygiene experiences during the sharing stage, I also filled in the empty statement cards and helped them include these new activity stages for a detailed understanding of their water-consuming behaviors. While facilitating a study with special users, completing these tasks might be challenging for the participants in future research. In such a case, researchers may involve more actively in carrying out the stages. Some tasks might also be refined and adapted considering the physical and mental constraints of the potential participants. For instance, during the sharing stage, the statement cards might be ordered before the sessions, and participants are asked to rearrange them or add new stages if they need. As asking their perceptions about water consumption in the reflecting stage, the researcher might visualize their understandings on their behalf for an easier facilitation.

Related to the diversity of participants

The findings from this user research study are specific to the sample derived from the cultural and geographical context of this doctoral study. While recruiting participants, they are selected deliberately to reflect particular criteria in the sampled population, considering certain categories of individuals may have a different perspective on water consumption and possess diverse behaviors. In future research, extending the selection criteria, for instance, including dependent individuals who cannot perform their self-care activities (e.g., people with disabilities) or kids with little concern about environmental issues, might contribute to explore diverse behavior types, determinants of behaviors, and user intentions. Covering a larger population by extending the geographical and cultural context of this research may also reveal diverse findings in relation to the individuals' behaviors and attitudes towards water consumption. Regions experiencing frequent water cuts or limited

access to water resources would contribute significantly to explore diverse behaviors and concerns about water consumption. It should also be recognized that cultural differences are quite effective in shaping water-consuming practices, as they are closely related to the individuals' beliefs about cleanliness and comfort. In that sense, including participants from diverse cultural backgrounds may also enrich the variety of findings.

Related to the research process

After conducting the sixth interview session, Covid19 cases began to appear around the world while the first case confirmed in Turkey right after conducting the eighth interview. This crisis eventually affected the conduct of the scheduled interviews. The interview sessions were planned to be carried out face-to-face since the adopted tools require physical interaction. Considering the significance of the pandemic, the facilitation of the interview sessions was postponed. In this process, analysis of the collected data progressed, and the online versions of the generative tools were developed. However, during the period when the number of cases decreased, it became possible to conduct the remaining interviews outdoors through paying attention to social distance. Within the scope of the study, it is not possible to make a comparison regarding the behaviors of the individuals participating in the study before and after the pandemic. Since this was not the main focus of this research, interview guideline was not developed to reveal the alterations in individuals' behaviors during pandemic. Nevertheless, how personal care and hygiene activities responsible for water consumption have been reshaped cannot be ignored. Participants' understandings related to perception of hygiene have changed which lead them to adopt water intensive behaviors. Their habitual behaviors are reconstructed (e.g., soaping hands for 20 seconds, showering as entering home from outside, etc.), and thus the frequency and duration of the activities increased. In the analysis of the data, after the seventh participant new codes did not emerge related to the behavior types, determinants of behaviors and user intentions. However, definitions of the existing codes were revised and enriched through the participants'

unique experiences and understandings, and diverse insights were received related to the behavioral strategies and speculative solution areas for the effective use of water.

3.8 Summary and Discussion

In this step of the doctoral research, diary study and generative interview sessions were conducted as complementary to each other. The particular emphasis of the research was to reveal the individuals' diverse behaviors that are responsible for intensive water consumption as performing personal care and hygiene practices in the bathroom, to expose attitudinal and contextual determinants of these behaviors and to understand individuals' diverse intentions towards adopting water effective use behaviors. Through investigating users' experiences, use patterns, strategies and needs, various behavior types that results in intensive use of water as performing activities of interest and a range of attitudinal and contextual determinants that leads to the performance of these behaviors were exposed. Gaining insights into the participants existing behaviors, and speculations about and attitudes toward potential paths for effective use of water revealed a variety of user intentions related to adopting water effective use behaviors. The findings from the study provide a valuable knowledge source for the designers and design researchers focusing on behavior change for the effective use of water. During the following step of the doctoral study, the potential ways of transferring this knowledge to the ideation process will be explored to support the development of ideas for influencing water effective behaviors among personal care and hygiene practices.

CHAPTER 4

DESIGNING FOR USER INTENTIONS: GENERATING DESIGN SOLUTIONS FOR EFFECTIVE USE OF WATER

Within the scope of this doctoral study, the findings from and insights into the literature review and the user research study were transferred into a projective generative design tool to be included in the idea generation processes for influencing sustainable behaviors for the effective use of water. This generative tool, named as *inspiration cards*, includes four card sets that are *behavior types, determinants of behaviors (attitudinal determinants and contextual determinants), user intentions,* and *design strategies cards.*

To evaluate the implications of the generative tool on the development of ideas focusing on sustainable behavior change, *Design for User Intentions (DUI)* design workshops were developed and facilitated. During this phase of this doctoral study, three DUI workshops were carried out with the participation of 88 undergraduate and graduate design students in total (Figure 4.1). The first DUI workshops focused on personal care and hygiene practices around the showering area (i.e., showering, bathing, and partial body cleaning), the second one focused on the activities around the washbasin area (i.e., washing hands, washing face, brushing teeth, washing hair and washing feet) while the final workshop adopted a more comprehensive approach and included activities around both showering and washbasin area.

The DUI workshop procedure comprised several successive stages, namely *sensitizing, introducing, generating I, sharing & reflecting I, generating II, sharing & reflecting II,* and *evaluating.* The order of the stages changed across the workshop sessions, yet their aim and objectives remained the same. Through the integration of the inspiration cards and idea generation tasks, the particular purpose of these stages

was to inspire the development of diverse ideas for influencing water-effective use behaviors among individuals with different intentions towards adopting change. The implications of the inspiration cards were mainly evaluated in terms of how they have contributed to the exploration of the problem area, how different intentions of users inform diverse solution areas, and how design strategies inspire ideation to promote sustainable behaviors. The workshop procedure and the incorporated tasks were also assessed to understand how they have contributed to the development of ideas and adoption of the generative tool. Based upon the findings from and insights into each workshop session, the inspiration cards and the workshop procedure were revised for the following workshop.



Figure 4.1: The focus of the DUI workshop sessions

This chapter presents the final step of this doctoral study through introducing the adopted methodology, the development of the inspiration cards and the workshop procedure, facilitation of the workshops and findings and conclusions from the study along with the reflections for the further development of the generative tool and the workshop procedure.

4.1 Research Design: Research through Design

In this step of the doctoral study, I adopted a *research through design* (RtD) approach to explore the ways of supporting designers in developing ideas for the effective use of water. RtD is a form of an action research approach that is utilized in humanities and social science and follows a systematic process (i.e., planning, acting, observing,

and reflecting) for generating knowledge (Swann, 2002). Similarly, RtD mainly focuses on creating knowledge through an iterative action and reflection cycle in a design process to provide a theory or explanation to be used in future studies (Frankel & Racine, 2010). Even some researchers recognize RtD as an inquiry focusing on the making of an artifact for the purposes of a societal change (Zimmerman et al., 2007; Swann, 2002), there are diverse approaches about how it should be practiced and what it should produce. The potential outcomes of RtD can be listed as design methods, design theory, conceptual frameworks, or new materials and technologies that can be applied to diverse types of design and design research in future studies (Gaver, 2012; Zimmerman et al., 2010). Adopting the RtD approach in this study will support (i) the development of a generative tool for communicating the research findings to inspire ideation, (ii) and the development of an ideation process for sustainable behavior change.

In this research through design process, design workshops were adopted as a generative research method to explore the possible ways of transferring research findings into ideation. Design workshops are creative participatory design sessions for exploring and generating ideas on assigned problems with a group of people (Hanington & Martin, 2012). They are commonly adopted in generative research where it engages participants, particularly non-designers, in creative activities through the integration of various *projective* (e.g., collages, drawing, card sorting, etc.) and *constructive* (e.g., Velcro modeling, flexible modeling kits, etc.) generative tools and techniques (Hanington & Martin, 2012). Projective tools enable participants to express their insights and experiences that are difficult to translate through verbal means, while constructive tools empower them to reveal their latent needs and preferences through creative exercises such as flexible modeling.

To communicate the findings from the previous stages of this doctoral study for the development of ideas for effective use of water, a projective generative tool, namely *inspiration cards,* was proposed *(see Section 4.2 Workshop Materials: Transferring Research Findings into a Generative Tool)*. Conducting design workshops with the

participation of individuals with a background in the field of design is considered valuable to investigate the implications of integrating the proposed generative tool into the design ideation processes. In this study, design workshops, which are named as *Design for User Intentions (DUI)* workshops, will focus on developing diverse design solution areas for influencing individuals to adopt behaviors for the effective use of water as performing personal care and hygiene activities in the bathroom environment. The outcomes of the workshop are intended to inform the development of the proposed generative tool through investigating how they affect the exploration of the problem area and the generation of diverse ideas for influencing individuals with diverse intentions towards adopting sustainable behaviors. The stages of this research through design study are presented in Figure 4.2.

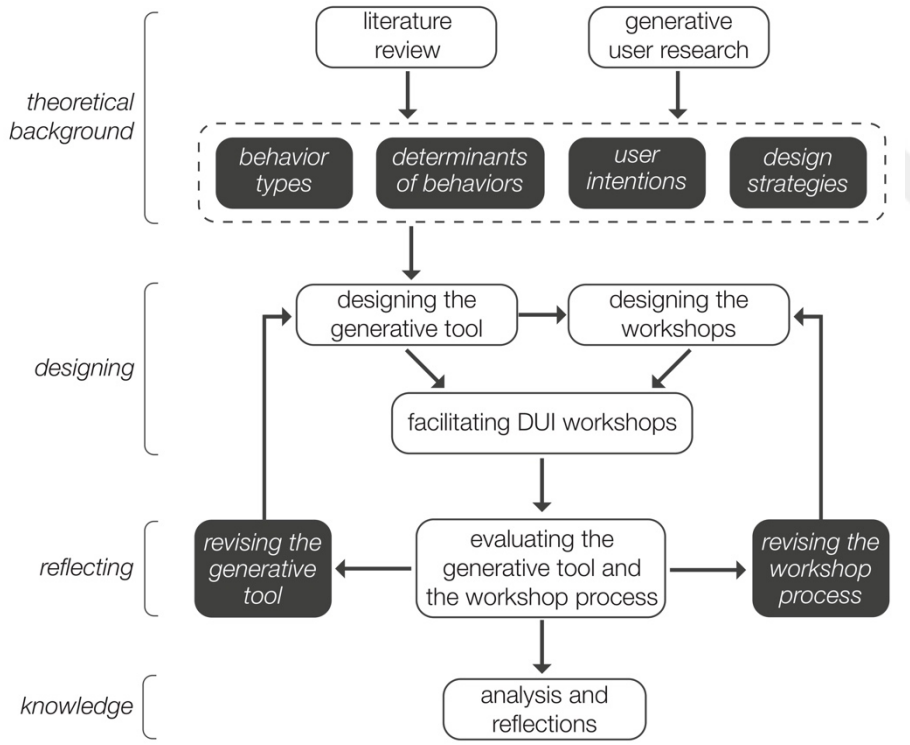


Figure 4.2: RtD process adopted in the second step of this doctoral study

Workshops, in general, can be conducted for diverse purposes, including *workshops as a means* to enhance the competencies and knowledge of the participants, *workshops as a practice* to develop something such as an idea or a process, and

workshops as a research methodology to explore a specific research area (Ørngreen & Levinsen, 2017). As conducting design workshops, the facilitator may have a variety of agendas, for instance, (i) to *explore* the participants' worlds through gaining an understanding of their needs and wants, (ii) to *generate* ideas through co-design exercises, and (iii) to *evaluate* a certain topic or ideas to provide feedback and insights for further development (Hanington & Martin, 2012).

In this doctoral study, there are certain *learning outcomes* for the participants where they experience a design process and a generative tool that can be translated and adapted into their further design processes. During the workshop sessions, participants *explore* the problem area and users' needs through the generative tool, *generate* ideas through the inspiration cards and carefully planned creative tasks, and *evaluate* the ideas and inspiration cards for further iterations. Even participants are expected to gain knowledge and develop ideas through the workshop; the DUI workshops are particularly conducted for the *purposes of research*, through which the main concern is to understand *how the proposed generative tool and the workshop procedure would support designing for sustainable behavior change*.

One critical limitation of the design workshops is that it is quite *labor-intensive* for the researchers to organize and facilitate the workshops, while engaging in the creative activities and tasks might be challenging for the participants. Nevertheless, comprehensive planning of the workshop process and carefully developing or preparing necessary materials, tools, and tasks for the planned activities prior to the sessions would enable to conduct the sessions successfully and reach the objectives of the research. *Staying on track with the planned timetable* is another important feature of the workshops in order not to frustrate the participants and to enhance their motivation (Hanington & Martin, 2012). To enable active engagement of the participants, integrated tools and creative tasks need to be considered in line with the skills and limitations of the targeted participants.

4.1.1 Planning Workshops

Prior to the DUI workshops, a comprehensive preparation phase was conducted to develop and plan the workshop procedure considering the particular aim and objectives of the study and potential limitations of the research method. There have been several revisions in the preparation phase along with the proposed generative tool considering the challenges in the pandemic including limitations in terms of physical interactions with the potential participants. During this process, various aspects have been considered inspiring from the checklist of questions offered by Chambers (2012) to be answered for an effective planning. In line with the scope of this doctoral study, responses to the prominent questions from the checklist has been presented below:

What is the purpose? It aims to evaluate the implications of the inspiration cards for developing design solutions for sustainable behavior change through allowing participants to generate ideas for influencing water effective personal care and hygiene practices through integrating the generative tool into their ideation process.

Who and how many? Through the study, participants will be engaging with various idea generation tasks to investigate their diverse experiences and insights in relation to the proposed generative tool, individuals with a background in the field of design will be recruited considering their familiarity with the adopted ideation methods and techniques. To facilitate discussions as reviewing and interpreting the content of the inspiration cards and brainstorm on the potential solution areas, participants will work in a collaborative manner. In each workshop session, participants will work in teams consisting of at least two people. Involving multiple participants is believed to enrich the variety of perspectives on the adopted tool and generated ideas. Three DUI workshops will be conducted; one focusing on personal care and hygiene activities around the showering area, one on the activities around the washbasin area, and final one encompassing both areas. Since the activities of interest are mundane

everyday practices that are carried out by everyone, the contributors of the workshop will also act as the users.

What expectations? The participants are expected to share their previous experiences on the activities of concern and develop ideas through the incorporated generative tool and techniques including brainstorming, scenario development and sketching. They will also evaluate the inspiration cards and workshop process through discussions.

What is your role and contribution? As a designer and a researcher, I design the workshop procedure along with the generative tool to be implemented in the sessions, guide the discussions and the workshop stages, document the workshop process and make inferences on the outcomes of and reflections into the workshop for the purposes of research.

Who else? Organizing and running workshops are often labor intensive for the facilitator. Considering the number of participants, the existence of co-facilitators considered useful to record the sessions effectively, support the researcher as guiding the workshop stages, facilitate discussions and respond to participants' potential questions.

Where and when? Traditionally workshops are conducted in a carefully selected physical space to inspire creativity and collaborative working, and necessary tools (e.g., pencils, papers, sticky notes, cards, etc.) are provided for the use of the participants to enable them to express their ideas and to enhance their creativity. Considering the emerging possibilities and constraints in relation to the pandemic, the DUI workshops are facilitated through online mediums. This adaptation can be considered as one of the main contributions of this research. The facilitators and participants gather in an online meeting via Zoom, an online video communication tool. During the online workshop sessions Miro is used to carry out design activities (e.g., ideation, sketching, etc.) considering the possibilities the platform provides for remote collaboration.

What will be needed? In online workshop sessions, participants' digital literacy and familiarity with the online tools become a concern. For video conferencing and real time collaboration, participants need a computer, stable internet connection and an account in the utilized online platforms (i.e., Zoom and Miro). During the workshop sessions, the inspiration cards are utilized to stimulate discussions and support the generation of design solutions, and online tools (e.g., online whiteboard, sticky notes, pen tool, etc.) are used for visual collaboration, and communicating and presenting ideas. For the documentation of the participants experiences and insights on the workshop process, the adopted tool and the generated ideas, the whole workshop session is recorded.

Participants' preparation? To warm up the participants to the research topic and enable them to be aware of their personal care and hygiene activities, *sensitizing* task is carried out as a self-exploration exercise. Similar to the revealing task in the previously conducted diary study, participants share their activity stages through transferring them on a timeline and evaluate their understandings about water consumption in relation to the activity stages they recorded.

What outputs will there be? The mind maps, scenarios, sticky notes and sketches for brainstorming and communicating the generated ideas, the participants' insights related to the generative tool and suggestions for their further development, and finally the participants' reflections on the generated ideas for influencing effective use of water among users with diverse intentions is the main outcomes of the workshops.

Responding to the prominent questions from Chambers's (2012) checklist, decisions regarding the structure and conduct of DUI workshops are determined. The details about the workshop procedure, development of the generative tool and the findings from the study will be presented through the following sections.

4.2 Workshop Materials: Transferring Research Findings into a Generative Tool

Together with the content of the user research findings, how these are communicated to designers and how this transition informs the design process are quite important to overcome the gap between design research and practice. Töre Yargın (2013), in her *model for effective communication of user research findings,* proposes three main goals for the designers' expected outcomes as utilizing user research findings (i.e., inspiration, guidance and justification). Designers intend to use the insights obtained from the user research as *an inspirational source* to conduct creative idea development, which would also support them to *empathize with the users*. The user research findings should also provide designers *guidance* through offering suggestions and potential ways that they may adopt during the design process. While communicating the ideas with the other stakeholders or persuading themselves during the decision-making process, designers also utilize user research findings to *justify* their design decisions. Colusso et al. (2017) recommend four main activities as integrating research findings into a design process (i.e., understanding, brainstorming, building and advocating). They propose that designers utilize research findings for *understanding* the design challenge and the problem space; *brainstorming* on the potential ideas to tackle a design challenge, *building* on the initial ideas to transform them into detailed ideas and *advocating* the ideas to prove to decision makers that the ideas are valuable.

Considering these approaches and categorizations, conveying the findings from the previous phases of this doctoral study (i.e., literature review and user research study) in a way that will meet the designers' expectations in terms of (i) understanding the problem area and the user *(understanding and inspiration)*, (ii) providing guidance in the idea generation process *(brainstorming and guidance),* (iii) elaborating on the generated ideas and refining *(building)* and supporting the importance and relevance of the developed ideas *(justifying and advocating)* have been the main focus of this

phase of the study. In line with these expected outcomes of the research findings to achieve effective communication with the designers, a generative tool named as *inspiration cards* was developed. It aims to inspire and support designers during the ideation phase of the design process for the purposes of generating ideas for sustainable behavior change. It should be noted that the inspiration cards were developed through several iterations in line with the findings from and insights into the facilitated workshop sessions, and researcher's own reflections. In the following section, the proposed generative tool, its development process along with the changes to it will be presented.

4.2.1 Development of Inspiration Cards for the DUI Workshop I

The initial inspiration cards, that have been incorporated into DUI workshop I, include three card sets; *(i) problem areas, (ii) user intentions* and *(iii) design strategies* for sustainable behavior change. Since the workshop has been facilitated in a national conference, UTAK 2020, the generative tool has been prepared in Turkish which can be found in Appendix C.

Problem areas cards include *behavior-oriented* (6 cards), *attitude-oriented* (7 cards), and *product and system-oriented* (6 cards) issues that are responsible for intensive use of water as performing personal care and hygiene activities. These cards aim to support the participants to understand the reasons for water consumption, reflect on them and explore solution areas for the effective use of water. As transferring problem areas emerged through the user research study into the generative tool, first each problem has been briefly defined. In this process, emphasis was on making definitions that are comprehensive enough in order not to lose the meaning of the problems, yet simple to enable participants' active engagement with the tool. The proposed cards include the *name of the problem area, its definition and a triggering question for inspiring ideation* (Figure 4.3). Since the first workshop focuses on the personal care and hygiene activities around the showering area, the definitions of the

problem areas are supported with *examples mentioned by the participants of the user research study* in relation to that specific area. Cards also include labels to identify whether they are linked to a behavior, attitude or product and system-oriented problems. Three different problem areas are further differentiated from each other through the choice of colors from a monochromatic color scheme. The card set also includes an introductory cover explaining the content of the card set.



Figure 4.3: Examples from the problem areas cards; *(top left)* introductory card, *(top right)* behavior, *(bottom left)* attitude, and *(bottom right)* product and system-oriented problem areas

User intentions cards include five diverse tendencies of individuals for adopting water effective use behaviors namely *mindful, willing, doubtful, reluctant* and *unconcerned*. The card set aims participants to realize the individuals' diverse beliefs, attitudes, perceived behavioral controls, awareness and intentions that needs to be considered as generating ideas to enhance the adoption of the design interventions for sustainable behavior change. Similar to the problem areas cards, the long descriptions of the user intentions emerged through the user research study were simplified to clearly define the distinctions between the user types. The card set was placed on a spectrum according to the degree of users' eagerness to alter their behaviors. Along with an introductory cover defining the content of the cards and

the name of the intentions, the proposed cards involve *the name of the user intention* and *a brief definition of the users' attitudes* towards adopting water effective behaviors (Figure 4.4).

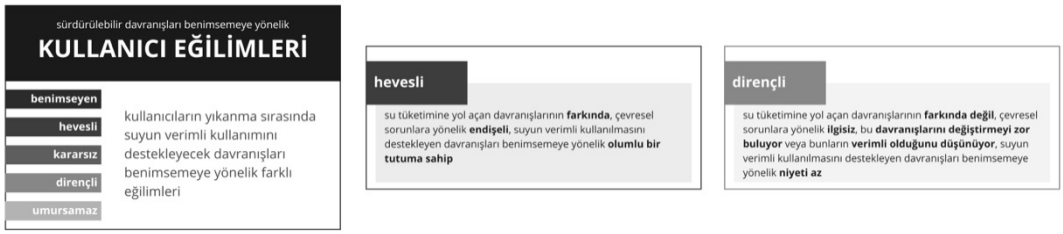


Figure 4.4: Examples from the user intentions cards; *(from left to right)* an introductory card, willing and reluctant user intentions cards

Design strategies cards consist of four diverse design strategies adopting diverse approaches for influencing behaviors; *informing, engaging, guiding* and *determining (see Section 2.5.3 Proposed Categorization for Design Strategies).* This card set aims participants to recognize various strategies and approaches to inspire ideation process as generating design interventions for sustainable behavior change. One main difference of the design strategies cards is related to its origins. Even the problem areas and user intentions mainly emerged from the analysis of the user research, design strategies developed through a comprehensive review and cross comparison of the existing design intervention strategies on the related literature. Prior to transferring this proposed categorization of the design strategies, their long definitions and blueprints for their implementation were simplified. Proposed cards include the *name of the strategy, its brief definition* and *a list of techniques* showing how to influence intended behaviors (Figure 4.5). To further clarify their integration into the ideation, *an exemplary case* is provided describing how the related design strategy can be utilized to influence sustainable behaviors. In order not to guide the participants towards certain solution areas during the ideation, sustainable driving was selected as an exemplary case which is different from the focus of this study (i.e., water consumption). The card set, similarly, includes an introductory cover defining the aim of the cards along with the name of the design strategies.

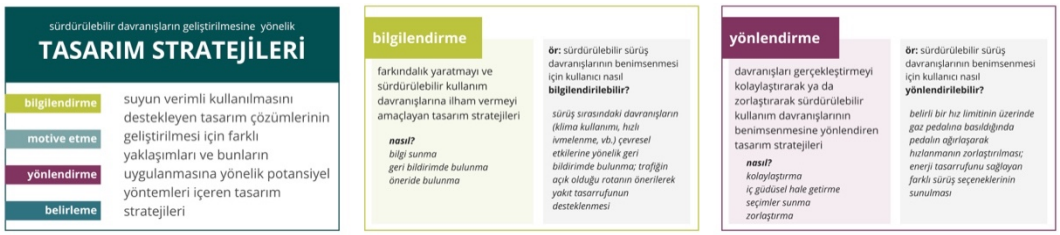


Figure 4.5: Examples from the design strategies cards; *(from left to right)* an introductory card, informing and guiding design strategies cards

4.2.2 Revising Inspiration Cards for the DUI Workshop II

Considering the participants' insights and suggestions and the researcher's reflections during the DUI workshop I, several revisions have been done to improve the proposed inspiration cards. Revised generative tool includes four card sets; *(i) behavior types, (ii) determinants of behaviors, (iii) user intentions* and *(iii) design strategies* for sustainable behavior change. The second workshop was integrated into a graduate course, ID 728 Generative Design Research for Sustainability, and the generative tool was prepared in English (Appendix D).

Through the reflections on the DUI workshop I, the categorization of the problem areas was reconsidered. Returning back to the analysis sheet of the user research study, it has been realized that the occurrence of the behavior-oriented problem areas is determined by the attitude and product and system-oriented problem areas. Considering this connection, the name of the categories was revised as *behavior types* and *determinants of behaviors*. Former behavior-oriented problem areas were renamed as *behavior types*, while the attitude-oriented problem areas were defined as *attitudinal determinants of behaviors* and product and system-oriented problem areas as *contextual determinants of behaviors* (Figure 4.6). In DUI workshop II, the particular focus would be on the personal care and hygiene activities around the washbasin area. In that sense, *examples from washbasin area* revealed through the user research study were included for clarifying the definitions of the cards. In the analysis of the user research findings, one of the behavior types namely *using water*

for diverse needs was not associated with the activities around the washbasin area, thus it was not included in the revised card deck for the DUI workshop II. Apart from that, in each category, the number of cards and their names remained unchanged while there had been minor graphical alterations (e.g., typeface, font size, colors, etc.) on the cards.

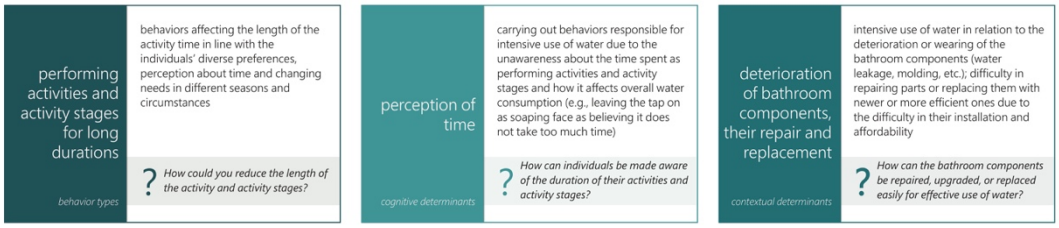


Figure 4.6: Examples from behavior types and determinants of behaviors cards from DUI workshop II

As revising the inspiration cards, there had not been significant alterations in user intention cards which were found quite clear by the participants. However, along with graphical changes, a scale demonstrating the users' intention or resistance to adopting change is included for further clarification (Figure 4.7).



Figure 4.7: Examples from user intentions cards from DUI workshop II

During DUI workshop I, as participants sharing their ideas through relating them with the design strategies they inspired from, it was realized that they had concerns about the content of the *engaging* strategy. Since the blueprints for the implementation of the engaging strategy were quite inclusive that encompass both motivational strategies, and strategies for enabling personalization and empowering users which might be responsible for the participants' misinterpretation of the card. Thus, in line with the participants' reflections, it has been decided to divide this

category into two separate strategies to have a distinct and clearer description of the diverse approaches (Figure 4.8). In that sense, design strategies aiming to incorporate individuals' interests and emotions and enhance their involvement to personalize and adapt design interventions in line with their needs and preferences for adopting responsible behaviors were named as *engaging* strategy. Meanwhile, design strategies aiming to influence environmentally responsible behaviors through motivational techniques including goal setting, comparing, encouraging and rewarding were called as *motivating* strategy.

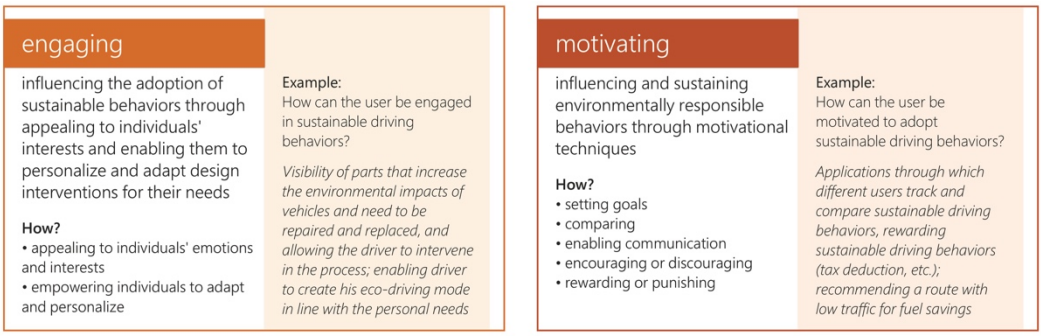


Figure 4.8: Revised engaging and motivating design strategies cards from DUI workshop II

4.2.3 Revising Inspiration Cards for the DUI Workshop III

Based upon the participants' evaluations of the inspiration cards during the second workshop session, final revisions were made on the generative tool. The categorizations of the inspiration cards and the number of the cards that each category includes remained the same. The third workshop was integrated into an undergraduate design studio course, ID 302 Industrial Design IV, where students are engaging with a design project aiming to empower effective use of water in the bathroom environment. The revised version of the inspiration cards can be found in Appendix E.

Considering the scope of the design project, in which the workshop session was incorporated, *the definitions of the behavior types and attitudinal and contextual*

determinants of behaviors were revised to encompass personal care and hygiene activities performed in the whole bathroom area. Also, diverse examples both from the washbasin and showering area from the user research study were included to further clarify the definition of the cards (Figure 4.9).

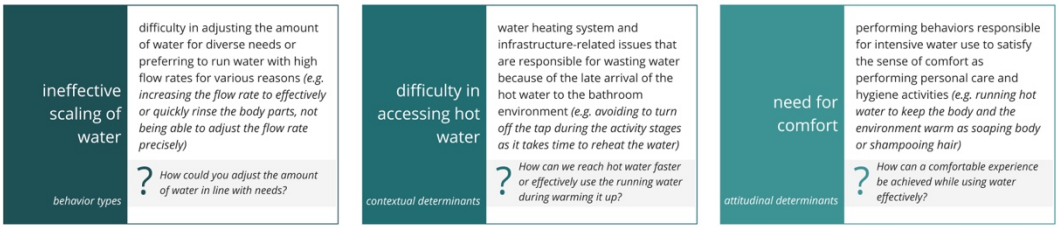


Figure 4.9: Examples from behavior types and determinants of behaviors cards from DUI workshop III

Quotes from the users' statements received through the user research study were incorporated into the user intentions cards to better transfer the behaviors and attitudes of individuals and empathize with them (Figure 4.10).

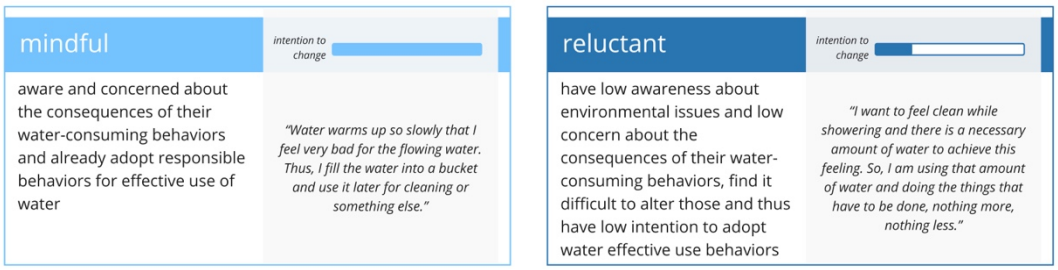


Figure 4.10: Examples from design strategies cards from DUI workshop III

Finally, considering the descriptive nature of the content of the design strategies cards, exemplary cases explaining the utilization of the design strategies were replaced with *the images of design solutions*. Examples were included into each design strategies card along with their *short descriptions* highlighting their relevance with the adopted design strategies (Figure 4.11).

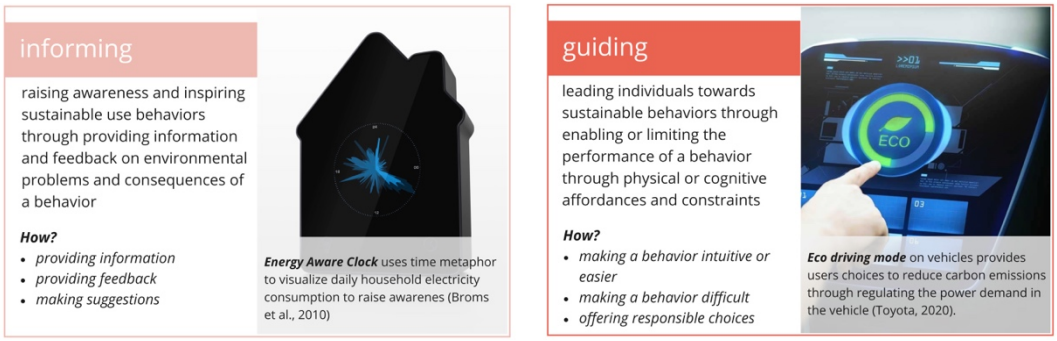


Figure 4.11: Examples from user intentions cards from DUI workshop III

Apart from the inspiration cards, there were several materials that are incorporated into the workshops. For sharing the workshop procedure and creating a workspace for the participants of the online workshop, *workshop canvas* and *team canvases* were developed on Miro. To inform the participants about the workshop process and support them throughout the sessions for creative tasks and presentations, materials including *workshop brief, sticky notes* and *workshop guideline* were prepared. The details about the workshop materials, their implementation and content will be shared in the following section through relating them with the relevant workshop stages.

4.3 Workshop Procedure

As previously mentioned, DUI workshops were conducted online where participants met via a Zoom meeting, and the individual and collaborative workshop tasks were carried out on a Miro board. The Miro board consists of two main components; (i) *a workshop canvas* (Figure 4.12) demonstrating the aim and objectives of the study, the main structure of the workshop along with the descriptions of the stages, and inspiration cards, and (ii) *team canvases* (Figure 4.13) that are developed to provide the participants with a collaborative working environment during ideation and necessary instructions in relation to the workshop stages (e.g., duration of the stages, blueprints for conducting the idea generation tasks, etc.). Team canvases are placed

on the separate locations of the Miro board to create a semi-isolated working space for the participants.

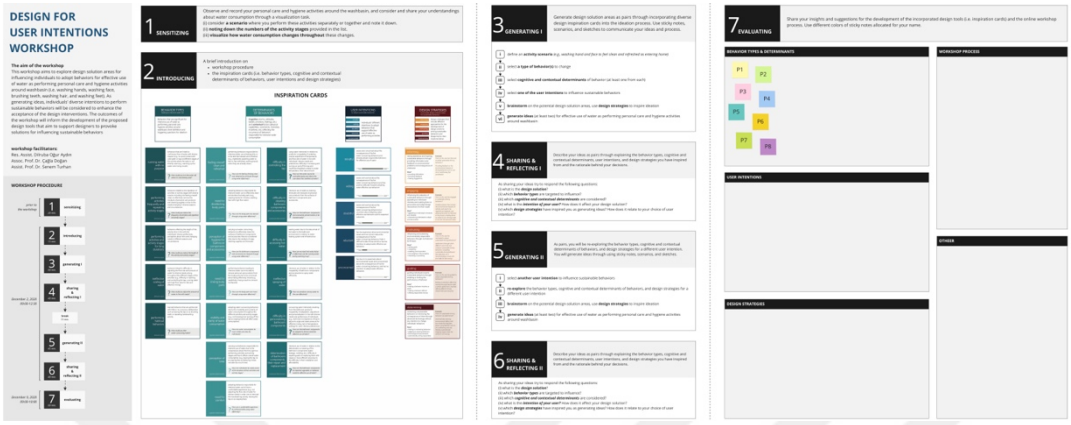


Figure 4.12: The workshop canvas from the DUI workshop II

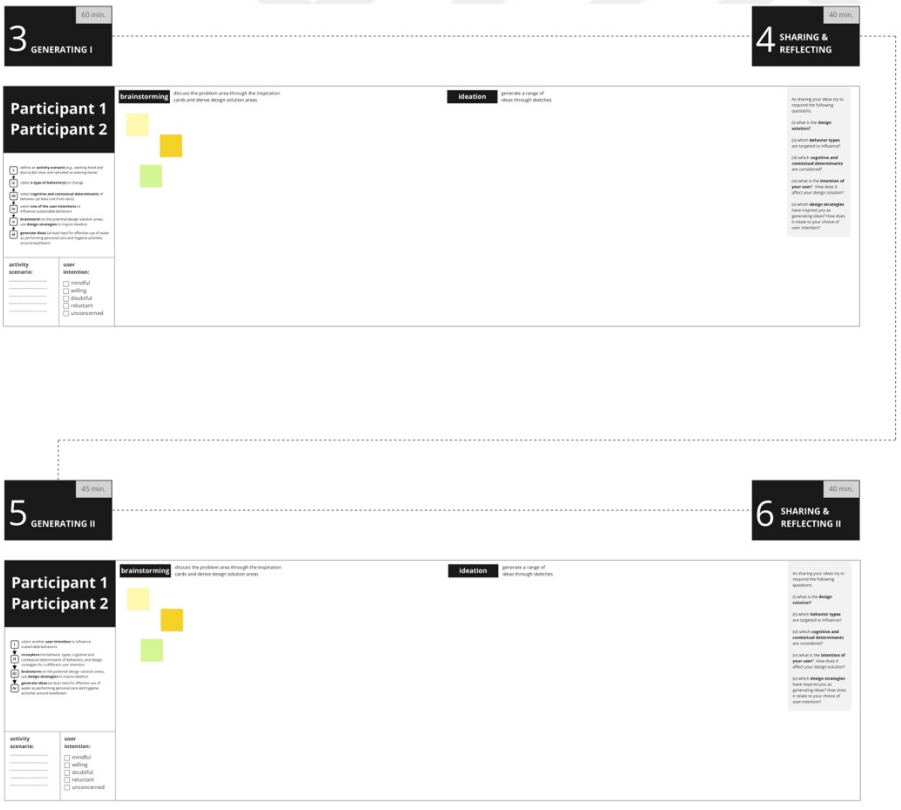


Figure 4.13: A sample team canvas from the DUI workshop II

DUI workshops include seven successive stages which are *sensitizing, introducing, generating I, sharing and reflecting I, generating II, sharing and reflecting II,* and *evaluating.* The order of the workshop stages showed differences across workshop sessions; however, their particular aim and content remained the same. In this part, the stages of the workshop, their intended aim, incorporated tools and tasks will be presented through highlighting the differences in three workshop sessions.

Prior to the workshops, an *online consent form* was emailed to the participants which included the aim and objectives of the workshop, its intended outcomes, expectations from the participants along with their legal rights (Appendix F). For the ones who did not respond to the consent form, it was reminded at the beginning of each workshop session.

Sensitizing: This stage aims to prime participants for the workshop sessions through enabling them to get familiar with the activities of interest and water consumption. To support them to share their unique experience, it is conducted individually where each participant has a separate timeline allocated to their names. As carrying out this task, participants are asked to recall and transfer their experiences in relation to the activities of interest on the empty timeline through noting down the numbers of the activity stages provided in the list. They are also encouraged to add new activity stages to the list to better reflect their experiences. In the first workshop, this stage was carried out *in the beginning of the session* through which the participants recalled their prior personal care and hygiene experiences around the showering area and documented the activity stages (Figure 4.14).

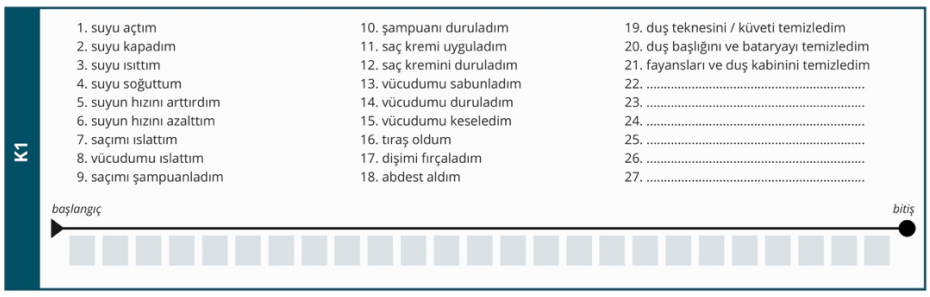


Figure 4.14: Sensitizing stage template from the DUI Workshop I

In the second workshop, the activities around the washbasin area (i.e., washing hands, washing face, brushing teeth, washing hair and washing feet) were more diverse, and conducting this task during the workshop would require too much time from the participants. Considering the participants' reflections on the previous workshop and the variety of the activities, the sensitizing stage was carried out *prior to the workshop*. As sharing their experiences in relation to the activities of interest, they were also asked to visualize their understandings about water consumption. This newly incorporated task aimed to enable participants to consider how their behaviors are responsible for water consumption. For the third workshop, there has not been any revision on the template, yet the activity stages were extended to include behaviors in relation to the both showering and washbasin area (Figure 4.15).

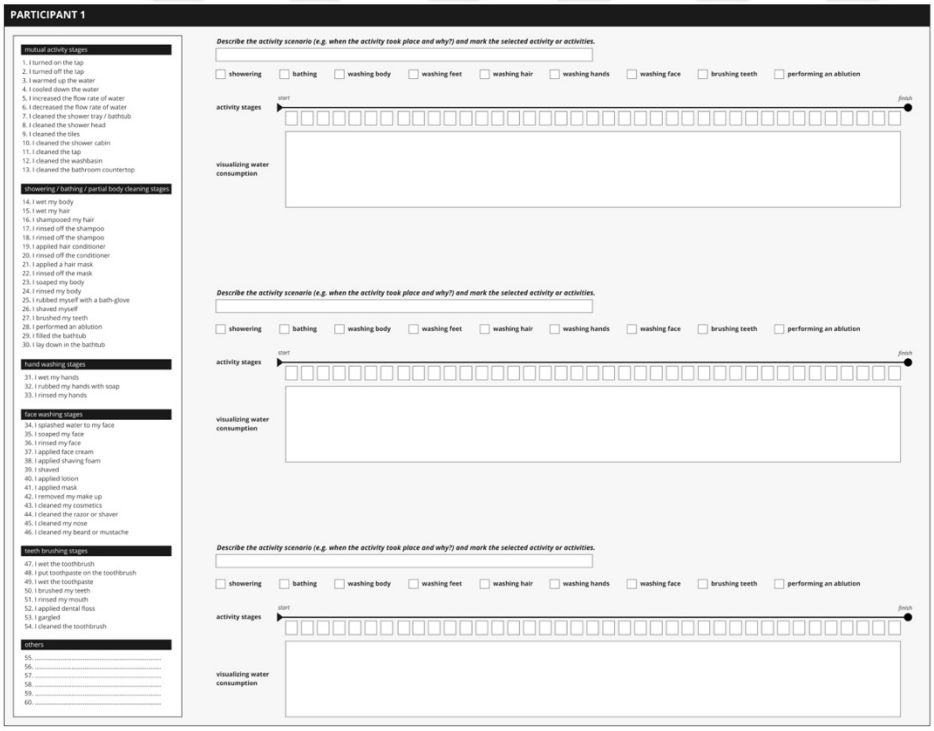


Figure 4.15: Sensitizing stage template from the DUI Workshop III

Introducing: Considering the variety of stages, the generative tool and ideation tasks that the workshop includes, a brief introduction is needed to explain the problem background, aim and scope of the study, workshop procedure and inspiration cards.

In DUI workshop I, introducing stage was carried out at the beginning of the workshop prior to the sensitizing stage, whereas in the second and the third workshop sessions a different approach was followed. Prior to the workshop a *design brief* including the problem background, aim of the workshop and its procedure was emailed to the participants to ensure they have reviewed the details beforehand (Appendix G & K). The *inspiration cards*, for the first two sessions, were introduced at the beginning of the workshop and simultaneously emailed to the participants so that they would engage with them more effectively. In the final workshop, on the other hand, the card set was emailed to participants together with the design brief, to enable them to allocate time to review the generative tool in detail.

Generating I: The particular aim of this stage is to develop design solutions areas for effective use of water through incorporating inspiration cards into the ideation process and following a certain procedure for their adoption. To create an immersive and collaborative environment to negotiate the meanings of the inspiration cards, participants work in groups of two or three. The idea generation tasks are conducted in each group's team canvas which has a flexible template to be adapted in line with the needs of the participants for effectively ideating and communicating the generated ideas. Since the idea generation is inherently not a linear process with strict distinctions between the stages, it is thought that creating a flexible canvas for different ideation tasks would make it easier for the participants to link the stages, insights, and ideas with each other. In this stage, participants are free to use sticky notes, texts, scenarios, and sketches to communicate their ideas and processes. As generating ideas, they follow several steps (Figure 4.16). First, they are asked to identify an activity scenario in which they perform the activities of interest (e.g., showering to warm up on a cold day, brushing teeth in a hurry, etc.). Then, they focus on one of the user intentions to influence sustainable behaviors. Here, it is aimed to empathize with and respond to the unique needs and preferences of a specific user intention to generate ideas that would enable them to adopt intended behaviors. Later, they select at least one behavior type to influence towards sustainable

directions and attitudinal and contextual determinants of behaviors (former problem areas) to understand the reasons behind the performance of water-intensive use behaviors. This step aims the participants to explore the problem area and its reasons and define intended behaviors to enable effective use of water. As defining the activity scenario, problem areas and user intentions, they *brainstorm on the potential design solutions*. During idea generation, they are advised to use design strategies to inspire the development of ideas for behavior change. Each team is asked to generate at least two diverse ideas for the effective use of water.

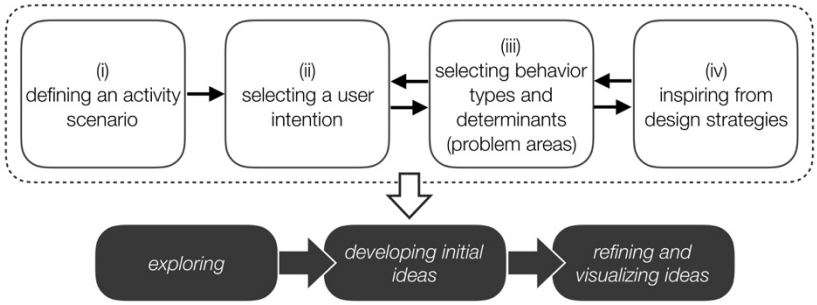


Figure 4.16: Steps of the Generating I stage of the DUI workshops

To provide participants an environment to work in collaboration with their teammates, Zoom breakout rooms were created. As facilitators, during the generating stages, we circuited around the teams working in separate rooms to be able to answer the emerging needs and questions of the participants. Considering the potential isolation feeling that emerges in digital working environments, collaborative working actively engaged them in the workshop process.

Sharing & Reflecting I: As completing the first round of idea generation stage, participants meet in the Zoom's main room and are expected to describe their ideas in teams through explaining *how the generated ideas would encourage sustainable behavior change, how they are inspired from the inspiration cards* and *the rationale behind their decisions*. To support them during the presentations the questions that they are expected to respond are provided on the team canvas. While each team shared their ideation process and generated ideas through relating them with the

inspiration cards, facilitators asked several questions to further comprehend their experiences with the inspiration cards and the idea generation steps. The workshop guideline including the comprehensive list of the questions can be found in Appendix H. In the final workshop session, this stage was carried out after the generating stage II where participants shared the ideas that they developed through the both ideation sessions.

Generating II: This stage aims to explore how design solution areas vary for the individuals' diverse intentions for adopting responsible behaviors. In that sense, participants are asked to re-explore the inspiration cards *for a different user intention* and generate ideas to influence their unsustainable behaviors. As designing for a different user intention, several steps are followed (Figure 4.17). While the focused activity scenario remains unchanged, they are asked to re-explore the previously selected inspiration cards and encouraged to include new ones which are found meaningful in relation to the selected user intention. They are similarly expected to generate at least two diverse ideas through using sticky notes, scenarios, and sketches to communicate the generated ideas and their ideation process. In the facilitation of workshops, one difference was related to the composition of the teams. In workshop II, as sharing their ideas, participants switched teams to share their experiences, knowledge and interpretation of the inspiration cards with the others. In this process, one team member remained in the team while the other member joined another team. Another difference was about the selected activity scenarios. In the final workshop, considering the scope of the design project, teams who focused on an activity around the washbasin areas in the first ideation session were asked to select another activity scenario around the showering area during the second round of ideation. This approach enabled them to explore various behaviors responsible for intensive use of water in the bathroom environment and develop diverse ideas for sustainable behavior change.

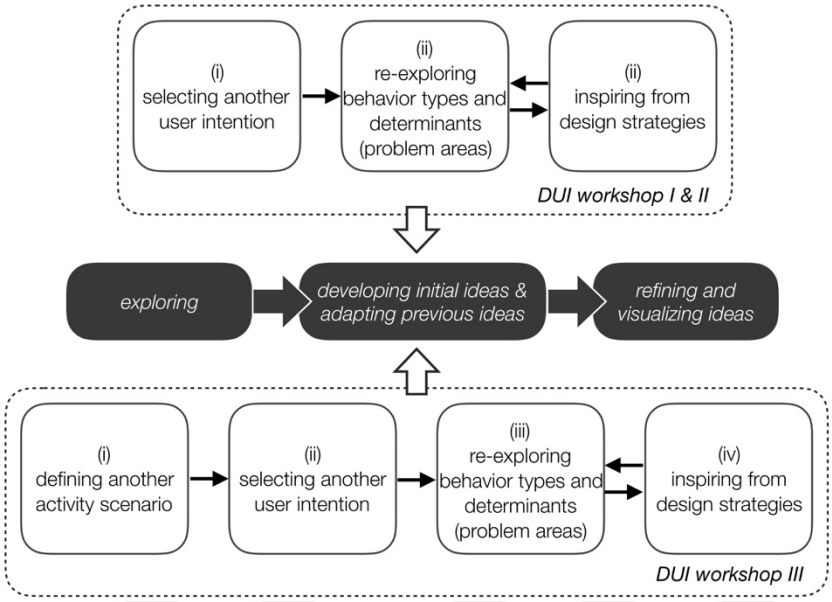


Figure 4.17. Steps of Generating II stage of the DUI workshops

Sharing & Reflecting II: The particular emphasis of this stage is to enable participants to share their ideas as teams through explaining *how focusing on a different user intention affect their ideation process and the utilization of the inspiration cards, how the inspiration cards are re-explored, how the generated ideas would encourage sustainable behavior change, how they are inspired from the inspiration cards and the rationale behind their decisions*. As they share their ideas, similarly, facilitators addressed questions to probe into their ideation process, proposed ideas and their experience with the inspiration cards (Appendix H).

Evaluating: This stage aims to gain insights into participants experiences with and suggestions for the online workshop procedure and the incorporated generative tool. The stage is conducted on the main workshop canvas where the particular topics of interest are highlighted (Figure 4.18). Participants are expected to translate their reflections on sticky notes with diverse colors allocated for them and attach their reflections under the related topic. Then, each participant elaborates on their notes to further clarify their experiences and suggestions. Considering the potential mutual and diverse experiences, this stage is developed in a flexible nature which

occasionally evolve into group discussions. To receive a detailed feedback related to the inspiration cards and workshop process facilitators addressed several questions from the workshop guideline (Appendix H).

Apart from minor graphical enhancements, this stage remained the same in the first two workshop sessions. In the final workshop session, however, considering the number of participants, this stage was transferred into an online questionnaire (Appendix I). The questionnaire design included *open-ended questions* to enable the participants to share their suggestions and comments for the further development of the card set and the workshop process, and *Likert scale questions* to support them to evaluate the generative tool and the implications of the workshop process.

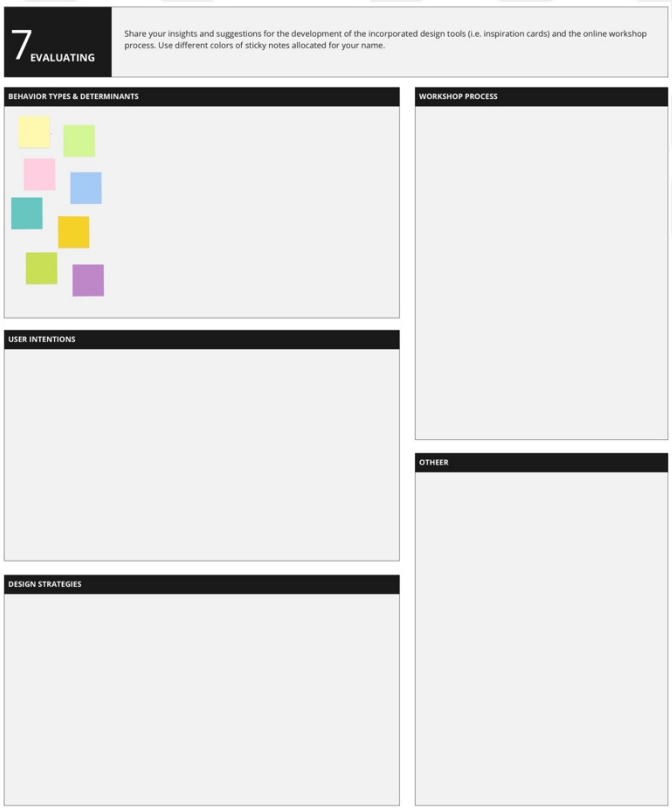


Figure 4.18: Evaluating stage template from DUI workshop II

4.4 Data Analysis

In the analysis of the design workshops, the particular emphasis was on (i) understanding how research findings that were transferred into the inspiration cards supported the participants to generate a range of ideas for influencing water-effective use behaviors. The analysis process also aimed (ii) to understand how and for what purposes inspiration cards are utilized throughout the ideation process and (iii) to acquire the participants' insights and suggestions for the inspiration cards and the workshop process to inform their development. To achieve these aims, the content analysis method was utilized to categorize and code the textual data and create consistent relations between the generated themes (Julien, 2008). During the analysis, both an inductive and deductive approaches were adopted while revealing codes and themes through detailed interpretations of the data.

The analysis started with the verbatim transcription of the video recordings of the workshop sessions to document the participants' statements and questions collected while ideating, sharing their ideas, and evaluating the generative tool and the workshop process. Then, these statements were transferred to an Excel Sheet and categorized in line with the related workshop stages and adopted inspiration cards. Through interpreting these statements, they are assigned with codes, which iteratively create sub-themes and themes.

Based upon the intended outcomes of the analysis phase, three different Excel Sheets were prepared including slightly different coding structures. One of these sheets analyzed the utilization of the inspiration cards to reveal the outcomes of their adoption for the ideation process (Table 4.1). Second Excel Sheet mainly focused on the participants' evaluations of the inspiration cards and workshop process and suggestions for their further development to support their effective integration into ideation (Table 4.2).

Table 4.1: An example from the coding process analyzing the utilization of the inspiration cards

# Team	Workshop stage	Participant's statements	Adopted inspiration cards	Utilization of the inspiration cards	Outcomes of the inspiration cards
Team 1	Sharing and reflecting I	1:48:12 During the pandemic, doubtful users are experiencing a dilemma. Even though they are concerned about the water use, they need to feel clean, and this need leads them to adopt habitual behaviors responsible for the intensive use of water.	user intentions behavior types attitudinal determinants of behaviors	empathizing with the users exploring and elaborating on the problem area	exploring
Team 1	Sharing and reflecting I	1:48:20 While focusing on how to change this habit, we thought that we could visualize water consumption to increase their awareness	user intentions design strategies	determining potential solution areas	generating

Table 4.2: An example from the coding process analyzing the participants' evaluations about the inspiration cards and workshop process

P#	Workshop stage	Participant's statements	Related inspiration cards and workshop process	Evaluations & suggestions
P2	Evaluating	5:04:11 Changing teams in between the stages was interesting. I didn't expect it to be such productive. Talking to different people enabled me to understand how they look at the problem space from a different perspective and gave me fresh ideas.	switching teams in generating stage II	supporting communication between team members reconsidering the problem area triggering ideation
P7	Evaluating	5:19:24 In the first generating stage, I didn't feel that I managed time well. We spent most of our time in understanding the inspiration cards since they were quite detailed. So, we didn't have much time for the ideation. Exploration of the cards might be a different stage.	duration of the generating stage I inspiration cards	a separate workshop stage for the exploration of the cards the descriptive nature of the inspiration cards

In the final Excel sheet, the generated ideas, were coded in line with the adopted *user intentions, behavior types and determinants of behaviors* (former problem areas), and *design strategies* for each idea to reveal how the integration of the inspiration cards inspired the development of diverse ideas for the effective use of water (Table 4.3). Through the coding process relating the generated ideas with the adopted inspiration cards enabled me to reveal diverse patterns as utilizing inspiration cards such as *the frequency of their adoption*, *diverse combinations of design strategies*, and *relations between the user intentions and design strategies* which will be discussed through the following sections presenting the *Outcomes of the DUI Workshop I, II & III (see Section 4.5.1.3, 4.5.2.3 & 4.5.3.3).*

Table 4.3: A section from the analysis sheet presenting generated ideas in relation to the inspiration cards

			Inspiration cards						
Workshop stage	**Activity Scenario**	**User intentions**	**Behavior types**	**Attitudinal determinants**	**Contextual determinants**	**Design Strategies**	**Initial Ideas**	**Refined Ideas**	**Description of the Refined Ideas**
Generating I	individuals coming home after spending time indoors during the pandemic	doubtful	performing activities and activity stages for long durations	perception of time		informing	making the user aware of the duration of the activity	Idea 1: informing the duration of use	vibrating shower head to provide information about the duration of use and water consumption
			running water without any purpose	perception of time visibility and clarity of water consumption		informing	visualizing water consumption	Idea 2: providing real-time feedback on water consumption	water bottle illustrations to visualize water consumption in a clear way and provides real-time information
			running water without any purpose	perception of hygiene for bathroom components	difficulty in cleaning bathroom components difficulty in accessing hot water	guiding determining	repurposing the water that flows during showering	Idea 3: automatically collecting water for repurposing	storing water as it warms up through an integrated reservoir and automatically repurposing it to clean the shower cabin
			running water without any purpose	perception of hygiene for bathroom components	difficulty in personalizing bathroom components difficulty in controlling the tap difficulty in cleaning bathroom components	guiding determining	minimizing contact with the bathroom components for the user who feels dirty	Idea 4: providing gestural interactions to control water	interacting with the controls through gestures or voice command to minimize contact
			performing activities frequently and repeating activity stages	need for rinsing body and body parts			psychologically supporting the feeling of being clean through appealing to different senses (e.g., colors, sound, smell)		
				perception of time		informing determining	automatically changing the flow rate of water to remind the user of the duration of the activity		
				perception of time		determining	decreasing the temperature of water to reduce the duration of use		

4.5 Facilitating the DUI Workshops

Within the context of this doctoral study, three DUI workshops were carried out. First workshop focused on the personal care and hygiene activities around the showering area (i.e., showering, bathing, and partial body cleaning), the particular emphasis of the second workshop was on activities around the washbasin area (i.e., washing hands, washing face, brushing teeth, washing hair, and washing feet), and the final workshop adopted a more inclusive approach and focused on the activities around the showering as well as the washbasin area.

In the previous sections, the generative tool, workshop procedure and materials were delivered through highlighting the mutual points and differences between the workshop sessions. This section will present the details about the facilitation of the DUI workshops separately through providing examples from each session. It will also share findings from the workshops and reflections on the workshop process and the generative tool through discussing their contributions and limitations.

4.5.1 DUI Workshop I

The first online DUI workshop was conducted on September 10, 2020 as a part of the 4th National Design Research Conference (4. Ulusal Tasarım Araştırmaları Konferansı [UTAK]) which was organized in the Department of Industrial Design at Middle East Technical University. Considering the conduct of the conference, the workshop was carried out in Turkish. The DUI workshop I aims to investigate the implications of inspiration cards on the development of ideas for influencing effective use of water as performing personal care and hygiene practices around the showering area (Oğur Aydın et al., 2020). The details about the sample, facilitation of the workshop, findings from and reflections into the workshop will be shared below.

4.5.1.1 Participants and Online Workshop Environment

The workshop was open to all with a background in the field of design including undergraduate and graduate students, academicians and industrial designers. Since the activities of interest are mundane everyday practices that are performed by everyone and would not require any expert knowledge, participants of the workshop would also be the users of the particular research area. As recruiting participants, the description of the workshop (e.g., aim and objectives, duration, facilitators, etc.) along with the expectations from the participants were announced by the conference team. The quota for the number of participants was announced between eight to ten. Even though 14 participants applied for the workshop, nine of them participated in the workshop. Two of the participants were undergraduate design students while seven participants were graduate students in industrial design. The online workshop was conducted via Zoom, an online video communication tool, while Miro is used for individual and collaborative design activities (e.g., ideation, sketching, presenting, etc.). There have not been experienced any technical problems related to the adopted online communication and collaboration tools. The workshop was carried out with two co-facilitators; Prof. Dr. Çağla Doğan and Dr. Alper Karadoğaner. The session took around 5 hours 15 minutes including the introduction in the beginning of the session.

4.5.1.2 Facilitating the DUI Workshop I

As conducting the workshop, seven stages were followed; *introducing, sensitizing, generating I, sharing and reflecting I, generating II, sharing and reflecting II* and *evaluating* (Figure 4.19). The details about the workshop stages and incorporated tools and tasks were presented in previous sections while this section will focus on the reflections on the stages in terms of their facilitation, adopted tools and their limitations.

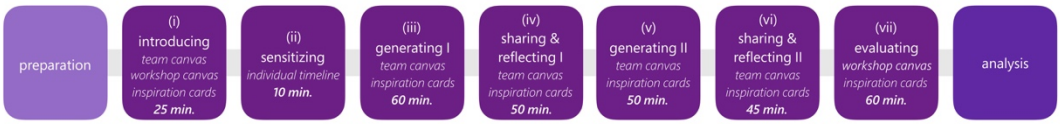


Figure 4.19: DUI workshop I stages and incorporated tools and tasks

Prior to the workshop, in order not to experience any technical issues, an email was sent to the participants to ensure that they have Zoom and Miro accounts, and the empty version of the Miro board was shared with them to ensure that they can access and edit the board.

Introducing (25 min.): This stage was conducted in the beginning of the workshop and started with the facilitators' and participants' brief introduction of themselves to get to know each other. Then, the problem background in relation to household water consumption and sustainable behavior change, workshop procedure, inspiration cards and other workshop materials and tasks were introduced. Later, for the following exercises teams were formed through using a random team generator tool. Four teams were created; three teams involved two team members while one team consisted of three members. Responding to the participants' emerging questions, we moved to the following stage.

Sensitizing (10 min.): In this stage, participants were asked to recall their previous personal care and hygiene experiences around the showering area and share the stages of their activities through noting down the numbers of the activity stages on the provided timeline (Figure 4.20). Even the provided list of activity stages were found quite comprehensive to describe their overall experience, some participants preferred to add new activity stages that they found related to water consumption (e.g., readjusting the temperature of water as it gets colder, soaping face, closing the bathroom window, adjusting the pressure mode of the shower head, etc.) to be able communicate their experiences in detail. Each participant conducted this stage individually which enabled them to get familiar with the activities of interest and water consumption, and warm up to the online workshop session.

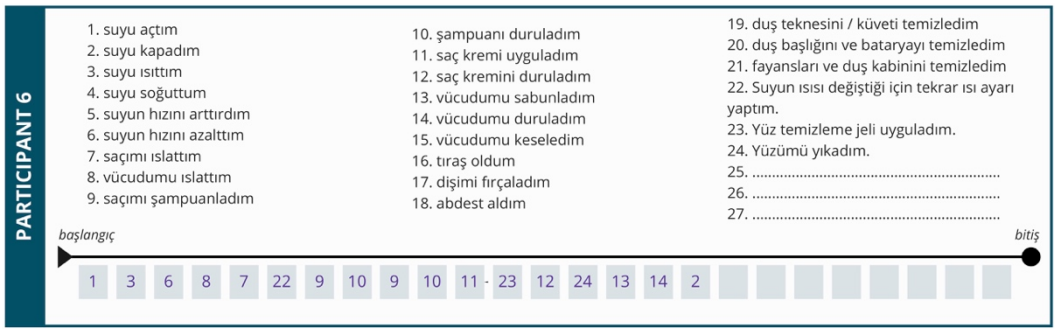


Figure 4.20: A sample filled out sensitizing canvas by Participant 6

Generating I (60 min.): As completing sensitizing stage, participants were reminded about the steps to be followed during the ideation. Then, each team was transferred to separate Zoom breakout rooms where they would work in collaboration with their teammates to generate ideas while the facilitators visited the breakout rooms for the emerging needs and questions of the teams. In this collaborative session, each team worked on their team canvases. Even though the developed team canvas enables flexible use, participants utilized the space with a quite similar approach. After selecting or generating an activity scenario, in the discussion part, each team used sticky notes to transfer the problem areas on their canvas and communicate their interpretations of the focused problem area. As framing the problem space through the selected problem areas and discussing the needs and expectations of the focused user intentions, participants started to generate initial ideas through noting them down on the sticky notes. In this process, teams tried to link the selected problem areas and inspired design strategies with the proposed ideas.

As the initial ideas were improved through the discussions with the team mates, they started to visualize them. In this stage, since the facilitators did not impose a certain method for visualizing ideas, some participants preferred digital sketching while others performed hand sketching. Throughout the diverse stages of the workshop, to motivate the participants, it has been emphasized that the quality of the sketches would not be the concern of this study. The developed ideas were labeled with the

related design strategies which they were inspired from. In this stage, four groups visualized 13 diverse ideas in total whereas some initial ideas remained on the sticky notes due to the time constraints of the workshop stage. Considering the allocated time for the exploration of the generative tool, it has been decided to extend the duration of this stage for the following DUI workshops.

Sharing and Reflecting I (50 min.): In this stage, teams present their ideation process and refined ideas in relation to the adopted inspiration cards. Each team started with the description of the activity scenario they selected. Then, they introduced the user intention they focused on and explained the rationale behind this decision. Later, the behavior, attitude, and product and system-oriented problem areas that were found significant and inspirational were shared through relating them with their choice of activity scenarios and user intentions. They stated that as discussing the problem areas, the initial ideas started to emerge which were immediately transferred on the sticky notes. Through briefly sharing these initial ideas, they explained how these were refined through the sketches (Figure 4.21). Even it was suggested to inspire from the design strategies as generating ideas, participants embraced two different approaches. Some ideas directly inspired from the blueprints provided on the design strategy cards while others associated with the design strategies after they were developed. Anyhow, it enabled us to see how various design strategies are implemented into the ideation process for developing ideas for diverse user intentions. Considering the particular aim of this stage which was to investigate how the inspiration cards are adopted in the ideation phase and how they stimulate solution areas for sustainable behavior change, facilitators addressed several questions to further probe into participants' experiences (Appendix H). During this stage, all of the participants and facilitators were present in the main Zoom room and the teams are encouraged to listen to each other's presentations to enable them to observe the different approaches adopted as generating ideas and diverse interpretations of the generative tool, which might be useful for the second round of the ideation. Since the participants shared their

ideation process and generated ideas in detail, and facilitators involved in the process with further questions, this stage took a bit longer than expected. As completing this stage, a 15 minutes break was given.

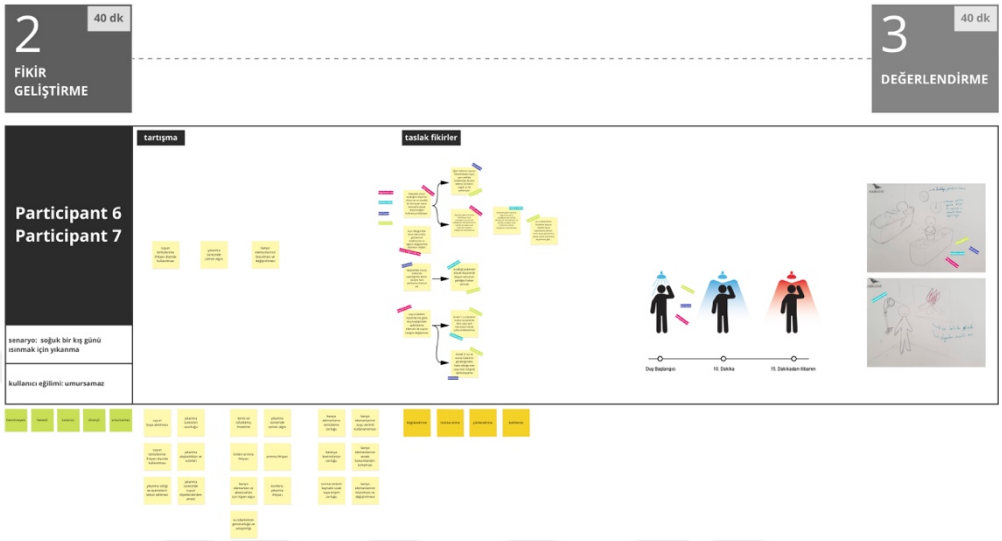


Figure 4.21: Team 3 presenting their ideas in sharing and reflecting I stage

Generating II (50 min.): In this second round of ideation, the teams were asked to target a different user intention to explore how solution areas differ in line with the individuals' diverse tendencies for adopting responsible behaviors. Through re-exploring the selected problem areas, some teams included additional behavior, attitude and product and system-oriented problem areas that they found relevant for the revised user intentions. They discussed the hypothetical needs, beliefs and behaviors of individuals to reconsider the problem area. As generating ideas and refining them targeting a diverse user intention often revealed the need to focus on diverse strategies. In total, 17 diverse ideas were visualized, and the generated ideas were labeled with the adopted design strategies. Since the participants were already familiar with the ideation process and the inspiration cards, this stage conducted smoothly, and they had the opportunity to share more time for visualizing the ideas when compared to the previous generating stage.

Sharing and Reflecting II (45 min.): As sharing their ideas, since the activity scenarios remained unchanged, participants started with the description of the altered user intentions and mentioned about the assumed needs, attitudes and expectations of the individuals possessing that intention. Then, they explained how the previously selected *problem areas were re-explored* and *introduced the newly incorporated problem areas and the reasons for their inclusion*. Describing the initial ideas on the sticky notes and how they relate these ideas with the focused problem areas and user intention, they move to describing their sketches. As they allocated more time for sketching, almost each idea was visualized. While presenting them, they first *described the proposed ideas through linking them with the design strategies they inspired from* and *explained how they would encourage sustainable behavior change* (Figure 4.22). Then, they tried to explain *how adopting a different user intention affected their ideation process*. In this process, facilitators asked questions to further clarify the adopted design strategies in relation to their choice of user intentions (Appendix H).

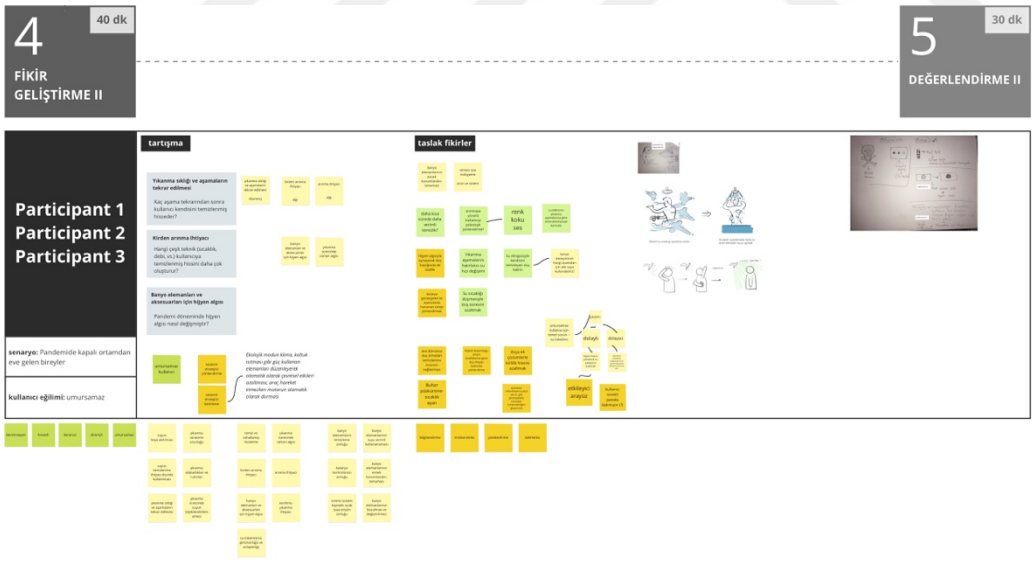


Figure 4.22: Team 1 presenting their ideas in sharing and reflecting II stage

Evaluating (60 min.): As presenting their ideas, participants shared their insight and reflections on the workshop process and the inspiration cards through discussions.

First, they were given time to transfer their insights on sticky notes and attach them under the related topics and then the discussions were held (Figure 4.23). Each participant attached several insights and suggestions and was actively involved in the discussions. The particular emphasis was on understanding *how the generative tool informed the ideation for influencing water effective use behaviors among individuals with diverse intentions* and *how the workshop process and incorporated tasks contribute to the development of ideas*. This understanding would inform the development of the workshop process and the generative tool for the following workshops. Through this stage, facilitators probed into the participants' reflections which were quite diverse and inspiring.

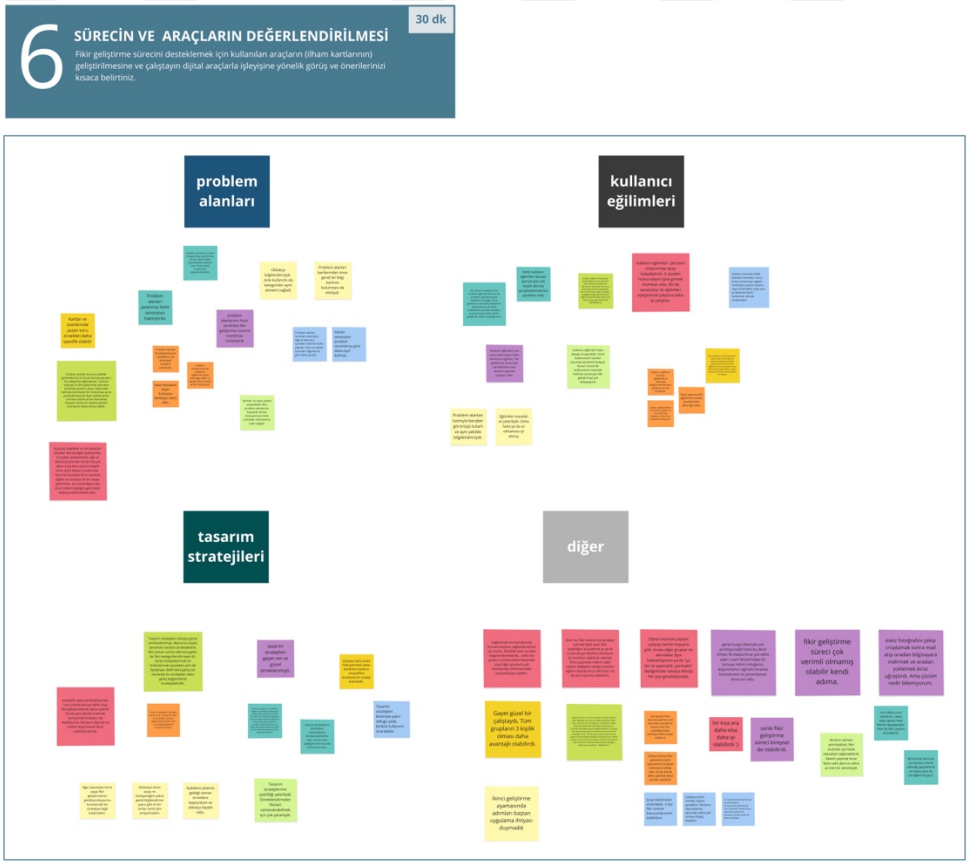


Figure 4.23: A scene from evaluating stage

This section presented how the first online DUI workshop was facilitated through explaining the workshop stages and the adoption of the workshop materials through

reflecting on them. The findings from the workshop will be discussed in the following section.

4.5.1.3 Outcomes of the DUI Workshop I

This section presents the findings from the *DUI workshop I* based on the interpretations of the generated ideas in relation to the adopted inspiration cards and the participants' insights and reflections. During the workshop, four teams developed a total of 55 initial ideas. Among these initial ideas, 30 of them were refined and presented during the sharing I and II stages. The initial ideas which were selected to be refined were not more preferable over the others, but the participants mentioned having a limited time allocated for the generating stages to further develop and visualize all of the ideas, which can be considered as one particular constraint of the workshop. Some initial ideas, on the other hand, were combined together to generate more comprehensive refined ideas. The comprehensive list of the refined ideas generated by the teams throughout the workshop session are presented in Table 4.4 through relating them with the adopted inspiration cards.

Each team focused on different activity scenarios related to the personal care and hygiene practices around the showering area. Three of the scenarios were among the provided list for inspiration, while one team selected a different scenario that they found quite significant for intensive use of water (i.e., individuals coming home after spending time indoors during the pandemic). As generating ideas with a focus on influencing behaviors for the effective use of water, the participants adopted various inspiration cards and their diverse combinations to inspire ideation. The distribution of the ideas related to the diverse inspiration cards will be presented and discussed in the below sections.

Table 4.4: The refined ideas in relation to the adopted inspiration cards for DUI Workshop I

	Behavior-oriented problem areas						Attitude-oriented problem areas							Product and system-oriented problem areas						User intentions					Design Strategies			
	running water without any purpose	using water for different purposes	performing activities frequently and repeating activity stages	ineffective scaling of water	performing activities and activity stages for long durations	performing habitual behaviors	feeling oneself clean and refreshed	need for disinfecting body and body parts	perception of hygiene for bathroom components and accessories	visibility and clarity of water consumption	perception of time	need for rinsing body and body parts	need for comfort	difficulty in controlling the tap	difficulty in cleaning bathroom components	difficulty in accessing hot water	ineffective spraying of water	difficulty in personalizing bathroom components	deterioration of bathroom components and their replacement	mindful	willing	doubtful	reluctant	unconcerned	informing	engaging	guiding	determining
Description of the Refined Ideas	**BT1**	**BT2**	**BT3**	**BT4**	**BT5**	**BT6**	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**UI1**	**UI2**	**UI3**	**UI4**	**UI5**	**DS1**	**DS2**	**DS3**	**DS4**
vibrating shower head to provide information about the duration of use and water consumption					●						●											●			●			
water bottle illustrations to visualize water consumption in a clear way and provides real-time information	●									●	●											●			●			
storing water as it warms up through an integrated reservoir and automatically repurposing it to clean the shower cabin	●								●						●	●						●					●	●
interacting with the controls through the gestures or voice command to minimize contact	●								●					●	●			●				●					●	●
providing real time information to visualize water consumption (i.e., skull for intensive use of water)			●		●					●														●	●			
enhancing the feeling of being cleaned through an interface providing instant feedback related to the activity stages			●		●		●	●			●													●	●			
providing feedback on the duration of shower through appealing to diverse senses (i.e., flashing light, warning sound)					●			●			●	●												●	●			
automatically reducing the temperature of water as the time passes to inform the users about the duration of use					●			●			●	●	●											●	●		●	●
spraying steam to the body to enable the user to feel clean as the water warms up	●		●				●	●						●		●								●				●

Table 4.4: The refined ideas in relation to the adopted inspiration cards for DUI Workshop I (continued)

	Behavior-oriented problem areas						Attitude-oriented problem areas							Product and system-oriented problem areas						User intentions					Design Strategies			
Description of the Refined Ideas	**BT1**	**BT2**	**BT3**	**BT4**	**BT5**	**BT6**	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**UI1**	**UI2**	**UI3**	**UI4**	**UI5**	**DS1**	**DS2**	**DS3**	**DS4**
learning from the user's routines and providing feedback related to the activity stages to increase awareness			●				●	●																●	●			●
demonstrating water consumption with the images that the user can relate to (i.e., cups, bottles) and warning the excessive use	●									●														●	●			
spraying alternative cleaning supplies (i.e., menthol) to the body to enable users to feel refreshed		●					●															●						●
enhancing the feeling of refreshment through shower panels or nozzles that blow air with menthol in line with the users' needs		●					●										●					●				●		●
shower cabin that scans the body and sprays water in line with the size of the body		●		●			●										●	●				●				●		●
an application that tracks, compares and set goals for water consumption behaviors to reward intended behaviors and punish unintended ones		●								●													●			●		
a shower cabin that senses pulse, fever, stress and needs of the user through the sensors to offer the most environmentally friendly showering experience	●			●			●	●					●	●			●	●					●			●	●	●
encouraging users to end the shower through informing the duration of use via changing the color of the water from blue to red		●			●					●	●		●											●	●	●	●	
informing the temperature of the environment, water and the body and automatically cooling down the water to punish long showers		●			●						●		●											●	●	●	●	●	●
conveying the feeling of being warm through appealing to different senses (sound of burning woods, the image of a wood fire) to encourage quick showers		●			●								●											●		●	●	●	●

Table 4.4: The refined ideas in relation to the adopted inspiration cards for DUI Workshop I (continued)

	Behavior-oriented problem areas						Attitude-oriented problem areas							Product and system-oriented problem areas						User intentions					Design Strategies			
Description of the Refined Ideas	**BT1**	**BT2**	**BT3**	**BT4**	**BT5**	**BT6**	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**UI1**	**UI2**	**UI3**	**UI4**	**UI5**	**DS1**	**DS2**	**DS3**	**DS4**
enabling users to repair, replace and personalize bathroom products in line with their needs and informing them about the activity process (temperature, etc.)				●														●	●		●				●	●		
informing users about their positive impacts on the environment via emotional stimulus (i.e., blooming trees, surviving animals)		●				●				●	●										●				●	●		
transparent shower system that enables users to see how the water is mixed and reached to the user to detect problems (i.e., calcification)		●				●				●									●		●				●	●		
circulating hot water within the shower seat to warm up the user without wasting water		●											●								●							
decreasing the flow rate of water as the movements of the user are slowed down to encourage quick showers				●	●						●		●									●				●	●	
automatically turning off the tap as users step forward from the shower head and turning it on as they stand underneath the shower head	●			●										●								●				●	●	
shrinking the area of water flowing from the shower head to punish long showers				●	●					●	●	●										●				●	●	
providing them real-time feedback about the water bill through a meter installed in the showering area to motivate users consume less water to turn save money						●				●														●	●	●		
enabling water to flow for a certain period of time and deliver a certain amount of water as the user activates the shower head				●		●											●							●			●	
informing water consumption through images that would appeal to users' emotions (i.e., visualizing water consumption as if it were running out of a fish's tank)					●					●														●	●	●		
rewarding behaviors for effective use of water with monetary incentives like tokens that can be collected and used for shopping						●				●														●		●		

User Intentions for DUI Workshop I

During the generating stages, the teams selected all four user intentions except the *mindful* ones. The main reason for not focusing on the mindful user intention was explained as these individuals are already adopting sustainable behaviors, and there is no need for a design intervention to change their behaviors, yet, they might be encouraged to maintain their existing behaviors. Hence, they focused *on willing, doubtful, reluctant* and *unconcerned* user intentions that are found more stimulating. The distribution of the refined ideas in relation to the adopted user intentions across the teams is presented in Table 4.5.

Table 4.5: Distribution of the refined ideas in relation to the adopted user intentions across the teams

	mindful	**willing**	**doubtful**	**reluctant**	**unconcerned**
Team 1			4		7
Team 2			3	2	
Team 3		4			3
Team 4			3		4
Total number of refined ideas	**0**	**4**	**10**	**2**	**14**

As selecting user intentions, participants adopted diverse approaches. Some teams were inspired by the activity scenarios they focused on as well as their current experiences or their observations of other people's behaviors. For example, Team 1 selected *doubtful* user in the first round of ideation, inspired by the contradictions they experienced related to water consumption during the pandemic. In the second round, they selected *unconcerned* user, considering it as a challenging category to influence sustainable behaviors.

As switching user intentions during the generating stages, some teams tried to focus on user intentions from the diverse ends of the spectrum in terms of their intention or resistance to alter their behaviors. Team 3, for instance, first targeted *unconcerned* users and then *willing* users, believing that this diversity would enable them to

explore the needs and attitudes of relatively diverse users and in turn enrich the variety of ideas. On the other hand, other teams focused on the individuals with lower intention to alter their behaviors, thinking that they would be more inspirational to generate diverse ideas to encourage sustainable behaviors.

Behavior-Oriented Problem Areas for DUI Workshop I

Throughout the workshop session, teams make use of various *behavior-oriented problem areas* to understand and elaborate on the problem area. Since teams focused on a different user intention when they moved to the second generating stage, they often selected diverse behavior cards that they found more relevant. This enabled the teams to explore various behavior patterns responsible for intensive water use and generate diverse ideas specific to each behavior pattern. Table 4.6 presents the distribution of the refined ideas across diverse teams and generating stages through relating them with the behavior-oriented problem areas that they are associated with.

Table 4.6: Distribution of the refined ideas in relation to the adopted behavior-oriented problem areas across the teams

	Team 1		Team 2		Team 3		Team 4		Total number of ideas
Behavior-oriented problem areas	**G1**	**G2**	**G1**	**G2**	**G1**	**G2**	**G1**	**G2**	
running water without any purpose	3	2		1			1		**7**
using water for different purposes			3	1	4	3			**11**
performing activities frequently and repeating activity stages		3							**3**
ineffective scaling of water			1	1		1	3	1	**7**
performing activities and activity stages for long durations	1	4			4		2	1	**12**
performing habitual behaviors						2		3	**5**

Participants linked some ideas with more than one card. For instance, Team 1 discussed that unconcerned users would often let the water run water as it warms up *(running water without any purpose)* since they are not worried about the wasted water. To feel themselves clean, they also believed to repeat certain stages

unnecessarily *(performing activities frequently and repeating activity stages).* Combining diverse cards supported the team to realize diverse behavior patterns of the selected user category and guided them to solve various problems through influencing sustainable behaviors. Based upon these concerns, Team 1 generated an idea which sprays steam to the body as the water warms up to use water responsibly and prevent repeating activity stages through enhancing the feeling of being clean with the steam (Figure 4.24).

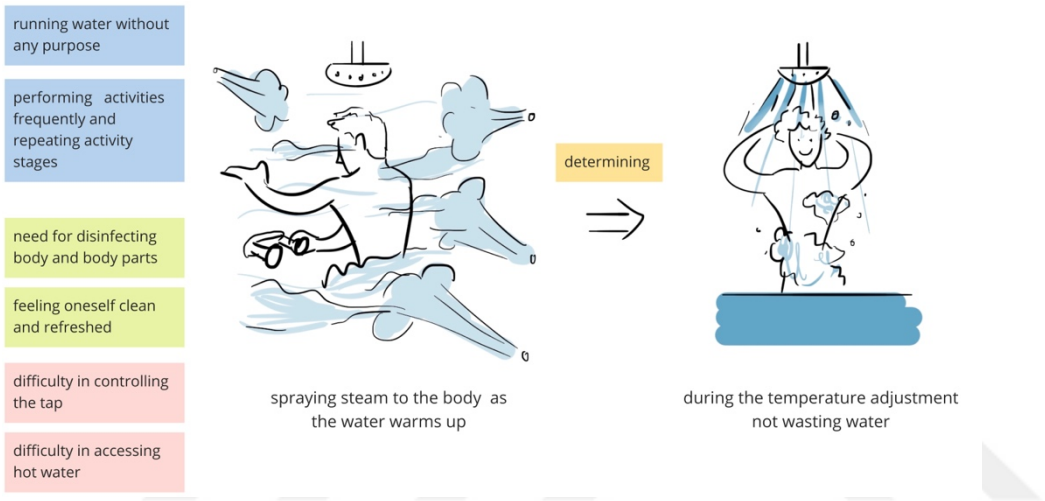


Figure 4.24: A scene from the Team 1's generating II stage demonstrating an idea incorporating diverse behavior-oriented problem areas (reproduced in English)

During the generating stages, even each behavior-oriented problem area has been experienced by the teams, *using water for different purposes* and *performing activities and activity stages for long durations* inspired the generation of more ideas. The activity scenarios selected by the teams (i.e., *showering to warm up on a cold winter day* and *showering to freshen up before going out)* were also effective in highlighting these two cards as they were directly referring to these behavior patterns for intensive use of water.

Attitude-Oriented Problem Areas

As generating ideas, teams utilized a variety of *attitude-oriented problem areas* to understand the attitudinal factors responsible for adopting behaviors associated with

intensive use of water. The teams focused on diverse cards in line with the activity scenarios, user intentions and the behavior and product and system-oriented problem areas that they selected. Different cards were often combined to diversify and clarify the problems. For instance, in Team 3's ideation session, unconcerned users' were assumed to take showers for long durations *(performing activities and activity stages for long durations)* simply to keep their body warm *(using water for different purposes)*. Since they have quite low awareness about the implications of their behaviors *(visibility and clarity of water consumption),* they often care for their comfort rather than the environment *(need for comfort)*. Their lack of concern about the amount of water they waste leads them to lose track of time while performing activities *(perception of time)*. Framing the problem space through linking the diverse inspiration cards, Team 3 proposed an idea which informs the duration of use via changing the color of water from blue to red to encourage unconcerned users to end the showering activity (Figure 4.25). This exemplary ideation process suggests that creating relations between the inspiration cards supported participants to incorporate different perspectives into the problem area and inspire design solutions.

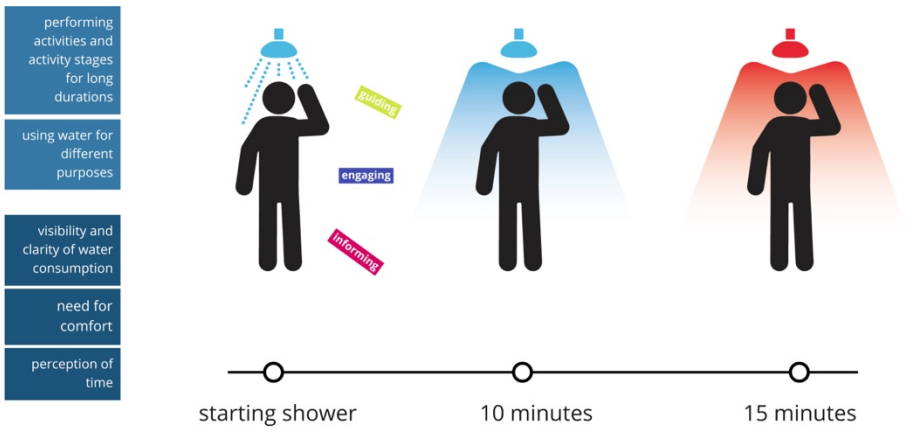


Figure 4.25: A scene from the Team 3's generating I stage demonstrating an idea incorporating diverse attitude-oriented problem areas (reproduced in English)

Similar to the previous card deck, during the second generating phase, the teams often preferred to utilize diverse attitude cards that they found more relevant to the

targeted user intentions. The teams stated that they used the attitude-oriented problem areas more effectively to explore the problem area when compared to the product and system-oriented ones. Within the card deck, *visibility and clarity of water consumption* and *perception of time* contribute to the development of more ideas which is followed by *feeling oneself clean and refreshed, need for comfort,* and *need for disinfecting body and body parts* (Table 4.7).

Table 4.7: Distribution of the refined ideas in relation to the adopted attitude-oriented problem areas across the teams

Attitude-oriented problem areas	Team 1		Team 2		Team 3		Team 4		Total number of ideas
	G1	G2	G1	G2	G1	G2	G1	G2	
feeling oneself clean and refreshed		3	3	1					**7**
need for disinfecting body and body parts		5		1					**6**
perception of hygiene for bathroom components	2								**2**
visibility and clarity of water consumption	1	2		1	1	2	1	3	**11**
perception of time	2	3			2	1	2		**10**
need for rinsing body and body parts		2					1		**3**
need for comfort		1		1	3	1	1		**7**

Product and System-Oriented Problem Areas

During the generating stages, diverse product and system-oriented problem areas were adopted by the participants to explore and elaborate on the contextual factors affecting individuals to perform behaviors responsible for intensive use of water. Teams' choice of activity scenarios, user intentions, and the behavior and attitude-oriented problem areas were mentioned to be effective for the selection of these cards. For instance, Team 1, who focused on doubtful individuals coming home after spending time indoors during the pandemic scenario, determined *running water without any purpose* as a significant behavior pattern for the intensive use of water particularly because of their hesitation to touch the controls during the activity stages. The team linked this behavior pattern with the attitude-oriented problem area

perception of hygiene for bathroom components, assuming that within the given scenario they would be doubtful about the hygiene of the controls and would probably prefer alternative ways for interacting. In relation to the previously mentioned inspiration cards, the team members considered the *difficulty in controlling the tap, difficulty in cleaning bathroom components,* and *difficulty in personalizing bathroom components* as potential contextual problems for intensive use of water. Participants combined different cards to diversify and clarify the problem area and came up with an idea minimizing contact while interacting with the controls (i.e., gestural or voice-based interaction for controlling water) (Figure 4.26).

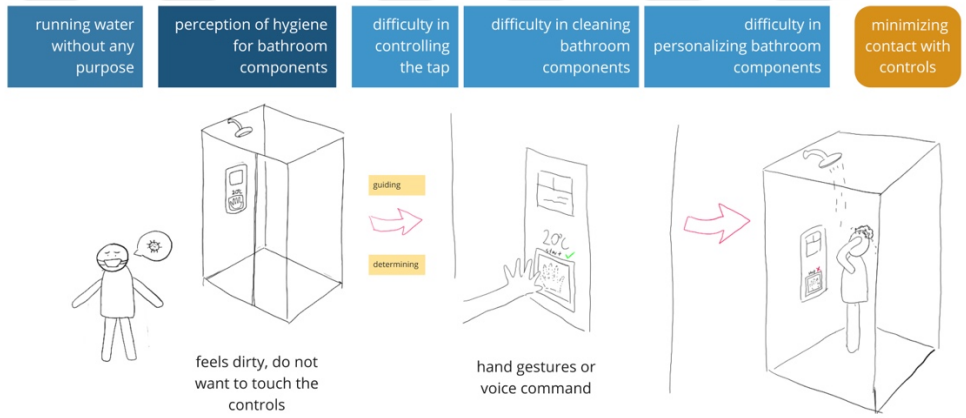


Figure 4.26: A scene from the Team 1's generating I stage demonstrating an idea incorporating diverse product and system-oriented problem areas (reproduced in English)

As generating ideas, the participants stated that the product and system-oriented problem areas inspired the generation of ideas particularly focusing on the interactions between the user and the product rather than the ideas for reconstructing existing behaviors. For this card deck, it can be inferred that each problem area was utilized quite evenly which is demonstrated through Table 4.8.

Table 4.8: Distribution of the refined ideas in relation to the adopted product and system-oriented problem areas across the teams

Product and system-oriented problem areas	Team 1		Team 2		Team 3		Team 4		Total number of ideas
	G1	G2	G1	G2	G1	G2	G1	G2	
difficulty in controlling the tap	1	1		1			1		**4**
difficulty in cleaning bathroom components	2								**2**
difficulty in accessing hot water	1	1							**2**
ineffective spraying of water			2	1				1	**4**
difficulty in personalizing bathroom components	1		1	1		1			**4**
deterioration of bathroom components and their replacement						2		1	**3**

Design Strategies

As integrating the design strategies into the generating stages, the teams utilized the cards either individually or through combining them with each other to enhance their effectiveness. Their choice of user intention is mentioned to be effective as deciding upon the design strategies to influence sustainable behaviors. Considering this, the distribution of the refined ideas is presented below in relation to the design strategies and targeted user intentions (Table 4.9).

Table 4.9: The distribution of the refined ideas in relation to the design strategies and user intentions

Design strategies	User Intentions					Total number of ideas
	mindful	willing	doubtful	reluctant	unconcerned	
informing		3	2		10	**15**
engaging		3	5	2	6	**16**
guiding			5	1	5	**11**
determining			5	1	5	**11**

During the workshop, teams had an opportunity to make use of all of the design strategies as generating ideas. Yet, there had been differences among diverse user intentions as adopting design strategies. For instance, as generating ideas for the unconcerned users, teams adopted diverse approaches. Considering their level of intention for adopting change and low concern for environmental problems, Team 1 often used *determining or informing* strategies individually through which water is either automatically used responsibly or the users are informed about the consequences of their behaviors. Team 3, on the other hand, utilized diverse combinations of *informing, engaging* and *guiding* strategies into their ideas suggesting that these would be effective to increase the unconcerned users' awareness and motivate them to pursue intended behaviors. Realizing that imposing a certain behavior to the unconcerned users might be perceived negatively and create a rebound effect, Team 4 also utilized different combinations of all four design strategies. For the doubtful users, the teams mentioned that they initially thought that *guiding* them through affordances and constraints would be more effective, yet the generated ideas were often associated with *determining* and *engaging* strategies as well as the *guiding*. Since these users are already aware of the environmental problems, a limited number of ideas were associated with the *informing* strategy. Considering the overall eagerness of the willing users to alter their behaviors, rather than the strategies where the products are in control, *informing* and *engaging* strategies were preferred to increase their awareness and empower them to adopt responsible behaviors. Since there had been a limited number of ideas developed for *reluctant* users, it is difficult to talk about a tendency over a certain design strategy.

As for the integration of the design strategies for the development of ideas, even teams adopted various approaches, *informing-engaging*, *guiding-determining* and *engaging-guiding-determining* were the most common combinations among the generated ideas. Team members mentioned that as generating ideas they often preferred to make use of more than one design strategy to provide users with various incentives to ensure behavior change.

4.5.1.4 Participants' Evaluations of the Generative Tool and the Workshop Process

Through the *evaluating* stage of the workshop, the participants shared their insights and experiences about the adopted generative tool and the workshop process individually. They also shared their suggestions to inform the further development of the DUI workshop. Below, the interpretation of the participants' evaluations will be shared in relation to the inspiration cards *(see Section 4.4 Data Analysis)* by highlighting the contributions and limitations of the workshop procedure and the generative tool, and participants' suggestions for their further development.

Problem areas *(behavior, attitude and product and system-oriented)* cards were found informative to understand and explore the existing problems in relation to the intensive use of water. The distinctions between categories were stated to be clear, while the names of the themes were self-explanatory, and their definitions were quite clear. The colors of the cards were also found effective as separating each category. Integrating the cards into the ideation process was considered as easy and triggering for brainstorming. The variety of the cards was mentioned to support the teams to incorporate diverse issues as exploring the problem area. However, one difficulty experienced was about *relating inspiration cards* with each other. Some participants considered the attitude-oriented problem areas more relevant to the user intentions and behavior-oriented problem areas that they focused on when compared to the product and system-oriented ones. Even integrating cards from all three categories was found challenging, they utilized each card throughout the ideation.

Since the *definitions of the cards were quite comprehensive*, it took a great deal of time to explore the card deck. Besides, their adoption is mentioned to accelerate the idea development process through enabling teams to familiarize themselves with the problem area quite effectively and inspire various solution areas. One other suggestion for the further development of the cards was related to including more *specific questions to inspire ideation*. However, since adopting such an approach

would guide the users as generating ideas, the content of the questions remained the same along with minor revisions for the second DUI workshop.

User intentions cards were similarly found informative to get familiar with the diverse users and understand their attitudes, concerns and beliefs towards adopting responsible behaviors. Inspiring from the user intentions, participants stated that they effectively created a scenario, empathized with the users and developed potential solution areas. For the definitions of the cards, it was suggested to incorporate other factors that were influential for the overall tendencies of users including their socio-economic and demographic differences. However, since the user research findings from the previous step of this doctoral study did not reveal such a cluster, it would not be possible to include these variables in the definitions. *The distinction between the user intentions* was mentioned to be clear to understand their level of willingness for adopting responsible behaviors and found visually consistent with the other cards. Nevertheless, a scale demonstrating the individuals' eagerness or resistance to alter their behaviors is decided to be incorporated into the cards for further clarification. The names of the user intentions were stated to be self-explanatory which might be the strength as well as the limitation of the cards. One may refuse to read through the definitions and assume the tendencies of users by themselves, which may result in the misinterpretation of the cards.

Switching user intentions in the second round of ideation was found triggering for generating ideas and for increasing the diversity of ideas. One suggestion was related to the adoption of the user intention cards. It was suggested to provide the participant with the flexibility to combine different user intentions as generating ideas since one user may adopt diverse intentions for the diverse stages of the same activity scenario. Even it is quite possible for the users to possess diverse intentions for water consumption during the different stages of the activities, considering the particular approach of the DUI workshops which is to explore the needs and preferences of individuals with a specific tendency towards adopting responsible behaviors, and

generate ideas aiming to stimulate change among those to enhance the acceptability of ideas, this suggestion was not implemented in the second DUI workshop.

One particular difficulty experienced in relation to the implementation of the user intention cards was related to the *mindful users*. Since these users are already performing responsible behaviors, participants often hesitated to select them. Instead, they mainly focused on the users with lower intentions towards adopting change. Overall, integrating diverse user intentions into the ideation was stated to enable participants to look at the problem area from a different angle, to include the needs and expectations of diverse users, and to enrich the diversity of ideas.

Design strategies, along with the examples for their implementation, were stated to be helpful in generating ideas. Since the design strategies were found complementary to each other, participants mentioned to often combine at least two strategies during ideation. This is believed to enable generating ideas that have more potential for the users to alter their behaviors towards intended directions through offering diverse incentives within the same idea. However, since there was no clear instruction about *the number of strategies* to be adopted, participants mentioned to hesitate as combining them. Considering that, for the second DUI workshop integrating different combinations of design strategies was decided to be encouraged.

Participants mentioned to sometimes feel obligated to select among the provided design strategies and they proposed to incorporate *an empty strategy card* to be filled by the participants. Supporting participants to explore new techniques during the ideation phase might have led to extending the scope of the strategies or proposing an entirely different strategy to stimulate change. Even the card set did not provide such flexibility, diverse techniques adopted by the participants to stimulate change contributed to the development of the design strategies cards during the analysis process. Based on the participants' reflections as describing their ideas in relation to the design strategies, *engaging strategy* was decided to be divided into two (i.e., engaging and motivating) to be adopted in the second DUI workshop. Even

participants mentioned to be somehow familiar with some of the design strategies; the card deck was proposed to be quite useful for non-designers as well. In general, it can be inferred that the design strategies, enabled participants to follow a certain path as developing ideas and inspired them with the potential techniques for stimulating change.

Workshop process was stated to be productive considering the flow of the workshop stages, integrated tasks and tools, group discussions, generated ideas, and the acquired knowledge. As the workshop stages took longer than expected, a flexible approach was adopted, and the duration of the tasks was extended. Yet, the participants mentioned that they would prefer to have more time, particularly for the generating stages, to better refine and visualize their ideas. To develop various and more detailed ideas, it was also suggested to facilitate the workshop throughout two diverse days. Considering these insights, allocated time for the stages was decided to be extended for the second DUI workshop, particularly for the generating I stage where participants engaged with the inspiration cards for the first time and had quite limited time for generating ideas.

Sensitizing phase, through which the participants recalled and documented the stages of their activities, was conducted in the beginning of the workshop as a warm-up task and stated to be very useful to get familiar with the activities of interest and water consumption. However, no further discussions were held related to this task during the workshop session. In that sense, this exercise was decided to be sent to the participants beforehand and asked to be conducted prior to the workshop session both to enable them to explore their activities in the context and also allocate more time for the other tasks during the online workshop session.

The workshop stages and the expectations from the participants were mentioned to be clearly defined. *Facilitating the workshops online* was believed to ease this, since throughout the diverse stages of the workshop it was possible to go back to the

workshop canvas and review the aim and objectives of the workshop stages as well as to check other teams' canvases to see and compare their processes.

One of the limitations of the online workshop was revealed to be the *collaborative sketching*. Even though, it is possible to visualize ideas collaboratively in a physical environment through adding on each other's sketches, they had to carry out the visualization task individually in an online context. Considering the time constraints, working with the same team was found effective; however, two of the participants suggested to mix groups for the second round of ideation to enhance the diversity of ideas and incorporate diverse perspectives into ideation. This suggestion was also determined to be adopted in the second DUI workshop to transfer the different understandings and techniques of the participants into diverse teams. Apart from *switching team members* in the generating stage II, it was also suggested to alter the activity scenarios to be able to focus on diverse problems and create diverse ideas. However, since the particular aim was to see how ideas diversify in line with the users' intentions, this suggestion was not adopted in the following workshop session.

4.5.1.5 Reflections on the Workshop I and Adaptation of the Generative Tool

The analysis of the workshop outcomes revealed several opportunities of the proposed inspiration cards for developing design solutions to influence behaviors for the effective use of water. Their integration into the ideation process enabled participants to (i) explore and elaborate on the problem area and the users' needs and expectations, (ii) identify and generate solution areas, (iii) refine and visualize the generated ideas, (iv) reconsider the ideas for different user intentions, and (v) support the ideas' relevance for sustainable behavior change through sharing ideas in relation to the adopted cards. The contributions of the inspiration cards for the development of ideas for behavior change will be discussed later in detail considering the

outcomes of the three design workshop sessions *(see Section 4.6 Conclusions for the DUI Workshops).*

To enhance the impacts of the inspiration cards, the participants adopted diverse approaches and utilized the tools individually or combined them with each other. Throughout the workshop, as a researcher, I along with the co-facilitators, guided the discussions and the workshop stages and addressed questions to the participants for further clarifications. However, as they generate ideas, we did not intervene in their ideation process in order not to steer them or affect how they adopt the generative tool. Instead, we visited Zoom breakout rooms to simply respond to their emerging questions. Even though the participants did not experience any significant difficulties in engaging with the generative tool or in relation to the workshop process, they had several suggestions for their further development. Based on the evaluations of the participants' and facilitators' own reflections, several changes related to the workshop process and the generative tools were decided to be made for the following workshop. Since the revisions on the generative tool *(see Section 4.2.2 Revising Inspiration Cards for the DUI Workshop II)* and the workshop process *(see Section 4.3 Workshop Procedure)* were mentioned in the previous sections; their short descriptions will be listed below.

Changes for the workshop materials:

- Categorization of the problem areas cards will be renamed (i.e., behavior types, attitudinal determinants of behaviors, and contextual determinants of behaviors),
- The engaging design strategy will be further divided into two (i.e., engaging and motivating),
- A scale demonstrating the users' intention or resistance to behavior change will be included in the user intentions cards,

- All of the workshop materials (i.e., the generative tool, workshop canvas, team canvas, workshop procedure and guideline) will be translated into English, and graphically enhanced,
- Workshop brief will be developed to be distributed prior to the workshop session.

Changes for the workshop process:

- Prior to the second round of ideation, teams will switch members to share their diverse perspectives and experiences with each other,
- The sensitizing stage will be carried out prior to the workshop, and a visualization task will be included to enable participants to consider how their behaviors are responsible for water consumption,
- The allocated time for workshop stages will be extended.

The following section will describe the DUI workshop II facilitation in detail through highlighting the reflections on the process and inspiration cards, present the findings from the study through discussing the potentials and limitations of the inspiration cards and the workshop process.

4.5.2 DUI Workshop II

The second online DUI workshop was integrated into a graduate course, ID 728 Generative Design Research for Sustainability, conducted by Prof. Dr. Çağla Doğan and Assist. Prof. Dr. Senem Turhan in the Department of Industrial Design at METU. In line with the constraints of the course hours, the DUI workshop II was conducted in two parts; first part on December 2, 2020 and the second part one December 9, 2020. The workshop was carried out in English. The particular aim of the workshop was to investigate the implications of the inspiration cards on the development of ideas for influencing effective use of water as performing personal care and hygiene

practices around the washbasin area (i.e., washing hands, washing face, brushing teeth, washing hair, and washing feet). This section will share the details about the sample, workshop procedure, outcomes of the workshop and reflections on the workshop process and the revised inspiration cards.

4.5.2.1 Participants and Online Workshop Environment

The graduate students from the Department of Industrial Design at METU who enrolled in the ID 728 Generative Design Research for Sustainability course were the participants of the workshop. 8 students participated in the workshop, yet one of the participants had to leave during the generating II stage due to health issues and rejoined during the evaluating stage. Consequently, the second round of ideation was conducted with 7 participants.

As conducting the session, similarly, Zoom and Miro were utilized for video conferencing and collaborative activities. The workshop was carried out with two co-facilitators Prof. Dr. Çağla Doğan and Assist. Prof. Dr. Senem Turhan. The session took around five and a half hours; the first part was completed in three hours while the second part took two and a half hours.

It should be noted that the participation in the workshop and the workshop outcomes were not graded by the course tutors. Within the context of the graduate course, students were expected to adapt the DUI workshop including the workshop procedure and the generative tool in line with their research areas (i.e., food waste, repairing and repurposing). In that sense, the DUI workshop method was used as a teaching material and participating in the workshop had several learning outcomes for the students. For instance, they experienced and observed the workshop procedure and materials, how it was facilitated and how the developed tool and tasks were adopted. Their insights and suggestions on the development of the generative tool also inspired them to develop their own generative tool for the following stages of the course.

4.5.2.2 Facilitating the DUI Workshop II

During the DUI workshop II, similar to the previous session seven successive stages were followed; *sensitizing, introducing, generating I, sharing and reflecting I, generating II, sharing and reflecting II* and *evaluating* (Figure 4.27). The details about the workshop process and adopted tools will be shared through emphasizing the changes and discussing their contributions and limitations.

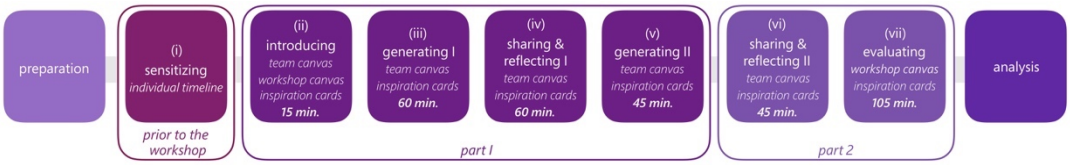


Figure 4.27: DUI workshop II stages and incorporated tools and tasks

Sensitizing: Considering the variety of activities of interest, this stage was conducted prior to the online workshop session. As sharing the Sensitizing Miro board with the participants, they were asked to imagine an activity scenario in which they perform the focused activities. In the selected scenarios, they may either perform the activities of interest separately or combine them (e.g., brushing teeth and washing face to get ready for the bed). Then, through recalling the activity stages, their behaviors and interactions with the products in the selected scenario, they were similarly asked to record their experiences on the provided timeline through noting down the numbers of the activity stages provided in the list. To better document their experiences, participants added several activity stages that are relevant to water consumption (e.g., collecting water in a bucket, rubbing wrist and lower arm with soap, rinsing face and razor after two to three shaving strikes). As recording the activity stages, they were also required to think about how water consumption changes throughout these stages and to visualize these changes through using lines, graphs, curves or colors to express their understandings (Figure 4.28). In this task, each participant drew a graph to communicate their perception while one participant supported the graph with a text

describing his/her understanding about water use. This warm up exercise was conducted individually and enabled them to familiarize with the workshop topic through considering their behaviors and perceptions about water consumption.



Figure 4.28: A sample filled out sensitizing canvas by Participant 5

Introducing (15 min.): In DUI workshop II, introducing stage was carried out in two phases. In the initial phase, as sharing the Sensitizing Miro board, *a project brief* was emailed to the participants that involves the problem background, aim of the workshop and the workshop procedure (Appendix G). On the day of the workshop, the procedure was reminded through explaining the details of each stage, and the inspirations cards were introduced. Lack of tangible interaction with the materials was one of the main constraints of the online workshops. Considering that, to enable participants to engage with the inspiration cards more effectively and explore their details, the generative tool was emailed to the participants. As introducing the workshop process and materials, teams were formed randomly. Four teams were generated involving two participants.

Generating I (60 min.): As forming groups, each team was assigned to separate Zoom breakout rooms to work on their team canvases with their pairs. The revised team canvas included the *ideation steps* that are expected to be followed by the participants which are *identifying an activity scenario, selecting behavior types and attitudinal and contextual determinants, defining a user intention* and *utilizing design strategies for generating ideas*. Teams first determined an activity scenario in relation to the personal care and hygiene activities around washbasin. Then, they selected a variety of behavior types and attitudinal and contextual determinants to specify the problem area. As selecting behavior types, teams simultaneously defined the user intention, since they stated that these two were closely related to each other. Some teams preferred to define the user intention first, and then selected the other inspiration cards. Through detailing the problem area in relation to the targeted user intention and the activity scenario, teams started to generate initial ideas. In this process, they inspired from several design strategies. As elaborating on the initial ideas through discussions, they started to visualize them. Since each participant had previously engaged with the Miro and its features, they all used Miro pen tool for sketching their ideas which eliminated the time and effort for uploading images on the board. The teams refined 14 diverse ideas in total. Based upon the participants' request, allocated time for this stage was extended during the session. This enabled participants to have enough time to explore the generative tool and develop ideas for the effective use of water.

Sharing & Reflecting I (60 min.): In this stage, as describing the generated ideas, teams were expected to respond to several issues including the *implications of the generated ideas in terms of sustainable behavior change, description of the selected inspiration cards, the reasons behind the adoption of these cards and how they informed the ideation*. Rather than interrupting the participants' presentation and addressing similar questions to each team, these questions were included on the right side of the team canvas to guide the flow of the discussions (Figure 4.29). As sharing ideas, each team described the activity scenario, adopted inspiration cards and

generated ideas through responding the provided questions. The structured presentations enabled to conduct this workshop stage within the allocated time.

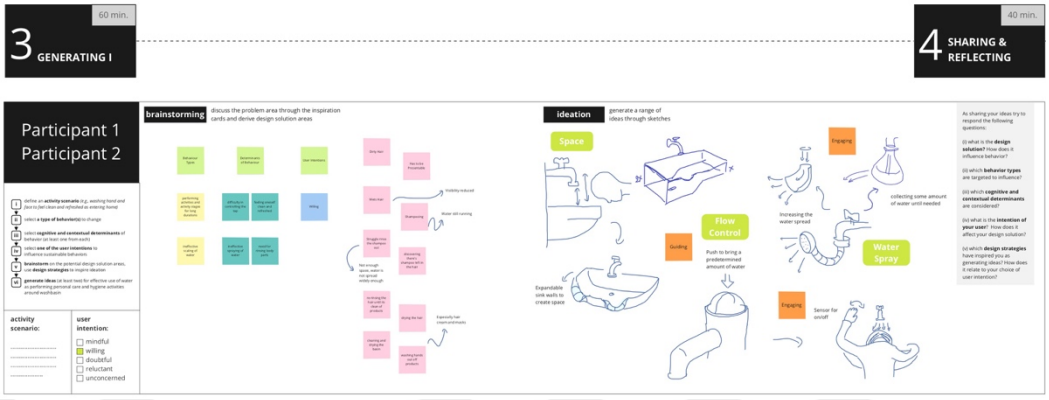


Figure 4.29: Team 1 presenting their ideas in sharing and reflecting I stage

Generating II (45 min.): In the second round of the ideation*, participants switched teams* to share their diverse experiences, knowledge and interpretation of the inspiration cards with the other team members. However, one participant had to leave the workshop session whose team mate joined another team as the third team member. In this stage, teams were expected to explore design solutions for the effective use of water through focusing on a different user intention. As designing for a different user intention, the activity scenario remained unchanged except for one team who further specify their scenario for kids. Then, each team re-explored the behavior types and determinants of behaviors and included several more cards that they found relevant for the targeted user intentions while omitting the ones appeared to be insignificant. Then, through revisiting the problem area, they started to generate ideas which were further developed and visualized. Through this stage, 12 diverse ideas were developed which were labeled with the design strategies they adopted. Considering the time constraints of the graduate course, the first part of the DUI workshop II was completed at the end of this stage.

Sharing & Reflecting II (45 min.): Participants shared their ideas during the second part of the workshop session which was conducted the following week. To enable participants to recall their ideas and ideation process, each team was given 15

minutes to review their team canvases. Later, we met in the main Zoom room, where each team shared their ideas and ideation process trough relating them with the incorporated inspiration cards (Figure 4.30). During presentations, they tried to respond the provided questions on the team canvas. The particular emphasis was on the focused user intention and its effects on the ideation process. After each team's presentation, facilitators addressed several questions for further clarification (Appendix H).

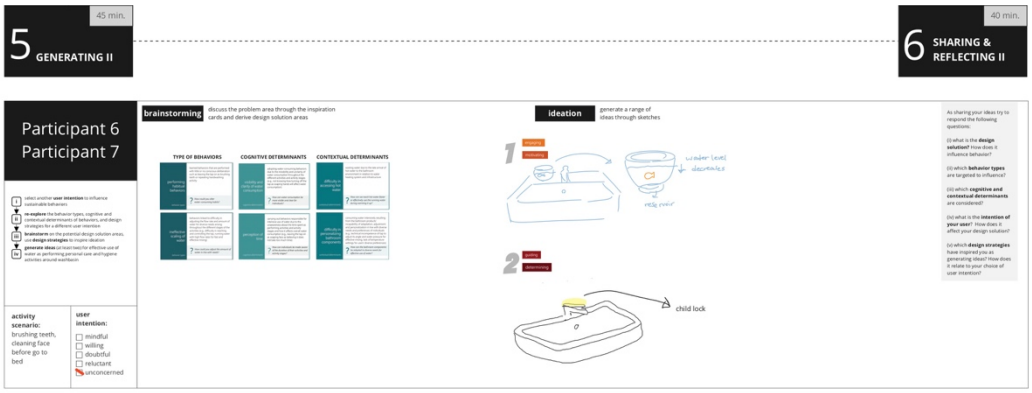


Figure 4.30: Team 2 presenting their ideas in sharing and reflecting II stage

Evaluating (105 min.): In this stage, participants were given time to think about their reflections on the workshop process and the inspiration cards, and suggestions for their further development. They were asked to transfer their insights on sticky notes and attached them under the related topics (i.e., behavior types and determinants of behavior, user intentions, design strategies, workshop process and other). It has been emphasized that their contribution would be valuable for the improvement of the generative method to encourage their involvement. While noting down their insights, they simultaneously shared them (Figure 4.31). A variety of insights and inspirational suggestions were received through immersive and collaborative discussions.

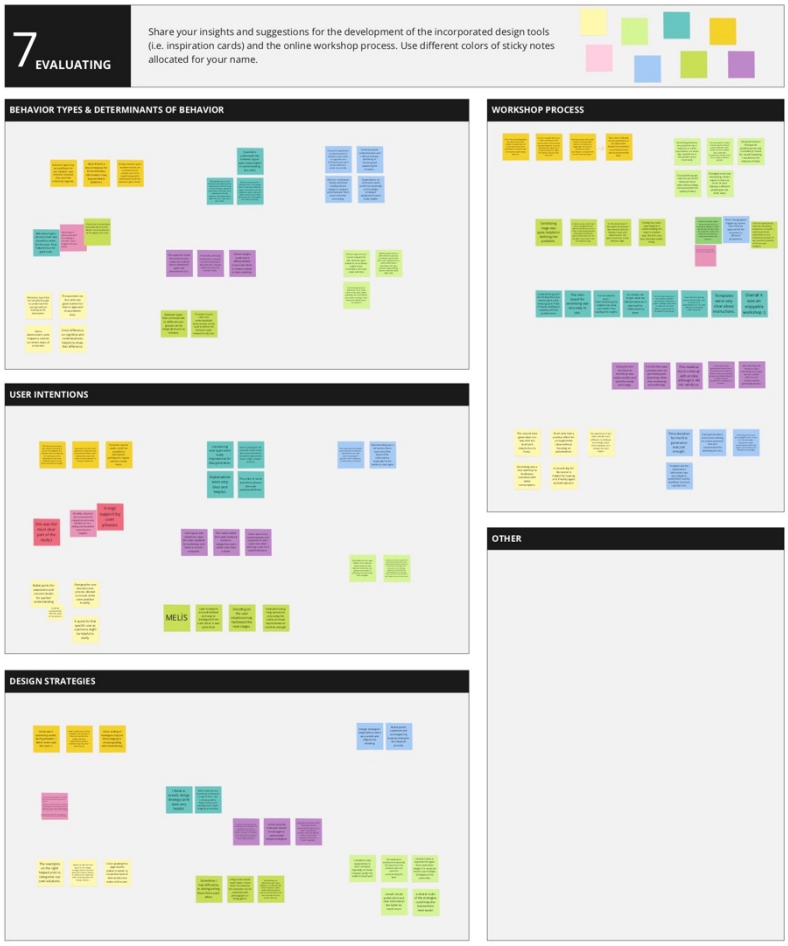


Figure 4.31: A scene from the evaluating stage

In this section, the facilitation of the online DUI workshop II, its stages and adopted tools were shared through highlighting the conducted revisions and their implications. Following sections will share the findings from the study through discussing its limitations.

4.5.2.3 Outcomes of the DUI Workshop II

Through the DUI workshop II, teams generated 24 initial ideas focusing on the effective use of water around the washbasin area. As participants refining their ideas, they often combined several initial ideas for more detailed solutions. Besides, it was also observed that a single initial idea inspired more than one refined idea through

the integration of different design strategies. Through the generating stages, 26 refined ideas were developed and presented during the sharing stages. Since the duration of generating stages was extended in this workshop session, participants had a chance to further explore all the initial ideas that they have developed. Table 4.10 presents the refined ideas throughout the workshop session in relation to the inspiration cards adopted by the teams.

In this workshop session, teams focused on diverse activities and activity scenarios (e.g., washing hair in the sink, brushing teeth and cleaning face before going to bed, etc.), which enabled them to explore and address diverse problems related to personal care and hygiene practices around the washbasin area. Below sections will present the findings form the workshop session through discussing the distribution of ideas in relation to the adopted inspiration cards.

Table 4.10: The refined ideas in relation to the adopted the inspiration cards for DUI Workshop II

	Behavior types					Attitudinal determinants of behaviors							Contextual determinants of behaviors						User intentions					Design Strategies				
	running water without any purpose	performing activities frequently and repeating activity stages	ineffective scaling of water	performing activities and activity stages for long durations	performing habitual behaviors	feeling oneself clean and refreshed	need for disinfecting body and body parts	perception of hygiene for bathroom components and accessories	visibility and clarity of water consumption	perception of time	need for rinsing body and body parts	need for comfort	difficulty in controlling the tap	difficulty in cleaning bathroom components	difficulty in accessing hot water	ineffective spraying of water	difficulty in personalizing bathroom components	deterioration of bathroom components and their replacement	mindful	willing	doubtful	reluctant	unconcerned	informing	engaging	motivating	guiding	determining
Description of the Refined Ideas	**BT1**	**BT2**	**BT3**	**BT4**	**BT5**	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**UI1**	**UI2**	**UI3**	**UI4**	**UI5**	**DS1**	**DS2**	**DS3**	**DS4**	**DS5**
a washbasin with a deeper section to place the head for easily washing hair			●	●		●					●		●							●							●	
flexible walls on the two sides of a the washbasin to create space for placing arms and neck while washing hair			●	●		●					●		●				●			●					●		●	
a push button to control the water that allows a predetermined amount of water to flow and minimizes the contact with the tap through stopping it automatically			●								●	●	●							●							●	●
interacting with the tap through hand gestures to eliminate physical interaction and allowing a predetermined amount of water to flow	●		●								●	●	●							●					●		●	●
a detachable hose type tap that enables water to reach everywhere and spread effectively			●								●		●			●				●					●		●	
extending the surface area with an accessory through which the water flows to provide users with water in line with their needs			●								●					●				●					●		●	
collecting water through a tap accessory and releasing certain amounts while washing hair			●								●					●				●					●			●
a hanging rope that releases a certain amount of water as pulling and gradually moves up and makes it difficult to reach during the activity		●		●		●					●		●										●				●	●

Table 4.10: The refined ideas in relation to the adopted the inspiration cards for DUI Workshop II (continued)

Description of the Refined Ideas	Behavior types					Attitudinal determinants of behaviors							Contextual determinants of behaviors						User intentions					Design Strategies				
	BT1	BT2	BT3	BT4	BT5	A1	A2	A3	A4	A5	A6	A7	C1	C2	C3	C4	C5	C6	UI1	UI2	UI3	UI4	UI5	DS1	DS2	DS3	DS4	DS5
gradually reducing the flow rate and pressure of water to encourage users to reduce the duration of use through making it harder		●	●	●		●				●	●					●							●				●	●
determining a daily amount of water allocated for a household and forcing users to use as little water as possible for each activity to be able to save water for the other activities	●	●	●	●	●	●	●			●													●			●		●
a tap with a timer that automatically turns off when the allocated time for the activity is over		●		●	●	●				●	●												●	●		●		●
informing the user about water consumption in an entertaining way, setting goals, providing tips and rewarding intended behaviors through an online game			●		●	●	●		●		●											●		●	●	●		
a joystick-like tap that enables individuals to regulate the water flow and water temperature precisely according to their personalized bathroom habits			●										●		●		●					●			●		●	
informing water consumption through creating an emotional connection with the environmental problems to encourage change (i.e., a fish bowl visualizing the water consumption in real-time)	●		●	●					●	●													●	●	●			
a tap with an integrated stopper that automatically reduces the duration of use by allowing the water to run for a certain period of time			●	●	●	●	●			●		●											●				●	●
comparing users' past and current water-consuming behaviors, informing them about their environmental impacts, and providing rewards for performing water effective use behaviors through an application	●				●				●													●		●		●		
turning on the tap like setting the alarm to determine the duration of use and demonstrating the passing time	●	●	●	●			●			●			●									●		●			●	●

Table 4.10: The refined ideas in relation to the adopted the inspiration cards for DUI Workshop II (continued)

	Behavior types					Attitudinal determinants of behaviors							Contextual determinants of behaviors						User intentions					Design Strategies				
Description of the Refined Ideas	**BT1**	**BT2**	**BT3**	**BT4**	**BT5**	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**UI1**	**UI2**	**UI3**	**UI4**	**UI5**	**DS1**	**DS2**	**DS3**	**DS4**	**DS5**
providing feedback about the passing time while the users run water without any purpose through a flashing light on top of the tap	●				●				●	●												●		●				
collecting water that flows while the water warms up through a tank integrated into the washbasin and reutilizing it for flushing or cleaning washbasin	●				●								●		●				●								●	●
convincing the hands or toothbrush are clean through a light integrated tap to persuade users to end the activity		●	●		●	●	●			●									●					●				
personalizing and controlling the flow rate of water with different gestures for an easier interaction			●									●	●				●		●						●		●	
a flow chart visualizing the history of individual water consumption, which also enables to set goals for saving water					●		●		●										●					●		●		
automated tap that runs water as placing the toothbrush under the tap and turns it off as displacing	●		●									●	●						●									●
personalizing and adjusting the flow rate of water and duration of use through tapping on the top of the tap (i.e., one tap for ten seconds of run, three taps for 20 seconds wait, etc.)	●		●							●			●				●		●						●		●	●
a smart mirror informing the activity stages and duration through colors (i.e., green, yellow, red) and automatically decreases the flow rate in case of excessive use		●	●	●	●	●	●			●		●	●									●		●				●
detecting bacteria at hands through a device with an ultraviolet light to reduce the repetition of activity stages and providing real gifts for adopting responsible behaviors		●			●	●	●															●		●		●		

User Intentions for DUI Workshop II

The teams focused on *mindful, willing, reluctant* and *unconcerned* user throughout the generating stages to influence their behaviors with the proposed design solutions, yet none of the teams selected the *doubtful* user (Table 4.11). However, participants did not mention any particular reason for not including this user intention category into their ideation process.

Table 4.11: Distribution of the refined ideas in relation to the adopted user intentions across the teams

	mindful	**willing**	**doubtful**	**reluctant**	**unconcerned**
Team 1		7			4
Team 2				2	2
Team 3	6			3	
Team 4				2	
Total number of refined ideas	**6**	**7**	**0**	**7**	**6**

While selecting user intentions, teams had diverse preferences. Some teams were inspired by their activity scenarios and selected the user intentions that they thought more relevant for that specific case. Team 3, for instance, decided their activity scenario as brushing teeth in a hurry which they believe is responsible for wasting too much water. In that sense, they selected *reluctant* users as they would probably be unaware of the water they waste and would not care about its environmental impacts. Similarly, the fact that the users in the scenario of washing hair in the sink, which Team 1 focuses on, do not take a whole shower but only wash their hair, led to the perception that they are *mindful* about water consumption.

Some teams focused directly on user intentions possessing higher resistance to alter their behaviors, thinking that the environmental effects of these individuals' current behaviors need to be positively affected through design interventions. Team 2 adopted this approach and focused on the *reluctant* user in the first round of ideation

and defined this user category as the one that needs immediate and significant attention for promoting sustainable behaviors.

As switching user intentions in the second round of the generating stage, with the aim of bringing a different perspective to the problem area, Team 2 reconstructed their activity scenario for children. Accordingly, they focused on the *unconcerned* users considering that children would have low awareness and concern about environmental issues. Team 1, who previously focused on the mindful users, wanted to experience how the same activity scenario would be handled for a user type with a quite different tendency and how this approach would affect the variety of ideas, and selected *unconcerned* users during the second round of ideation. Similarly, after the reluctant users, Team 3 preferred to explore how individuals could maintain their existing responsible behaviors or make them more effective and selected *mindful* users. The diverse approaches and concerns that the teams adopted as selecting user intentions supported the incorporation of different understandings of users' preferences and needs into the ideation process.

Behavior Types for DUI Workshop II

During the generating stages, teams utilized a wide range of behavior types in order to understand the behaviors responsible for intensive use of water and brainstorm on the potential reasons for their performance. The diversity of the adopted cards often increased in the second generating stage where they focused on a different user intention and incorporated diverse issues relevant for that specific user type. Thus, throughout the workshop session each behavior type has been utilized at least once by more than one team and supported the participants to generate diverse ideas to alter these behaviors (Table 4.12).

Table 4.12: Distribution of the refined ideas in relation to the adopted behavior types across the teams

Behavior types	Team 1		Team 2		Team 3		Team 4		Total number of ideas
	G1	G2	G1	G2	G1	G2	G1	G2	
running water without any purpose	1	1		1	3	3			**9**
performing activities frequently and repeating activity stages		4			1	1	2		**8**
ineffective scaling of water	7	2	2	2	1	4	1		**19**
performing activities and activity stages for long durations	2	4		2	1		1		**10**
performing habitual behaviors		2	1	1	2	3	2		**11**

Although the individual use of the cards supported the development of ideas, it was observed that they were mostly used together through diverse combinations. For example, Team 1's system idea, which aims to create a water economy for households through determining a daily amount of water allocated for houses and forcing individuals to use as little water as possible for each activity to be able save water for the remaining activities, inspired from the utilization of all five behavior types cards (Figure 4.32). The combination of inspiration cards enabled participants to enrich the problem area by incorporating diverse issues responsible for intensive use of water and develop holistic solutions.

Although all behavior type cards were utilized during the workshop, *ineffective scaling of water* inspired the development of more ideas. The main reason for this was stated as the difficulties experienced when interacting with the washbasin tap including not being able to precisely adjust the flow rate of the water, hesitating the touch the controls with a soapy hand, finding the controls difficult to interact or not wanting to interrupt the activity.

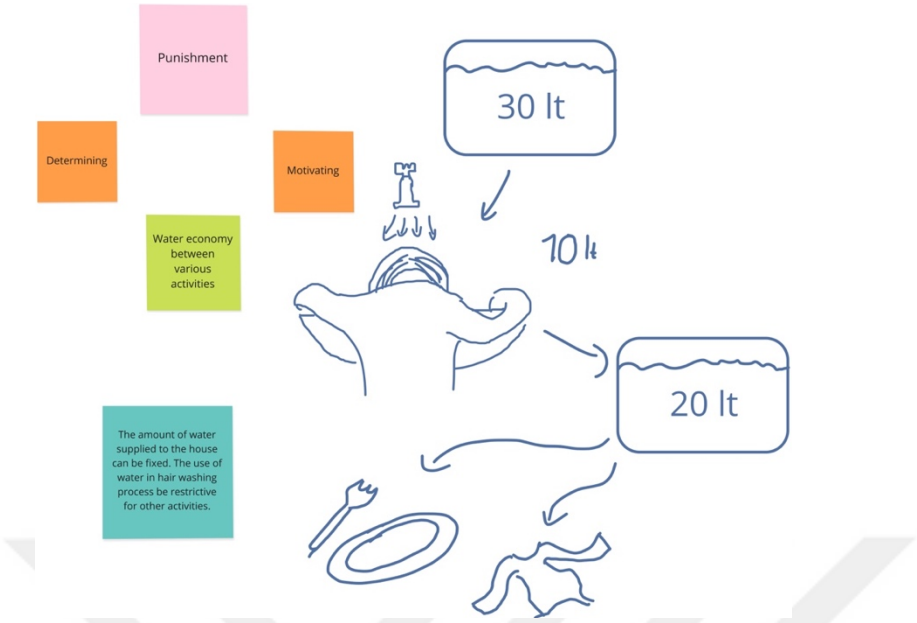


Figure 4.32: A scene from the Team 1's generating II stage demonstrating an idea incorporating diverse behavior types

Attitudinal Determinants of Behaviors for DUI Workshop II

Similar to the previous DUI workshop, participants used diverse attitudinal determinants to be able to comprehend the reasons behind adopting water-intensive behaviors and influence them towards the intended directions. As selecting attitudinal determinants cards, their choice of activity scenarios and user intentions were quite effective as well as the behavior types. Even though, a single attitudinal determinant might have inspired the development of ideas; participants mostly combined more than one card that they found related to each other. For instance, as brainstorming on the unconcerned users' potential behavior patterns, Team 2 assumed that they often perform activities for long durations *(performing activities and activity stages for long durations)*, repeat certain stages *(performing activities frequently and repeating activity stages)* and do not adjust the flow rate effectively *(ineffective scaling of water)*. Believing that these behaviors leading to intensive use of water are performed as users are unconscious and uninformed about the implications of water consumption *(visibility and clarity of water consumption)* and

unaware about the duration of use *(perception of time)*, Team 2 generated an idea that visualizes the water consumption in real-time through a fish bowl animation (Figure 4.33). The combination of these diverse cards enabled the team members to realize the essence of the problem and developed ideas accordingly.

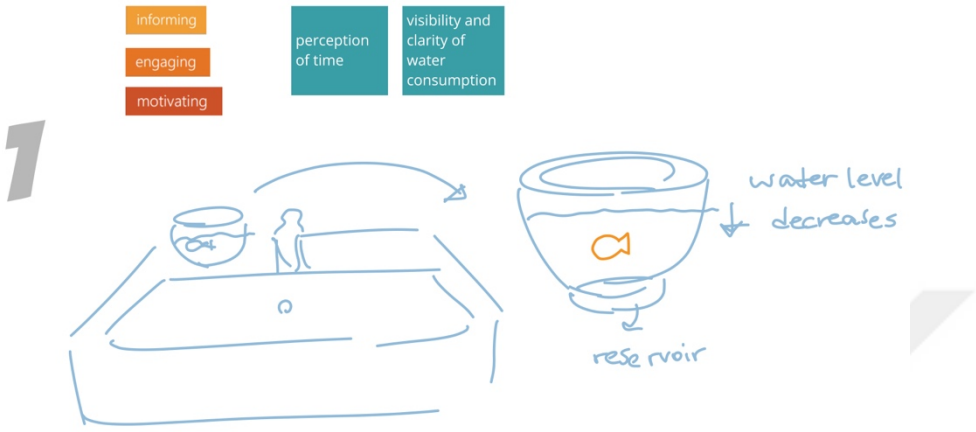


Figure 4.33: A scene from the Team 2's generating II stage demonstrating an idea incorporating diverse attitudinal determinants

During the second generating stage, the diversity of the adopted attitudinal determinants has increased. The main reason for this diversity was related to the new user intention targeted by the participants, and the different behavior types that these users would perform.

Throughout the generating stages, attitudinal determinants, including *feeling oneself clean and refreshed, perception of time* and *need for rinsing body and body parts,* supported the development of more ideas when compared to the rest. None of the teams utilized *perception of hygiene for bathroom components*; however, they did not mention any specific reason for this (Table 4.13). Since cleaning the washbasin area is often considered as a complementary activity performed during or at the end of the personal care and hygiene activities, the teams may not think of it as a significant part of the activity scenario of their choice and did not recognize it as a relevant problem for the effective use of water.

Table 4.13: Distribution of the refined ideas in relation to the adopted attitudinal determinants of behaviors across the teams

Attitudinal determinants of behaviors	Team 1		Team 2		Team 3		Team 4		Total number of ideas
	G1	G2	G1	G2	G1	G2	G1	G2	
feeling oneself clean and refreshed	2	4	1	1		1	2		**11**
need for disinfecting body and body parts		1	1	1	1	2	2		**8**
perception of hygiene for bathroom components									**0**
visibility and clarity of water consumption			1	1	2	1			**5**
perception of time		3		2	2	2	1		**10**
need for rinsing body and body parts	7	3	1						**11**
need for comfort	2			1		2	1		**6**

Contextual Determinants of Behaviors for DUI Workshop II

As generating ideas, participants make use of diverse contextual determinants in relation to the activity scenarios, user intentions, behavior types and attitudinal determinants that they targeted. Their choice of cards enabled them to gain insights into the factors, including perceived difficulties, costs and affordances, that influence the structure of behaviors leading to intensive use of water. In a scenario where willing users wash their hair in a sink, it is realized that users cannot make use of the water effectively *(ineffective scaling of water)* since they are having difficulties reaching and interacting with the water source *(difficulty in controlling the tap)*. One other reason is they need to rinse the shampoo from their hair effectively *(need for rinsing body and body parts)* through spraying water to different parts of the head with diverse pressures *(ineffective spraying of water)*. However, since the washbasin was not designed particularly for hair washing activity, it provides limited flexibility for use. Through relating the inspiration cards with each other and framing the problem area, Team 1 came up with a detachable hose type tap idea which enables water to reach the head, and wet and rinse the hair effectively (Figure 4.34).

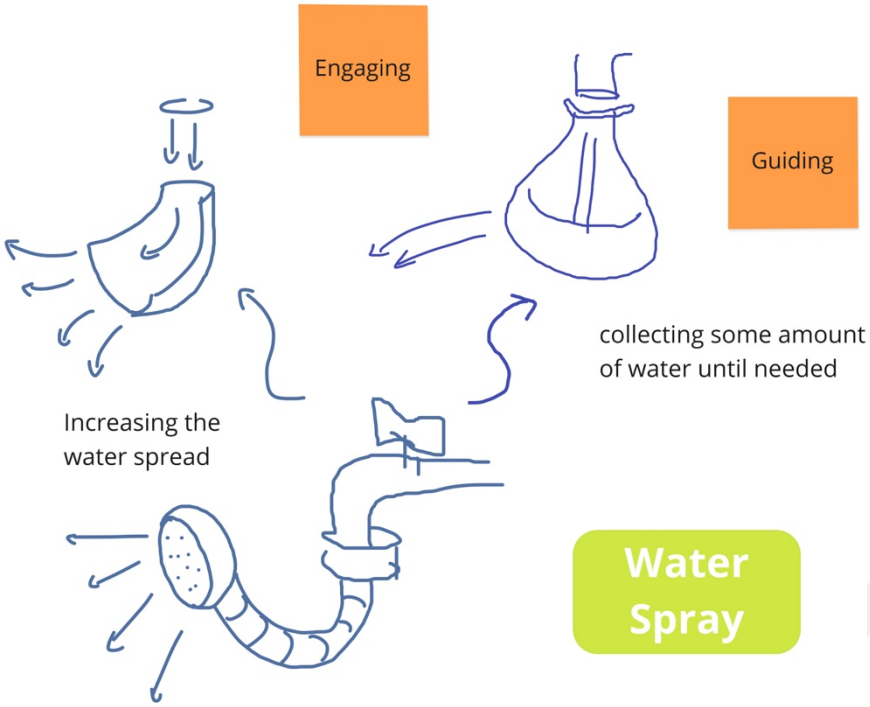


Figure 4.34: A scene from the Team 1's generating I stage demonstrating an idea incorporating diverse contextual determinants

As in the previous workshop, the number of ideas associated with the contextual determinants was less when compared to the attitudinal determinants. The main reason for this, as exploring the problem area, participants often focused on the attitudinal factors like beliefs, attitudes, concerns and intentions of users rather than the environment shaping the performance of these behaviors. Within this card deck, *difficulty in controlling the tap* inspired the development of more diverse ideas. None of the teams selected *difficulty in cleaning bathroom components* and *deterioration of bathroom components and their replacement.* Similar to the attitudinal determinant *perception of hygiene for bathroom components*, the reason for not focusing on these contextual determinants might be related to the difficulty that the participants experienced as recognizing the significance of post-use and maintenance scenarios that could be related to adopting water-intensive behaviors. Table 4.14 shows the distribution of the refined ideas through relating them with the contextual determinants of behaviors adopted by the teams.

Table 4.14: Distribution of the refined ideas in relation to the adopted contextual determinants of behaviors across the teams

Contextual determinants of behaviors	Team 1		Team 2		Team 3		Team 4		Total number of ideas
	G1	G2	G1	G2	G1	G2	G1	G2	
difficulty in controlling the tap	5	1	1		1	4	1		**13**
difficulty in cleaning bathroom components									**0**
difficulty in accessing hot water			1			1			**2**
ineffective spraying of water	3	1							**4**
difficulty in personalizing bathroom components	1		1			2			**4**
deterioration of bathroom components and their replacement									**0**

Design Strategies for DUI Workshop II

Through the workshop session, participants utilized all of the design strategies as brainstorming on the potential design solutions and developing and refining them. They mostly used more than one strategy as generating ideas for the effective use of water. Considering the potential relation between the user intentions and adopted design strategies, the distribution of the refined ideas is presented below (Table 4.15).

Table 4.15: The distribution of the refined ideas in relation to the design strategies and user intentions

Design strategies	User Intentions					Total number of ideas
	mindful	willing	doubtful	reluctant	unconcerned	
informing	2			6	2	**10**
engaging	2	5		2	1	**10**
motivating	1			3	3	**7**
guiding	3	6		2	3	**14**
determining	3	3		2	5	**13**

Even each design strategy has been utilized during the generating stages, teams revealed diverse preferences as selecting and relating the strategies with the targeted user intentions. Considering the *reluctant* users' low awareness about the environmental issues, Team 3, adopted the *informing* strategy and enhanced the ideas with techniques for *motivating* the users to pursue intended behaviors. However, believing that these two design strategies would not be enough to influence pro-environmental behaviors, they also incorporated *determining* and *guiding* strategies into their ideas. Since the *reluctant* users often find it difficult to alter their unsustainable behaviors, Team 2 mainly focused on making interactions easier for them through using *guiding* strategy. Though, during the ideation, they also utilized *informing*, *engaging* and *motivating* strategies to increase their awareness and enhance their eagerness to adopt and maintain responsible behaviors. For the *willing* users, Team 1 did not adopt informing and motivating strategies as they are already familiar with the environmental consequences of behaviors and have high motivation to adopt change. However, they may be experiencing contextual or attitudinal difficulties, so that they mainly focused on *guiding* strategy to make the activities around the washbasin area easier. *Engaging* strategy was also adopted to empower these users through enabling them to alter, adjust or personalize the context in line with their needs and consume water more effectively. As generating ideas for the *unconcerned* users, Team 1 mentioned to focus on extreme measures to control their behaviors. They mainly forced the user to consume water effectively through *determining* strategy or make certain interactions more difficult with the *guiding* strategy. Considering the overall attitude of the unconcerned user, *motivating* strategy was also used not to save water but to save money.

Similar to the previous workshop, participants used diverse combinations of the design strategies to enrich the stimulus for influencing behavior change. They mostly preferred to combine strategies that are closer to each other in terms of users' power in the decision-making process for adopting change. Within the generated ideas,

engaging-guiding, informing-motivating and *guiding-determining* were the most common combinations of strategies.

4.5.2.4 Participants' Evaluations of the Generative Tool and the Workshop Process

In this section, the findings from and insights into the participants' evaluations will be presented in relation to the inspiration cards and the workshop process. Along with the participants' experiences, limitations of the generative tool and the workshop process will be discussed and suggestions for their further development will be shared.

Behavior types and attitudinal and contextual determinants of behaviors cards were mentioned to be very helpful to *start brainstorming on the potential problems* that the user would be experiencing and the various factors responsible for them. As the card deck encompasses a range of behaviors and their diverse determinants, it enriches the *variety of the issues to be addressed* during ideation. The titles of the cards were found *self-explanatory* and the questions were considered as a useful *starting point for approaching the problem area*. Even it was not the main intention, determinants of behaviors were stated to be stimulating for *building a use scenario*. This scenario building stage, adopted by two teams, enabled them to look at the activity from a broader perspective and recognize diverse problems for intensive use of water. The card set was also mentioned to be effective while imagining the users and their potential behaviors and preferences as engaging with the activities of interest. The distinction between the cards was found quite clear, while the selected colors for the cards supported that.

Even the definitions of the cards were mentioned to be very useful and clear, participants also found them quite challenging as it takes time to review them all. To overcome this, inspiration cards were sent to the participants prior to the workshop session; anyhow *a separate workshop stage for the exploration of the cards* could be

integrated. Since the definitions of each card include significant findings from the user research and encompass prominent examples from the participants' experiences in relation to the personal care and hygiene activities, the content was decided to remain the same for future workshops.

In the earlier stages of the generating stage, two participants stated to have experienced difficulties as *relating the behavior types and determinants with the activity scenarios* they selected. In such cases, they simply extended the definition of the cards through including examples in relation to their activity scenarios and utilized the cards. Likewise, one other participant had a difficulty as relating the behavior types, which are inherently negative, with the mindful users. In that case, the participant similarly preferred to redefine the cards for that specific user intention. This showed the flexibility of the cards to be adapted into diverse cases and for various user intentions.

User intentions were stated to be very inspirational to *empathize with the users* in relation to their concerns and attitudes towards adopting pro-environmental behaviors, and they acted as *a facilitator for generating ideas*. The definitions of the user intentions were mentioned to be well-defined, while the scales underneath the cards were quite helpful for *distinguishing the users' level of eagerness* for adopting change. During the second generating stage, switching user intentions allowed participants to *look at the problem from a different perspective, evaluate the existing solutions* for a diverse user type, and *adopt diverse techniques and strategies* to influence sustainable behaviors.

Since the definitions of the user intentions mainly focusing on the users' awareness and concerns about environmental problems and perceived difficulties for adopting change, participants sometimes *seek for more detailed information* about the other tendencies or characteristic of their users. It was suggested that user intentions could also be used to create personas to inspire ideation. For the following workshop sessions, developing a persona could be encouraged to enrich the users' potential

needs, expectations and preferences that could be stimulating for ideation, yet the main focus should be on their overall attitudes for adopting sustainable behaviors.

To better empathize with the users, *quotes from the users' statements* received through the user research study were suggested to be incorporated into the card deck. For the following workshop, relevant statements of the user research participants were decided to be included for further clarification.

Design strategies cards and particularly the techniques for their implementation were found quite inspirational to guide participants as generating ideas. The examples for their implementation were also considered as helpful to understand and adapt them with the purposes of effective use of water. However, some participants suggested the *inclusion of visuals and reduction of texts* to enhance the clarity of the design strategies and ease their implementation. Based on this suggestion, for the following workshop it was decided to include images of design solutions in relation to each design strategy and brief explanations about how these solutions would stimulate sustainable behavior change. The color palette adopted in the design strategies made it easier for the participants to *recognize the level of intervention* they are supposed to make on the users through the proposed design solutions.

Similar to the previous workshop, participants often combined multiple design strategies to enhance the ideas and ensure sustainable behavior change. Sometimes even participants aimed to influence behaviors through a certain design strategy, after generating ideas they found out that the developed ideas were relevant to other strategies as well. This reveals that initial selection of strategies may trigger the idea generation but through the process of refinement, the strategies that those ideas match may change. Overall, despite the different approaches as utilizing the design strategies, they stimulated participants to adopt and combine various techniques for influencing change.

Workshop process including the workshop brief, and the team and workshop canvases were found helpful to understand the workshop procedure and follow the

session effectively. Participants found *sensitizing stage* as a useful warm-up task to recognize their behavior patterns and realize their perceptions about water consumption.

Switching teams between the generating stages was found triggering for ideation, since it enabled them to reconsider the problem area through the inclusion of different perspectives and approaches of the new team members. It also supported team members to reach a shared understanding about the problem area through enabling communication and discussions. Along with switching teams, *altering user intentions* is stated to enrich the variety of generated ideas through contributing to the previously generated ideas or developing new ones.

Even sketching on Miro was found challenging; participants often focus on the content of the ideas and how they relate them with the inspiration cards rather than the quality of their sketches. In terms of the duration of the stages, as they discussed the inspiration cards with their teammates during the initial generating stage, they had limited time for refining and visualizing their ideas. In the second generating stage, on the other hand, even they were familiar with the cards, this time switching teams required time for adapting to new team members and sharing their diverse perspectives. Considering this, for the following workshop, *the duration of the generating stages* was decided to be extended. The *online setting for the workshop* was considered to be useful as enabling collaborative work through fast discussions and sketches with the provided tools and also enabling isolation from the other teams through the breakout rooms.

4.5.2.5 Reflections on the Workshop II and Adaptation of the Generative Tool

Considering the participants' reflections on the DUI workshop I, several revisions were conducted both on the workshop procedure and the generative tool. The integration of the *workshop brief* primed participants through informing them about

how the workshop would proceed and what would be expected from them. So, they were easily involved in the generative tasks. Conducting the *sensitizing phase prior to the workshop* enabled participants to share more time to think about their existing behaviors as engaging with the activities around the washbasin. *The inclusion of a visualization task into the sensitizing stage* enabled participants to consider their behaviors in relation to the water consumption that they are responsible for. They often included additional notes on the visualization task to better define their behaviors and perceptions. It was seen that this understanding was transferred into the brainstorming and supported the diversity of problem areas addressed for intensive use of water.

Considering the revisions on the inspiration cards, re-categorizing the problem areas as *behavior types* and *determinants of behaviors* ease the tool's utilization as relating them with each other during brainstorming. *Separating the motivating and engaging strategies* supported the exploration of diverse solution areas through the integration of diverse techniques for stimulating change.

Switching teams between the generating stages enabled the participants to share their diverse approaches for generating ideas, understandings about the inspiration cards and perspectives related to the problem area. For example, after selecting the activity scenario, one team generated a timeline to map the activity stages to better understand the problem area. This task, in fact, enabled them to relate the behavior types and determinants of behaviors to these activity stages and explore the problem area in detail. When the teams switched members, Participant 2 shared this technique with her new teammate, and they adopted it for another activity scenario to further explore the problem area for a new user intention.

Even the duration of the workshop stages was extended, and the inspiration cards were shared prior to the workshop session, participants needed more time to refine their ideas, particularly during the first generating stage. In that sense, a separate workshop stage might have been considered for the participants to explore the

inspiration cards individually or discuss their content in a collective manner which would be incorporated into the final workshop.

Considering the participants' suggestions on the inspiration cards, several revisions were decided to be conducted for the following DUI workshop. (i) The images of design solutions in relation to the design strategies will be included in each card; (ii) for each user intention card, quotes from the users' statements will be added to further clarification; and (iii) the duration of the generating stages will be extended. The facilitation of the DUI workshop III, reflections on the workshop process and limitations will be shared through the following section.

4.5.3 DUI Workshop III

The third DUI workshop was facilitated on May 6, 2021 within the context of an undergraduate design studio course, ID 302 Industrial Design IV, in the Department of Industrial Design at METU. The studio project entitled *"Sustainable Design Scenarios and Solutions for Encouraging Water Effectiveness in Bathroom Environments*" (Appendix J) aimed to explore and develop sustainable design solutions for the effective use of water with a particular focus on the user needs, preferences and behaviors around the showering and the washbasin area in the bathroom environment. In the project schedule, the DUI workshop was planned to be facilitated right after the literature research and user observations that the students carried out as teams. During the workshop, participants explore and interpret the potential problem areas together as a team, but they generate ideas individually. For the following stages of their design project after the workshop session, this approach enabled the transition from teamwork to individual work through which they were expected to focus on a specific bathroom environment (i.e., washbasin or showering area) based on the ideas that they developed through the DUI workshop.

Considering the aim and objectives of the project, the scope of the workshop was extended, and it included personal care and hygiene practices around the showering

and washbasin area. Similar to the previous workshop, it was aimed to investigate the implications of the inspiration cards on the development of ideas for influencing the effective use of water among individuals with diverse intentions for adopting change. Through this section, the details about the sample, workshop procedure, findings from the workshop and reflections on the workshop process and the inspiration cards will be discussed.

4.5.3.1 Participants and Online Workshop Environment

71 undergraduate students who enrolled in the ID 302 Industrial Design IV course participated in the workshop session. Participants worked as teams consisting of 2 (2 teams), 3 (21 teams) and 4 (1 team) members. Though, six teams consisting of 3 members were included in the analysis phase of the study, whose members shared their full consent to participate in the study and share the ideas they develop through the workshop session.

During the workshop session, similar to the previous sessions, for introducing the workshop process, enabling communication with the participants, and sharing ideas Zoom was used, while Miro was utilized for collaborative and creative tasks including brainstorming, sketching and presenting ideas. The workshop was facilitated with the help of the studio team Prof. Dr. Çağla Doğan, Asst. Prof. Dr. Senem Turhan, Inst. Aernout Kruithof, and research assistants Koray Canlar, Ayşe Kaplan, Zeynep Yalman Yıldırım and Itır Güngör Boncukçu. The workshop session was completed in around five and a half hours.

Within the context of the studio course, the DUI workshop was used as *an idea generation method* which bridges the gap between design research and ideation through the integration of inspiration cards. During the workshop, participants as teams explored diverse issues related to water consumption and generated ideas aiming to influence effective use of water as performing activities in the bathroom environment. The students' participation in the workshop was not graded by the

course tutors as that was considered as a supportive stage for exploring and developing diverse ideas on the selected bathroom environments, but it had several learning outcomes for the students, including the familiarization with the problem area and users, and recognizing diverse techniques and strategies for influencing sustainable behaviors.

4.5.3.2 Facilitating the DUI Workshop III

As conducting the workshop, different from the previous ones, participants shared their ideas in one stage. Thus, six successive stages were followed; *sensitizing, introducing, generating I, generating II, sharing & reflecting and evaluating* (Figure 4.35). The reflections on the workshop stages, procedure and inspirations cards will be shared through discussing their contributions and limitations.

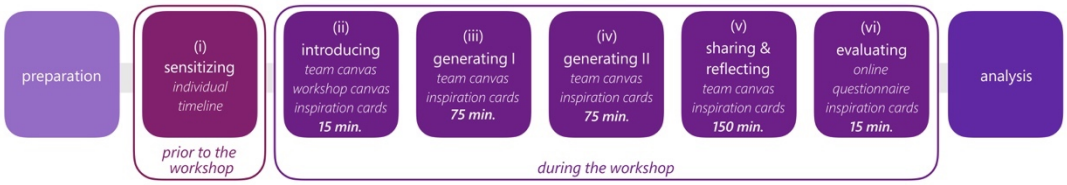


Figure 4.35: DUI workshop III stages and incorporated tools and tasks

Sensitizing: Considering the scope of the workshop and the variety of personal care and hygiene activities performed in the bathroom, *sensitizing stage* was conducted prior to the workshop. Thereby, participants managed to share time to recall and document their behaviors as performing activities of interest. As sharing the Sensitizing Miro board with the participants, they were expected to follow the same steps in DUI workshop II for completing this task. First, they were asked to describe an activity scenario through which they perform the activities. Then, they were asked to recall the activity stages, their behaviors, and interactions with the products in the selected scenario and transfer their experience on the timeline through noting down the numbers of the activity stages. Even a comprehensive list of activity stages was provided for them, they preferred to include new stages to better reflect their

behaviors (e.g., brushing hair, filling a bucket, cleaning the facial cleaning machine, etc.). Finally, they were expected to communicate their understandings about water consumption through thinking about how the amount of water changes during the recorded activity stages and visualize these changes. In this exercise, participants mostly used graphs to communicate their perceptions. They repeated these steps for three different personal care and hygiene practices, at least one performed around the washbasin area and one other around the showering area (Figure 4.36). This individually conducted stage enabled participants to empathize with the problem area through realizing and reflecting on their own water-consuming behaviors.

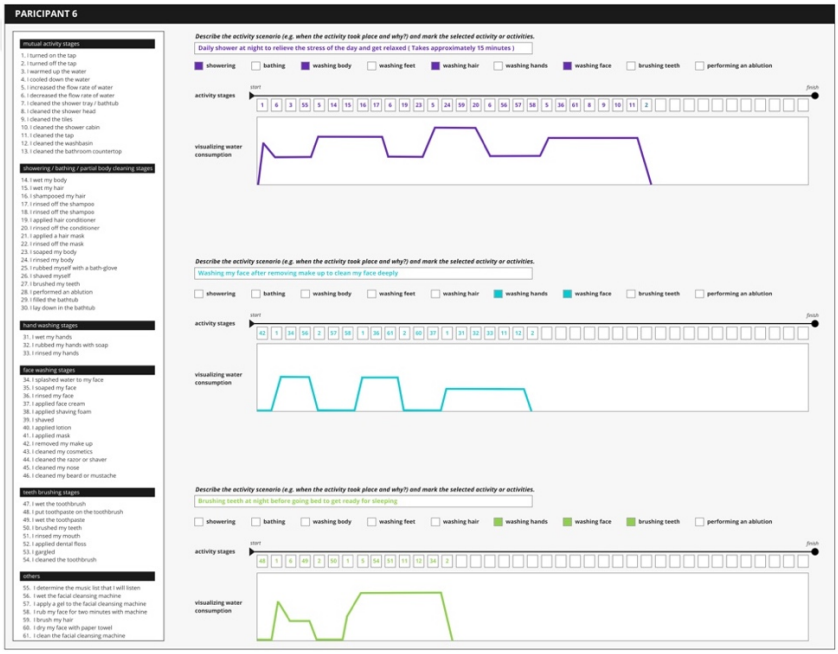


Figure 4.36: A sample filled out sensitizing canvas by Participant 6

Introducing (15 min.): Similar to the DUI workshop II, the introducing stage was conducted in two steps. First, the inspiration cards (Appendix E) and the workshop brief (Appendix K) including the problem background, aim and scope of the workshop and the workshop procedure were emailed to participants. In this initial step, it was aimed to prime participants to the workshop through enabling them to share time to review the generative tool and try to comprehend what is expected from them. In the beginning of the workshop session, the details of the workshop stages

were explained, and inspiration cards were introduced. Since the design project was already carried out as teams, participants continue to work with their teammates through the workshop session. In total, 24 teams were formed. As responding to the participants' emerging questions, the participants were divided into breakout rooms with their teammates where they would work together to generate ideas for the effective use of water.

Generating I (75 min.): In this stage, participants worked on their team canvasses and were suggested to follow certain stages as generating ideas. First, they *defined an activity scenario* that is performed either around the washbasin or the showering area. Then, they *selected one of the user intentions* to influence sustainable behaviors. In line with their choices, they *explored and selected behavior types and attitudinal and contextual determinants of behaviors* that they found significant and relevant. Based upon the selected inspiration cards, they tried to *frame the problem area* through elaborating on the potential issues responsible for intensive use of water. Through the *adoption of design strategies*, this exploration led them to *develop initial solution areas*. Later, they *refined their ideas and visualized them* over group discussions (Figure 4.37). Participants preferred both digital sketching and hand sketching based on their skills and available tools. The refined ideas were labeled with the inspiration cards that stimulate the development of each idea. During this stage, facilitators visited the breakout rooms to respond the emerging needs and questions of the teams. Through this ideation session, 27 ideas were refined and prepared to be presented during the sharing and reflecting stages.

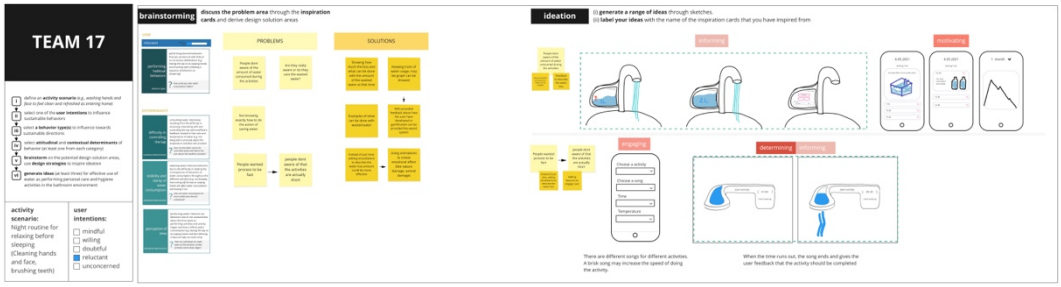


Figure 4.37: Team 17 working on their team canvas during generating I stage

Generating II (75 min.): As completing the first generating stage, teams *defined another activity scenario*. If they focused on an activity around the washbasin area in the previous stage, in the second round of ideation, they were asked to define an activity scenario around the showering area. The particular reason for switching activity scenarios was related to the scope of the project in which the DUI workshop was included as an idea generation method. Since the project covered personal care and hygiene activities performed in the bathroom environment, this approach enabled participants to generate various design solutions in relation to diverse areas in the bathroom. Along with the activity scenarios, teams also selected *a different user intention* to explore diverse problems and solution areas to influence sustainable behaviors among a different user category. As *re-exploring the problem area* for a different user intention and an activity scenario, they often included new behavior types and altitudinal and contextual determinants that they found relevant to their new case, while some cards that became irrelevant were omitted. Reflecting on the needs and expectations of the new user intentions, teams generated ideas that were further refined and visualized (Figure 4.38). Since individuals with diverse tendencies for adopting change would react differently to design interventions, teams also *reconsidered the design strategies* in relation to the targeted user intentions. In this task, teams generated 23 refined ideas in total that were labeled with the related inspiration cards for the sharing and reflecting stage.

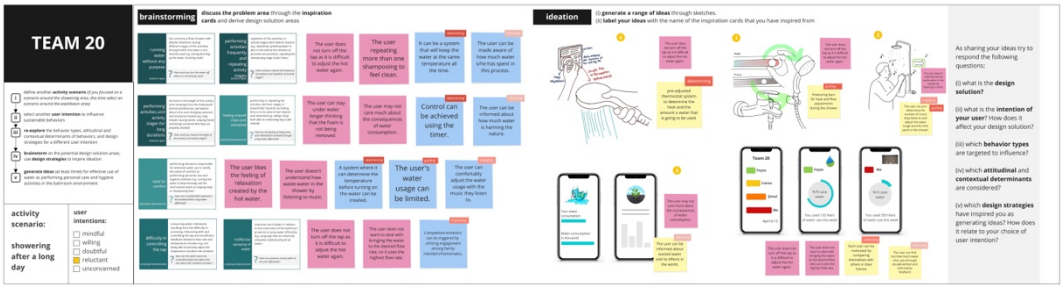


Figure 4.38: Team 20 working on their team canvas during generating II stage

Sharing & Reflecting (150 min.): After completing two rounds of generating stages, each team shared their ideas. On the right side of the team canvases, there

were a list of question that the participants were expected to respond as presenting their ideas. The questions included the (i) the description of the design solutions, (ii) their choice of user intentions, behavior types, and the determinants of behaviors and how these affected their ideation process, and (iii) the design strategies that they are inspired from and their relations with the user intentions. Each team described their choice of activity scenarios, adopted inspiration cards and generated ideas through responding to the provided questions. For the second round of ideas, they also discussed how the altered activity scenarios and user intentions influenced the ideation process through explaining how they reframed the problem area, reconsider and incorporated diverse inspiration cards and developed design solutions accordingly. During the break prior to the sharing and reflecting stage, the teams had time to arrange their team canvasses which enabled them to present their ideas in a structured way through effectively linking the ideas with the adopted inspiration cards. At the end of each team's presentation, facilitators asked questions for further clarification when necessary (Appendix H).

Evaluating (15 min.): Considering the number of the workshop participants, this final stage of the session was transferred into an online questionnaire. It included both open-ended and Likert scale questions to gain insights into the participants' experiences with and suggestions for the online workshop process and the incorporated inspiration cards (Appendix I). The Likert scale questions related to the inspiration cards supported participants to evaluate *the clarity of the definitions and distinction between the categories, cards' usefulness in familiarization with the problem area and the users and recognizing different approaches for promoting sustainable behaviors, their easiness to integrate into the ideation* and *their effectiveness for inspiring diverse ideas.* Open-ended questions, on the other hand, aimed to receive participants' comments and suggestions for the further improvement of the inspiration cards. In relation to the workshop process, the questions intended to understand participants' overall reflections about the implications of the *sensitizing stage, switching user intentions and activity scenarios,*

workshop brief and *workshop procedure* and receive their suggestions for the further improvement of the workshop. Sixty participants responded to the online questionnaire during the evaluating stage.

4.5.3.3 Outcomes of the DUI Workshop III

In this final DUI workshop, 24 teams consisting of 71 undergraduate students have participated in the session. However, in line with their consent to be a part of this doctoral study, 6 teams involving 18 participants were included in the analysis process. Throughout the workshop session, six teams generated 50 ideas. Since the duration of the generating stages was extended and the teams were more crowded when compared to the previous workshops, they managed to refine all 50 ideas and present them during the sharing stage. In addition to changing user intentions, which was common for all three workshops, switching activity scenarios during the second round of ideation, which was one particular difference of this workshop, also supported the variety of the generated ideas. The refined ideas throughout the workshop session are presented in Table 4.16 through relating them with the inspiration cards adopted by the teams.

Through the workshop session, the selection of activities and activity scenarios were quite diverse (e.g., washing face for a fresh start to the day, showering after an online class to feel relaxed, nighttime routine after a day spent outside, etc.). This diversity supported them to explore diverse problem areas and in turn, develop various design solutions for the effective use of water. While selecting activity scenarios, participants also mentioned being inspired by the scenarios they focused on during the sensitizing stage. Since they already become familiar with the existing issues for intensive use of water through that task, they would like to elaborate on that knowledge. During the session, participants adopted a range of inspiration cards and their diverse combinations as they brainstorm on the potential solution areas and generate ideas which will be presented and discussed through the following sections.

Table 4.16: The refined ideas in relation to the adopted inspiration cards for DUI Workshop III

	Behavior types						Attitudinal determinants of behaviors							Contextual determinants of behaviors						User intentions					Design Strategies				
	running water without any purpose	using water for different purposes	performing activities frequently and repeating activity stages	ineffective scaling of water	performing activities and activity stages for long durations	performing habitual behaviors	feeling oneself clean and refreshed	need for disinfecting body and body parts	perception of hygiene for bathroom components and accessories	visibility and clarity of water consumption	perception of time	need for rinsing body and body parts	need for comfort	difficulty in controlling the tap	difficulty in cleaning bathroom components	difficulty in accessing hot water	ineffective spraying of water	difficulty in personalizing bathroom components	deterioration of bathroom components and their replacement	mindful	willing	doubtful	reluctant	unconcerned	informing	engaging	motivating	guiding	determining
Description of the Refined Ideas	**BT1**	**BT2**	**BT3**	**BT4**	**BT5**	**BT6**	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**UI1**	**UI2**	**UI3**	**UI4**	**UI5**	**DS1**	**DS2**	**DS3**	**DS4**	**DS5**
collecting water for reutilizing through the pressure sensors located on the shower tray that senses the user is not in the shower, but water runs unnecessarily while warming up	●					●					●		●			●					●								●
determining the duration of use for the showering activity and tracking the remaining time and water through a screen			●		●		●			●	●										●				●	●			
a smart panel that detects different users and adopt to their needs (e.g., automatically adjusting the flow rate and water temperature in line with the activity stages)				●			●											●			●								●
a pressure pad installed on the shower tray to control the flow of water without interacting with the tap	●												●	●							●							●	
spraying steam to keep the environment warm and providing preset temperatures for personal needs	●	●											●	●			●	●			●					●		●	
a shower panel offering users responsible choices to spray less water to their body to keep it warm	●	●		●				●				●	●				●	●			●							●	
a tap offering easier use through rotating its head and extending its hose for diverse needs				●					●			●	●	●	●			●					●			●		●	

Table 4.16: The refined ideas in relation to the adopted inspiration cards for DUI Workshop III (continued)

	Behavior types						Attitudinal determinants of behaviors							Contextual determinants of behaviors						User intentions					Design Strategies				
Description of the Refined Ideas	**BT1**	**BT2**	**BT3**	**BT4**	**BT5**	**BT6**	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**UI1**	**UI2**	**UI3**	**UI4**	**UI5**	**DS1**	**DS2**	**DS3**	**DS4**	**DS5**
an adaptable tap controller that has a pressure panel installed under the sink to enable users to control the tap with their feet	●							●					●	●									●					●	
a tap that automatically turns itself off detecting the cleaning products are rinsed and drained from the washbasin	●	●	●			●	●				●	●		●									●						●
enabling adjustments (i.e., selecting activity type, duration, water temperature, flow rate) prior to the activity and providing feedback through the activity stages via a digital panel	●		●		●						●		●	●				●				●			●	●		●	
color changing lights integrated into the shower head and music to provide real time feedback related to the duration of use, and an application showing the history of water consumption for each showering activity			●		●		●			●	●		●									●			●		●		
a shower cabin spraying pressurized water and steam for users' preferences to convince them about being clean and providing feedback on the activity stages and duration	●		●		●			●				●					●	●				●			●	●		●	
a smart tap that offers temperature adjustment and different duration options in line with the dirt level of hands and automatically turns on and off the water flow as squeezing soap	●				●			●			●			●			●	●						●	●	●			●
a washbasin that includes integrated holes to automatically clean the surface, a tap with a digital screen to see and adjust the temperature of water, shows the water consumption and automatically turned off when the water is consumed intensively	●		●	●					●	●					●		●	●						●	●	●			●
providing a predetermined amount of soap and time for the user to sterilize their hands	●		●	●				●			●	●					●							●					●

Table 4.16: The refined ideas in relation to the adopted inspiration cards for DUI Workshop III (continued)

	Behavior types						Attitudinal determinants of behaviors							Contextual determinants of behaviors						User intentions					Design Strategies				
Description of the Refined Ideas	**BT1**	**BT2**	**BT3**	**BT4**	**BT5**	**BT6**	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**UI1**	**UI2**	**UI3**	**UI4**	**UI5**	**DS1**	**DS2**	**DS3**	**DS4**	**DS5**
visualizing the water consumption, water flow and temperature throughout the showering process through a display located on the tap				●						●												●			●		●		
offering diverse shower modes that adjust the water temperature, flow rate and direction of water flow in line with the different showering needs (e.g., relaxing, energizing, relieving pain, etc.)		●		●			●					●	●	●			●	●				●				●		●	
visualizing the water use through a shower head and shower tray that change color from green to red	●				●	●				●												●			●				
sliding a window wiper upwards and downwards to remove the stains on the shower cabin without using water			●						●						●				●			●						●	
filtering system within the tap to reduce calcification to prevent blockage, ease cleaning, reduce wasting water and make the user feel cleaner		●		●	●		●		●						●		●		●			●							●
a digital display that provides personalized modes (e.g., water temperature, flow rate, etc.) for the diverse showering preferences of individuals sharing the same bathroom				●			●	●				●	●	●				●				●			●	●		●	
a detachable accessory that enables water to circulate within the shower mixer tap till it reaches desired temperature	●					●							●			●						●							●
shower mixer tap spraying steam to warm up the bathroom environment and using water effectively		●		●									●			●	●					●							●

Table 4.16: The refined ideas in relation to the adopted inspiration cards for DUI Workshop III (continued)

	Behavior types						Attitudinal determinants of behaviors							Contextual determinants of behaviors						User intentions					Design Strategies				
Description of the Refined Ideas	**BT1**	**BT2**	**BT3**	**BT4**	**BT5**	**BT6**	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**UI1**	**UI2**	**UI3**	**UI4**	**UI5**	**DS1**	**DS2**	**DS3**	**DS4**	**DS5**
arranging certain time periods for the tap to turn itself off automatically during the activities where the water is not used continuously	●				●	●					●			●		●							●					●	●
enabling water to flow over the tap through its form during the cleaning process to prevent splashing around and creating stains			●						●						●				●				●						●
a tap with a ball joint neck that rotates in every direction to offer flexible use for the diverse needs of the user					●				●			●	●	●	●			●					●					●	
enabling users to adjust the height of the sink for diverse activities and the needs of diverse users to use water effectively					●								●					●					●			●		●	
wall mounted tap and controls to reduce the water stains resulting from splashing water			●						●						●								●						●
spraying water from different directions through the water outlets located on the inner side of the washbasin to effectively wash and rinse the face	●		●	●			●	●				●		●			●						●					●	
providing real time information related to the water consumption and duration of use through a screen attached to the tap					●	●				●	●												●		●				
demonstrating the water consumption with real life images (e.g., pool, wine bottle, etc.) for clarity and showing the history of water consumption through a chart to stimulate intended behaviors						●				●													●		●		●		
a transparent tap that make the consumed water visible, and an integrated application enabling users to select the activity type, song, duration and temperature of water in line with needs which ends the music as the pre-adjusted duration of use is completed					●	●	●			●	●	●											●		●	●			

Table 4.16: The refined ideas in relation to the adopted inspiration cards for DUI Workshop III (continued)

Description of the Refined Ideas	Behavior types						Attitudinal determinants of behaviors							Contextual determinants of behaviors						User intentions					Design Strategies				
	BT1	BT2	BT3	BT4	BT5	BT6	A1	A2	A3	A4	A5	A6	A7	C1	C2	C3	C4	C5	C6	UI1	UI2	UI3	UI4	UI5	DS1	DS2	DS3	DS4	DS5
a shower head that sprays less water with high pressure through preset modes and visualizes water consumption through color changing halo around the head		●		●	●		●			●			●				●	●			●				●	●		●	●
enabling users to pre-adjust the showering mode (e.g., relaxing, quick shower, etc.) duration of use, temperature of water prior to the shower and informing them about the remaining time through color feedback on the shower head		●			●		●				●							●			●				●	●			
a shower cabinet reutilizing wasted hot water as a steam to keep the temperature of the environment constant which also wets and rinse body with less water through the water outlets placed in diverse locations and offers diverse showering modes		●		●			●					●	●				●	●			●					●			●
making it physically challenging to increase the flow rate of water to encourage using low flow rates				●									●	●								●						●	
enabling individuals to set goals for using water effectively and tracking and informing the consequences of their water consuming behaviors through an application						●				●												●			●		●		
adjustable tap head for flexible use and effective rinsing which offers diverse pressure modes (e.g., mixing air with water, diverse spray patterns, etc.)			●	●								●			●		●	●				●				●		●	
water heating mode that cleans the shower surfaces through the water outlets around the top of the cabin as the water warms up	●		●						●						●	●							●					●	●
a water efficient body spray which uses steam to keep the body warm and comfort the user while the water is turned off (e.g., shampooing)		●					●						●			●							●					●	●

Table 4.16: The refined ideas in relation to the adopted inspiration cards for DUI Workshop III (continued)

	Behavior types						Attitudinal determinants of behaviors							Contextual determinants of behaviors						User intentions					Design Strategies				
Description of the Refined Ideas	**BT1**	**BT2**	**BT3**	**BT4**	**BT5**	**BT6**	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**UI1**	**UI2**	**UI3**	**UI4**	**UI5**	**DS1**	**DS2**	**DS3**	**DS4**	**DS5**
shower head with a timer and water pressure adjustment to spray water effectively in line with diverse needs				●							●	●					●						●					●	●
enabling precise temperature adjustment through a water heating system which recirculates the water as it warms up to reduce waste	●												●	●		●							●						●
activating a timer as turning on the tap to be aware about the duration of the activity					●	●					●										●				●	●			
a tap with pre-adjusted heat and flow rate settings	●			●									●	●		●					●							●	
creating a personalized profile to pre-adjust the individual needs and preferences (i.e., water temperature and flow rate) through an application	●			●									●	●				●			●					●			
tracking individuals' water consumption patterns, enabling them to set goals to reduce their consumption and informing them about how performing responsible behaviors would contribute to nature			●		●	●				●											●				●		●		
easier and precise adjustment of temperature and flow rate of water through a sliding bar	●			●										●									●		●			●	
informing the duration of use through music (i.e., selecting songs before the shower)					●	●					●		●										●		●	●			
providing data about the consequences of individuals' water consumption patterns and comparing household members' consumption through an application	●			●	●	●				●				●									●		●		●		
pre-adjusted thermostat system to determine the heat and the amount of water that is going to be consumed through the shower	●			●									●	●		●							●			●			●

User Intentions for DUI Workshop III

Through the generating stages, teams focused on *willing, doubtful, reluctant* and *unconcerned* user intentions while the *mindful* category was not selected by any team. Even the teams explained the reasons for their selection of the user intentions, they did not specify any particular reason for not including mindful users into the ideation process. Similar to the DUI workshop I, this could be related to this user's already established responsible behaviors. Table 4.17 shows the distribution of the refined ideas in relation to the adopted user intentions across the teams.

Table 4.17: Distribution of the refined ideas in relation to the adopted user intentions across the teams

	mindful	willing	doubtful	reluctant	unconcerned
Team 4		6		3	
Team 10			3		3
Team 15			8	6	
Team 17		3		3	
Team 18			3	4	
Team 20		4		4	
Total number of refined ideas	**0**	**13**	**14**	**20**	**3**

During the selection of user intentions, teams adopted similar approaches as the previous workshop participants. Their selection of activity scenarios guided some teams to certain user intentions. For instance, Team 10, focusing on the washing hands activity after coming home from outside to disinfect the hands, believed that this activity would result in intensive use of water particularly for the *unconcerned* users since they were quite careless and unaware about the environmental impacts and would adopt reckless behaviors, and thus they targeted that user category. Some teams, on the other hand, considered the potential environmental contributions of altering the behaviors of more challenging users with lower intention to adopt responsible behaviors (e.g., reluctant users) and focused on these user categories.

In the second round of ideation, as they switched the user intentions, participants often preferred to focus on a user category from the diverse parts of the spectrum in term of their intention or resistance to adopting pro-environmental behaviors. Team 20, exploring the face washing activity for a fresh start to a day for *willing* users, targeted *reluctant* users for showering after a long day, believing that this diversity would enhance the variety of problems for intensive use of water. However, some teams preferred to select adjacent user intentions (i.e., doubtful and reluctant), believing that altering the activity scenarios would already enrich the problems and focusing on users with lower intention to adapt change would be more stimulating. These diverse approaches and understandings of participants in relation to the user intentions enabled them to explore diverse user intentions and include different perspectives about the users into the generating stages.

Behavior Types for DUI Workshop III

As brainstorming on the potential reasons for intensive use of water and generating ideas for influencing these towards sustainable directions, teams incorporated a wide range of behavior types cards into the ideation. Through the workshop session, all of the behavior types cards were utilized by diverse teams and stimulated discussions on understanding the problem area and developing ideas for the effective use of water (Table 4.18). The distribution of refined ideas across adopted behavior types cards revealed that *running water without any purpose* and *ineffective scaling of water* inspired the development of more ideas while the ideas associated with *using water for different purposes* was rarer.

Table 4.18: Distribution of the refined ideas in relation to the adopted behavior types across the teams

Behavior types	Team 4		Team 10		Team 15		Team 17		Team 18		Team 20		Total number of ideas
	G1	G2	G1	G2	G1	G2	G1	G2	G1	G2	G1	G2	
running water without any purpose	4	2	2	3	2	2				2	2	3	**22**
using water for different purposes	2	1			3			3		1			**10**
performing activities frequently and repeating activity stages	1	1	3	2	1	3			1	1	1		**14**
ineffective scaling of water	2	1		2	5	1		2	2	1	2	3	**21**
performing activities and activity stages for long durations	1		3	1	2	3	2	2			2	2	**18**
performing habitual behaviors	1	1			2	1	3		1		2	2	**13**

While making use of the behavior types cards, teams rarely use them alone whereas they often preferred to combine them with other inspiration cards to be able to have a comprehensive understanding of the problem area. Their choice of user intentions was also quite effective as deciding upon the behavior types. For instance, as brainstorming on the potential behavior patterns of reluctant users, Team 20 assumed that these users would leave the tap on because of the perceived difficulty of readjusting temperature *(running water without any purpose)*, would not mind the flow rate as they prioritize their comfort (*ineffective scaling of water and performing habitual behaviors*) and would not care about the environmental consequences of their behavior and act recklessly (*performing activities and activity stages for long duration*). This combination of diverse behavior types enabled the team to adopt a holistic approach to the problem area and guided them to come up with an application idea which provides real-time information about the implications of the individuals' water consumption patterns to increase their awareness and compares household members' water use to further motivate them to act responsibly (Figure 4.39).

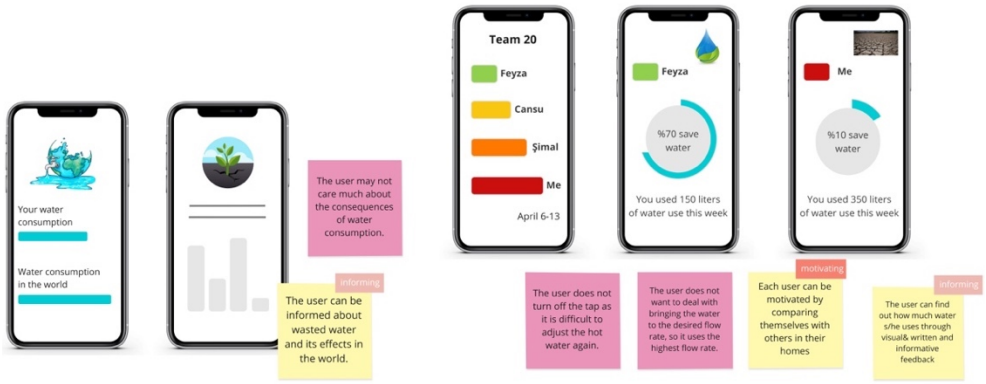


Figure 4.39: A scene from the Team 20's generating II stage demonstrating an idea incorporating diverse behavior types

Attitudinal Determinants of Behaviors for DUI Workshop III

During the workshop session, participants similarly make use of a range of attitudinal determinants in relation to the selected activity scenarios, user intentions and behavior types, and they preferred to combine multiple cards that they found relevant to each other. Team 17, for example, thought that reluctant users are often *performing activities and activity stages for long durations* and *performing habitual behaviors* as they are neither aware of the water consumption that these behaviors are causing (*visibility and clarity of water consumption)* nor recognize the time they spent (*perception of time)*. Framing the problem through combining these cards, the team came up with an idea providing real-time and meaningful feedback about the consumed water and duration of use through a screen attached to the tap (Figure 4.40).

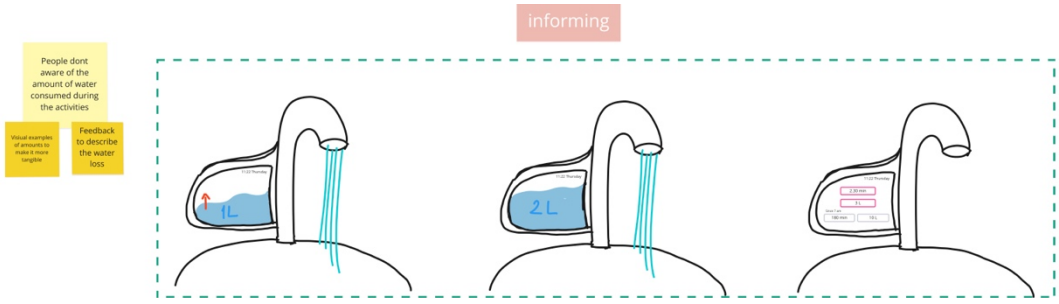


Figure 4.40: A scene from the Team 17's generating I stage demonstrating an idea incorporating diverse attitudinal determinants

In the second round of ideation, in line with the focused activity scenarios and user intentions, the teams kept some of the attitudinal determinants, included more relevant ones or omitted the ones that they found unrelated. Anyhow, each team tried to re-explore the attitudinal determinants for their new case. The distribution of the refined ideas across the attitudinal determinants of behaviors that inspired them is shown in Table 4.19. It can be inferred that the *need for comfort* supported the development of more ideas while the *need for disinfecting body and body parts* and *perception of hygiene for bathroom components* were associated with fewer ideas.

Table 4.19: Distribution of the refined ideas in relation to the adopted attitudinal determinants of behaviors across the teams

Attitudinal determinants of behaviors	**Team 4**		**Team 10**		**Team 15**		**Team 17**		**Team 18**		**Team 20**		**Total number of ideas**
	G1	**G2**	**G1**	**G2**	**G1**	**G2**	**G1**	**G2**	**G1**	**G2**	**G1**	**G2**	
feeling oneself clean and refreshed	2	1	1		3	1	1	3		1			**13**
need for disinfecting body and body parts	1	1	1	2	1	1							**7**
perception of hygiene for bathroom components		1		1	2	3				1			**8**
visibility and clarity of water consumption	1		1	1	2		3	1	1		1	1	**12**
perception of time	2	1	2	2		1	2	1		1	1	1	**14**
need for rinsing body and body parts	1	2	1	1	2	2	1	1	1	1			**13**
need for comfort	4	2	2		4	2		2	1	2	2	2	**23**

Contextual Determinants of Behaviors for DUI Workshop III

With the aim of recognizing the contextual factors that contribute to adopting water-intensive behaviors, teams utilized a range of contextual determinants through the generating stages that are found relevant to the targeted activity scenarios, user intentions and behavior types. For example, in brushing teeth, washing hands and face routine performed by doubtful users, Team 18 stated that users often have difficulties as adjusting the water pressure *(ineffective scaling of water)*, since the taps would not offer diverse pressure settings and let the water run intensively

(ineffective spraying of water). They also mentioned repetitively rinsing personal care products and cleaning supplies *(performing activities frequently and repeating activity stages, need for rinsing body and body parts* and *difficulty in cleaning bathroom components)* because of the limited flexibility of the taps to spread water effectively *(difficulty in personalizing bathroom components)*. Considering these, the team developed an adjustable tap head idea which offers flexible use and offers effective rinsing through diverse pressure modes (e.g., mixing air with water, diverse spray patterns, etc.) (Figure 4.41). The incorporation of multiple inspiration cards and creating relations between them, supported the team to comprehend the core of the problem and generate an idea accordingly.

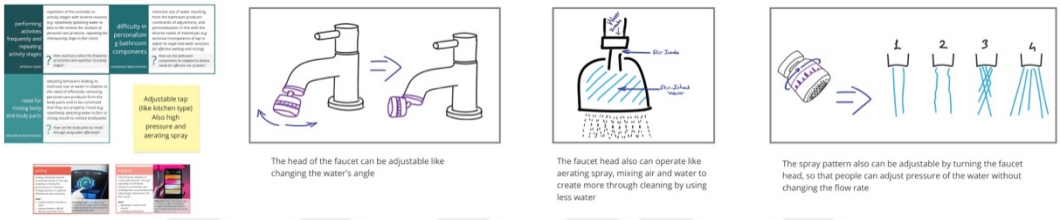


Figure 4.41: A scene from the Team 18's generating I stage demonstrating an idea incorporating diverse contextual determinants

Compared to the previous DUI workshops, the participants were inspired by the contextual determinants more effectively as brainstorming on the problem area and generating ideas. Among the card deck, *difficulty in controlling the tap* and *difficulty in personalizing bathroom components* contributed to the development of more ideas. *Deterioration of bathroom components and their replacement*, on the other hand, inspired fewer ideas when compared to the rest which was quite similar in the previous workshop sessions. The distribution of the refined ideas across the adopted contextual determinants of behaviors are presented in Table 4.20.

Table 4.20: Distribution of the refined ideas in relation to the adopted contextual determinants of behaviors across the teams

Contextual determinants of behaviors	Team 4		Team 10		Team 15		Team 17		Team 18		Team 20		Total number of ideas
	G1	G2	G1	G2	G1	G2	G1	G2	G1	G2	G1	G2	
difficulty in controlling the tap	2	3	1	1	2	3			1	1	2	3	**19**
difficulty in cleaning bathroom components		1		1	2	3			1	1			**9**
difficulty in accessing hot water	1				2	1				3	1	1	**9**
ineffective spraying of water	2		1	3	3	1		2	1	1			**14**
difficulty in personalizing bathroom components	3	1	2	2	2	2		3	1		1		**17**
deterioration of bathroom components and their replacement					2	1							**3**

Design Strategies for DUI Workshop III

Similar to the previous workshops, teams' selection of design strategies was strongly influenced from the focused user intentions and their assumed tendencies for adopting sustainable behaviors. Table 4.21 below illustrates the distribution of the refined ideas in relation to the design strategies and user intentions. As the table suggests, each design strategy inspired the development of ideas quite evenly except the *motivating* strategy which was utilized less when compared to the rest.

Table 4.21: The distribution of the refined ideas in relation to the design strategies and user intentions

Design strategies	User Intentions					Total number of ideas
	mindful	willing	doubtful	reluctant	unconcerned	
informing		5	7	6	2	**20**
engaging		7	5	5	2	**19**
motivating		1	3	2		**6**
guiding		5	7	10		**22**
determining		4	3	9	3	**19**

Teams embraced diverse approaches as inspiring from design strategies and relating them with their choice of user intentions. Assuming that the reluctant users would not prefer to put so much effort to act responsibly, Team 15 mainly used *guiding* (e.g., flexible tap neck) and *determining* (e.g., turning off the tap automatically) strategies so that it would be easier for them to use water effectively. Team 17, on the contrary, inspiring from the need to increase reluctant users' awareness about environmental issues and enable them to maintain intended behaviors adopted *informing* (e.g., real-time feedback on the duration of use), *engaging* (e.g., offering personalized adjustments) and *motivating* (e.g., comparing the history of water consumption) strategies during ideation.

Since the willing users are already aware of the consequences of their behaviors, Team 4 often used *engaging* (e.g., precise temperature adjustments for personal needs), *guiding* (e.g., offering responsible choices to spray less water) and *determining* (e.g., automatically collecting and reutilizing water) strategies to make them perform water effective behaviors in an easier way. Team 20, however, preferred to enhance the awareness of willing users through providing knowledge that is invisible to them through *informing* strategy (e.g., visualizing the duration of use and the implications of responsible behaviors on nature). They also utilized *engaging* strategy (e.g., enabling personalized adjustments) to empower them as interacting with the products.

Teams either used the design strategies alone or combined multiple strategies together to ensure behavior change through providing various incentives. *Informing, engaging* and *motivation* strategies which give the user relatively more power as making decisions about their behaviors were mostly preferred to be used in combination with the other strategies to enhance their impacts. However, *guiding* and *determining* strategies were often utilized alone as generating ideas. During the ideation *informing-engaging, informing-motivating* and *engaging-guiding* were among the frequently adopted combinations of design strategies for stimulating change.

4.5.3.4 Participants' Evaluations of the Generative Tool and the Workshop Process

This final stage of the DUI workshop was transferred into an online questionnaire owing to the number of participants. Sixty participants responded to the questionnaire, which includes both open-ended and Likert scale questions to gain insights into the participants' experiences and suggestions for the workshop session (Appendix I). Likert-scale questions were analyzed through the calculation of mean values for each statement, while for the open-ended ones, the *content analysis* method was adopted. The findings from the participants' evaluations will be shared through discussing the contributions and limitations of the inspiration cards and the workshop process.

Behavior types and attitudinal and contextual determinants of behaviors cards were found quite successful in terms of *the clarity of the definitions* of each card. Particularly, provided examples were mentioned to be supportive of comprehending the definitions of the cards. Some participants even suggested to include more examples to be able to recognize diverse problems. However, some of the participants had concerns about the descriptive nature of the cards and preferred to have shorter explanations, especially in a workshop where they have limited time for exploration.

They were very satisfied with the cards' *usefulness in familiarization with the problem area.* Card deck was stated to be comprehensive as it includes various issues related to intensive use of water that helped them to discuss and elaborate on the problem area. Some participants suggested incorporating an empty card through which the participants would include new behavior types or determinants that they have observed or experienced and generate more diverse ideas. Participants also found the cards *easy to integrate into ideation* and shared positive opinions about their *effectiveness for inspiring diverse ideas*. The questions on the cards guided them effectively as transitioning from the developed problem areas to the initial

ideas. Figure 4.42 demonstrates the participants' overall evaluations of the behavior types and attitudinal and contextual determinants of behaviors cards.

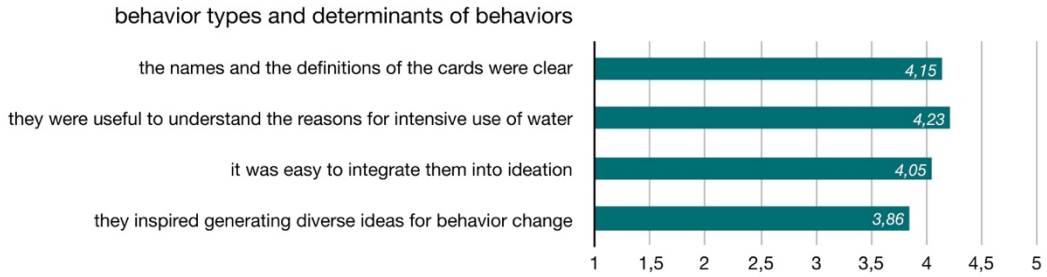


Figure 4.42: Participants' evaluations of the behavior types and the determinants of behaviors cards

User intentions cards were indicated to be useful as *empathizing with the users* and supported participants to understand the reasons for their behaviors. Some were quite eager to utilize these user categories to develop personas for the further stages of the design project. Even participants stated to be very satisfied with *the clarity of the definitions* and *the distinction between the categories,* some had difficulties as recognizing the difference between reluctant and unconcerned users. However, user statements on the right side of the cards stated to be supportive as clarifying the distinction between the user intentions through enabling them to recognize the actual users' insights and attitudes for adopting change. They mainly considered the cards as *easy to integrate into ideation,* with one exception. Mindful users were found challenging during the ideation process since they were already acting responsibly and would not need any further incentives to alter their behaviors. Overall, the card deck was stated to be very *effective for inspiring diverse ideas* and *adaptable to diverse design projects*. Participants' evaluations of the user intentions cards in relation to the addressed questions can be seen in Figure 4.43.

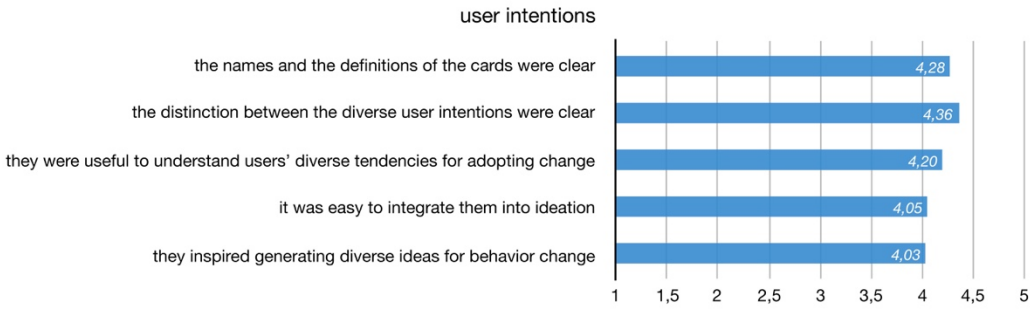


Figure 4.43: Participants' evaluations of the user intentions cards

Design strategies cards were mainly considered satisfactory in terms of their *clarity of the definitions*. Images of product examples and their explanations helped the participants to further relate the strategies with real-life design solutions. Even they indicated to be very satisfied with *the distinction between the categories*, some suggested including more categories to support the diversity of ideas. Since the proposed categorization of the design strategies encompasses quite diverse techniques and approaches adopted for sustainable behavior change in the related literature and includes a new strategy (i.e., engaging) aiming to empower the users, this categorization will not be extended further for future adaptation of the card set.

During the sharing and reflecting stage, none of the teams experienced any difficulty as relating their ideas with the provided design strategies. The content of the cards supported the participants while *recognizing the diverse approaches for promoting sustainable behaviors*. The diverse techniques for their implementation (e.g., making suggestions, setting goals, making a behavior difficult to perform, etc.) were stated to be very useful to realize diverse approaches to adopt while generating ideas for behavior change. The cards were mentioned to be *easy to integrate into ideation,* yet, a few participants used the cards to categorize the ideas they had already developed rather than to stimulate ideation. In general, they were quite positive about the cards' *effectiveness for inspiring diverse ideas*. It can be inferred that the effective integration of the cards has been improved significantly considering the changes that

were made prior to this final workshop. Figure 4.44 illustrates the participants' overall evaluations of the design strategies cards.

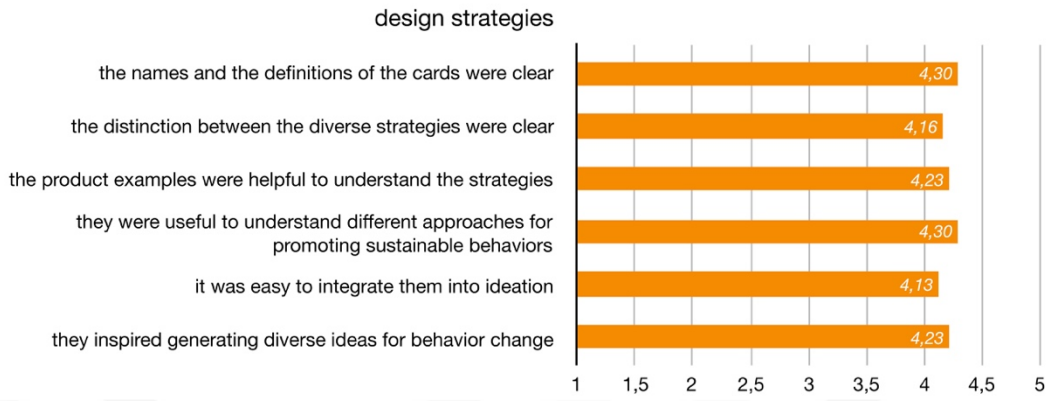


Figure 4.44: Participants' evaluations of the design strategies cards

The workshop process was indicated to enable participants to consider different issues and approaches and generate quick and diverse ideas. Participants showed eagerness to adopt the workshop procedure and the inspiration cards, particularly the user intentions and design strategies, into their future design projects.

Even though the *sensitizing stage* was found quite helpful to recall their behaviors and realize their concerns and understandings about water consumption, they mainly suggested better incorporating this task with the workshop stages. The activity scenarios from this stage, for instance, were recommended to be further explored during the generating stages. *Switching the user intentions* during the generating stages was indicated to be helpful to develop diverse ideas in a relatively short period of time. *Similarly switching the activity scenarios* supported the teams to generate quick and various ideas through focusing on diverse issues related to the different personal care and hygiene activities performed in the showering and the washbasin areas. *Workshop brief* and *inspiration cards* distributed prior to the session were found helpful to understand the aim of the workshop and its procedure. However, some participants did not review it earlier; in that sense *introducing* stage carried out during the workshop session, which mainly aimed to briefly remind the participants the procedure and the content of the cards may remain limited for those participants.

Anyhow, they were satisfied with the *workshop procedure* and followed the steps quite successfully. Collaborative work also supported them in discussing and solving the unclear issues about the workshop session. Participants' overall evaluations of the workshop process are demonstrated in Figure 4.45.

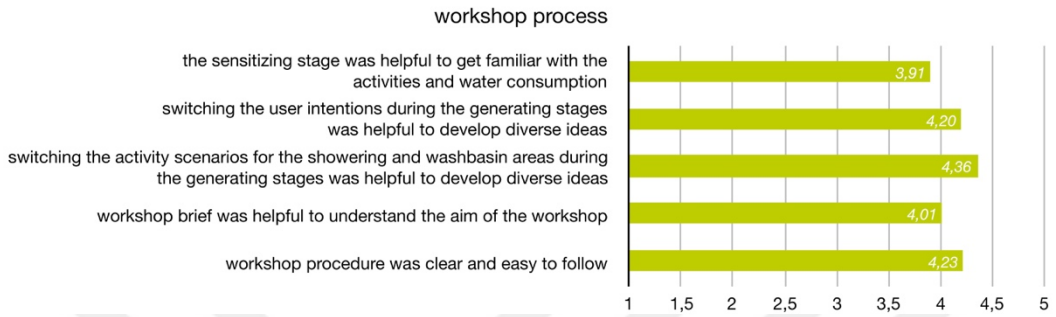


Figure 4.45: Participants' evaluations of the design strategies cards

One suggestion was related to including an additional step between the generating and sharing and reflecting stages to enable participants to prepare their team canvasses through relating the inspiration cards with the developed ideas. As sharing their ideas, however, each team managed to relate their ideas with the adopted inspiration cards quite successfully through the incorporated labels and their verbal presentations. They also suggested extending the duration of the generating stages to enhance the quality of their sketches. Since the particular aim of the workshop was to investigate how inspiration cards would support the development of diverse ideas, the quality of the sketches was not the main concern. In future adaptations of the inspiration cards, the content of the cards was suggested to include more visuals like design strategies cards for quick idea development sessions.

4.5.3.5 Reflections on the Workshop III

Based on the scope of the design project in which this workshop was included and the participants' reflections on the previous DUI workshop, several revisions were carried out on the inspiration cards and workshop process. First of all, since the project was encompassing all the personal care and hygiene activities performed

within the bathroom environment*, the definitions of the behavior types and attitudinal and contextual determinants of behaviors were revised* and more diverse examples both from the washbasin and showering area were included. Participants did not experience any significant difficulty in relation to the clarity of the definitions*. The number of students participated in the workshop* was quite high (71 students) when compared to the previous workshop sessions (9 and 8 students). However, the contributions of the co-facilitator eased the facilitation, particularly during the generating stages through visiting the teams for responding emerging questions and the sharing and reflecting stage which was conducted in three separate sections. In this workshop, rather than switching team members, participants *switched activity scenarios* which supported the teams to explore a range of problems and develop quite diverse solutions for influencing behaviors for the effective use of water as performing activities both around the washbasin and the showering area.

Including images of design solutions into the design strategies cards was found quite effective to understand and discuss the implementation of the strategies into ideation. *Incorporating quotes from the users' statements into the user intention cards* was also found helpful to be able to relate with the actual users' concerns and attitudes about water consumption. Finally, *extending the duration of generating stages* enabled participants to refine their initial ideas and present them quite clearly in relation to the inspiration cards that they have inspired from. This also contributed to the number of ideas developed by the teams which was more diverse when compared to the previous workshops.

4.6 Conclusions for the DUI Workshops

The adoption of the inspiration cards supported the participants in various ways throughout the diverse stages of the workshops. Through the analysis of the participants' statements, the particular purposes of the inspiration cards were grouped as *exploring, generating, refining, reconsidering* and *supporting*. These

purposes are quite similar with the previously discussed expectations of designers as utilizing user research findings (Colusso, 2017; Töre Yargın, 2013) *(see Section 4.2 Workshop Materials: Transferring Research Findings into a Generative Tool).* It adds on the proposed categorizations with the *reconsidering* dimension, as the proposed generative tool encourages designers to re-evaluate the problem space for the users with diverse intentions towards change and develop or adapt ideas accordingly. Table 4.22 presents the purposes of the inspiration cards in relation to the adopted cards in three DUI workshop sessions.

For the *exploring* purposes, the user intentions cards enable participants to *empathize with the users* through understanding their attitudes, environmental concerns, perceived behavioral controls and eagerness or resistance to adopting sustainable behaviors. This understanding supported them in discovering the needs, preferences, and expectations of these users related to water consumption, and in turn, revealed various problems that the users might be experiencing. Along with the user intentions, behavior types, and determinants of behaviors cards (i.e., former problem areas cards), helped the participants *to explore and elaborate on the problem area* through gaining insights into diverse behaviors that are responsible for intensive use of water and the attitudinal and contextual factors associated with their performance. During the DUI workshop II, these cards were also used *for building a use scenario* through which participants imagined the users and their potential behaviors as engaging with the activities and recognize diverse problems for intensive use of water. Through facilitating discussions with the team members, the participants *identified significant problem areas* to be incorporated into the ideation. Figure 4.46 demonstrates how Team 1 in DUI workshop II utilizes the inspiration cards to familiarize with the users as well as the problem area.

Table 4.22: Purposes of the utilization of the inspiration cards

Purposes of the inspiration cards		DUI WORKSHOP I					DUI WORKSHOP II					DUI WORKSHOP III				
		Behavior-oriented problem areas	Attitude- oriented problem areas	Product and system-oriented problem areas	User intentions	Design strategies	Behavior types	Attitudinal determinants of behaviors	Contextual determinants of behaviors	User Intentions	Design strategies	Behavior types	Attitudinal determinants of behaviors	Contextual determinants of behaviors	User Intentions	Design strategies
exploring	empathizing with the users				•					•					•	
	exploring and elaborating on the problem area	•	•	•	•		•	•	•	•		•	•	•	•	
	building a use scenario						•	•	•	•						
	identifying significant problems	•	•	•	•		•	•	•	•		•	•	•	•	
generating	determining potential solution areas	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	adopting diverse techniques for stimulating behavior change				•	•				•	•				•	•
	following a procedure for ideation	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	developing diverse initial ideas	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	assessing the ideas' relevance with the problem space	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	selecting ideas for further development	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
refining	detailing selected ideas	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	visualizing ideas					•					•					•
reconsidering	re-evaluating the problem area for a different user intention	•	•	•	•		•	•	•	•		•	•	•	•	
	re-evaluating the design strategies for a different user intention				•	•				•	•				•	•
	developing ideas for a different user intention	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	adapting previously generated ideas to a different user intention	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
supporting	supporting design decisions	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

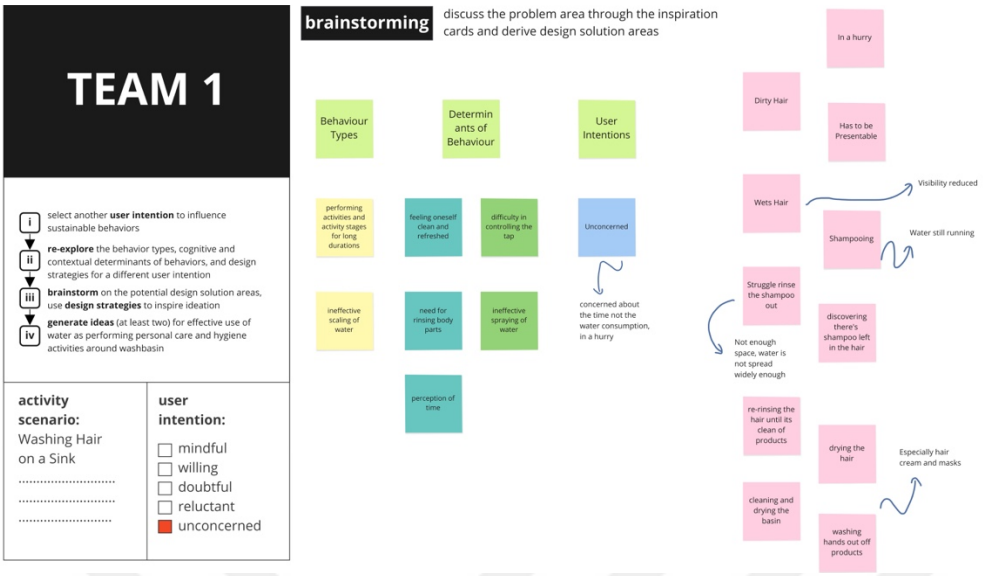


Figure 4.46: A scene from the DUI workshop II; Team 1's canvas as exploring the inspiration cards

During *generating* ideas, inspiration cards guided participants while *determining potential solution areas* within the previously identified problem space. Through the integration of the design strategies cards, they had an opportunity to recognize and *adopt diverse techniques for stimulating behavior change.* The utilization of the inspiration cards also supported them to *follow a procedure for ideation* which enabled the participants to focus on the intended problem area and the specific user category and generate ideas that are directly related to sustainable behavior change. As *developing diverse initial ideas*, participants made use of each card sets. Once the initial ideas emerged, they *assessed the ideas' relevance with the problem space* and *selected ideas for further development.* An example for the adoption of the inspiration cards for generating ideas was presented in Figure 4.47.

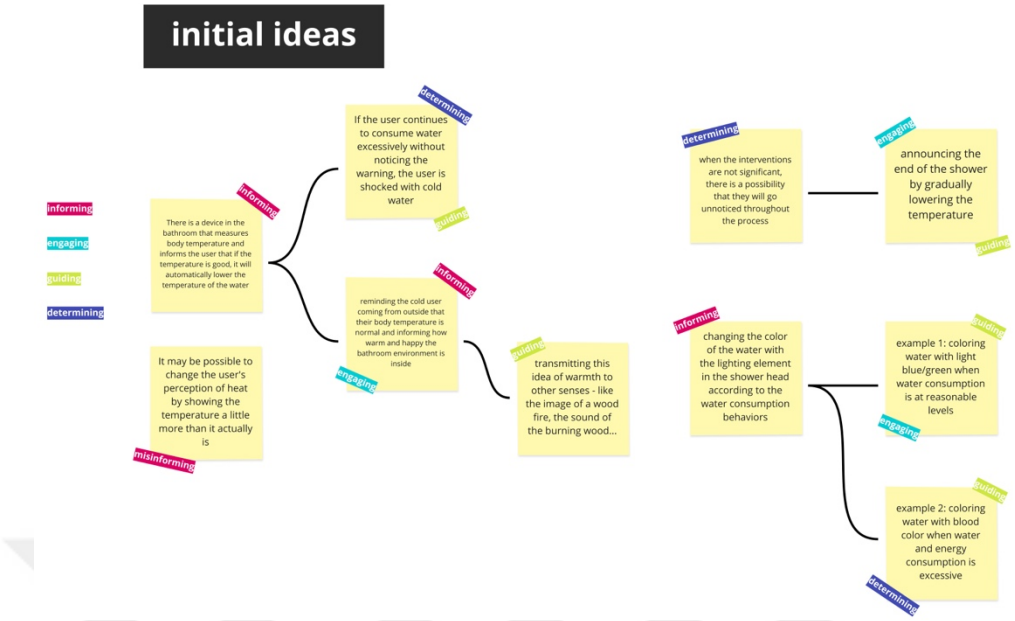


Figure 4.47: A scene from the DUI workshop I; Team 3's canvas as generating initial ideas for effective use of water (reproduced in English)

As *refining* ideas, they *detailed the selected ideas* reconsidering the content of the cards that inspired them. Then, they *visualized the ideas* for the presentation. During the visualization stage, they used both hand sketches and digital drawings based on the available tools and their skills. The below scene from Team 1's ideation process from DUI workshop I demonstrates how they refined and visualized their ideas in relation to the adopted inspiration cards (Figure 4.48).

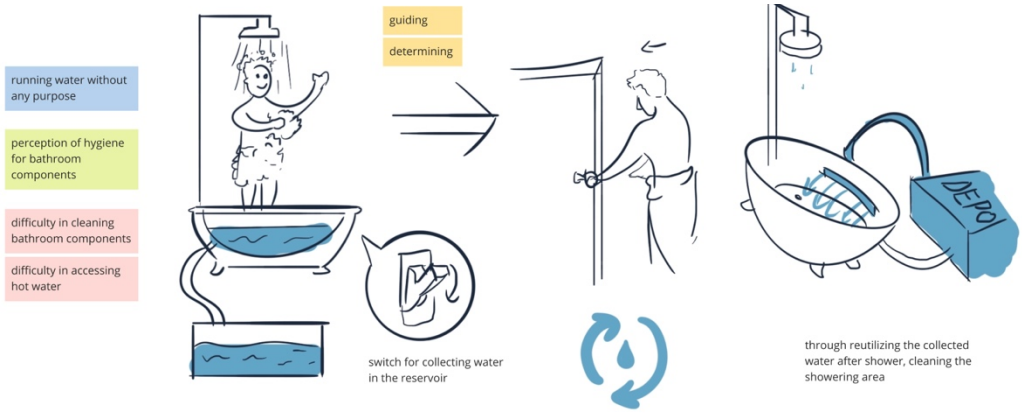


Figure 4.48: A scene from the Team 1's canvas as refining their ideas for sharing (reproduced in English)

While *reconsidering* ideas during the second round of ideation in each workshop session, teams targeted a diverse user intention and consequently *re-evaluated the problem area for a different user intention* considering their diverse behaviors responsible for water consumption. Since the previously adopted design strategies might be irrelevant for a different user intention, they also *re-evaluated the design strategies* in line with the needs and expectations of the targeted users. This evaluation leads to *adapting previously generated ideas to a different user intention* through incorporating relevant inspiration cards and omitting unrelated ones. However, participants often preferred *developing ideas for a different user intention* believing the prior ones would not be useful to encourage sustainable behaviors considering the users' level of intention for adopting change. During the DUI workshop III, along with the user intentions, participants also switched activity scenarios which led to the *re-exploration of the inspiration cards for a different activity* and supported the diversity of the generated ideas.

For the purposes of *supporting* the generated ideas, participants tried to link the inspiration cards that they have adopted during the workshop process with the refined ideas and presented the ideas through referring to them. Adopting inspiration cards helped them to *support their design decisions* through justifying their relevance for influencing behaviors for the effective use of water (Figure 4.49).

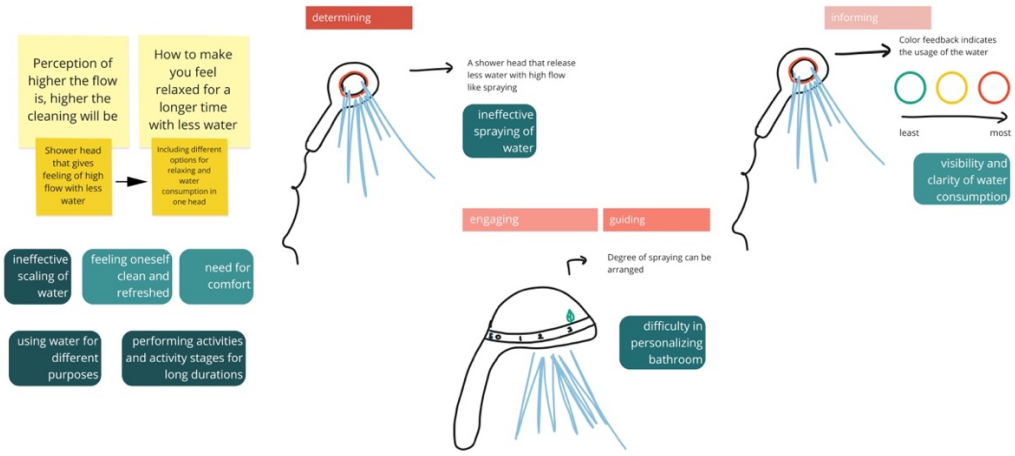


Figure 4.49: A scene from the DUI workshop III; Team 17's canvas as supporting their ideas with the adopted inspiration cards

4.7 Summary and Discussion

In this final stage of the doctoral study, three design workshops were facilitated to investigate the implications of the workshop procedure and the inspiration cards. This chapter presented the development of the inspiration cards and the workshop process, their adaptation in each workshop session, and findings from the sessions through reflecting on their contributions and limitations for developing ideas aiming to influence behaviors for the effective use of water in the bathroom environment which are briefly summarized in Table 4.23.

The scope of the workshops in terms of the targeted personal care and hygiene practices were different in each session. First workshop focused on the activities around the showering area, the second one targeted the activities around the washbasin area while the final one had incorporated activities from both areas. The duration of the workshops was quite similar, though *the allocated time for workshop stages* showed differences in each session (i.e., longer durations for the generating stages). Even the overall workshop procedure remained the same, *the order of the stages revised* based upon the findings from each session (i.e., performing sensitizing stage prior to the workshop, combining sharing and reflecting stages). Through these iterations, *new tasks and workshop materials* were included (i.e., visualization task and design brief) and *the facilitation of the stages* were altered (i.e., switching teams and activity scenarios, online questionnaire for the evaluating stage). Based upon the findings from each session, *the inspiration cards were revised and refined* to increase their effectiveness to support ideation. *A scale demonstrating the users' eagerness to adopt change* and *quotes from the user research findings* were included in the user intentions cards. Considering the scope of each workshop session, *the definitions of the behavior types and determinants of behaviors cards were revised* to encompass examples from the user research study. *The design strategies cards were revised* to include five strategies and *exemplary design solutions* along with their short descriptions were included to better communicate the implications of the strategies.

Table 4.23: Summary of the DUI workshop sessions

	WORKSHOP I	WORKSHOP II	WORKSHOP III
aim and scope	personal care and hygiene practices around the **showering area**	personal care and hygiene practices around the **washbasin area**	personal care and hygiene practices around the **showering and washbasin area**
facilitation	9 participants 5 hours 15 minutes	8 participants 5 hours 30 minutes	71 participants (18 participants were included in the analysis) 5 hours 30 minutes
development of the workshop process	included **seven successive stages**; introducing, sensitizing, generating I, sharing & reflecting I, generating II, sharing & reflecting II and evaluating	**the order of introducing and sensitizing stages** was changed **visualization task** was incorporated into the sensitizing stage **participants switched teams** in the second round of ideation **a design brief** was included	**sharing and reflecting stages were combined** and facilitated after the generating stages evaluating stage was conducted as an **online questionnaire** **activity scenarios were changed** in the second round of ideation **inspiration cards were sent to the participants before the workshop** to be reviewed
development of the inspiration cards	user intentions cards included the name and definition of the individuals' awareness, attitudes, concerns and constraints in relation to water consumption definitions of the cards were specific to the showering area included 4 **design strategies** (informing engaging, guiding and determining)	**a scale demonstrating the users' intention or resistance** to adopting change is included in the user intentions cards definitions of the cards were revised to include research findings from the washbasin area included 5 **design** strategies (informing engaging, motivating, guiding and determining)	**quotes from the users' statements** received through the user research study were incorporated into the user intentions cards definitions of the cards were revised to include research findings from the showering and washbasin area the **images of design solutions** along with their short descriptions were included
utilization of the inspiration cards	55 **initial ideas**, 30 **refined ideas** were generated	24 initial ideas, 26 refined ideas were generated	50 initial ideas were generated and all of which are refined
user intentions cards	none of the teams selected **mindful** users **doubtful** and **unconcerned** users were selected more frequently **unconcerned** users inspired the development of more ideas	none of the teams selected **doubtful** users **reluctant** users were selected more frequently each user intention inspired the development of ideas evenly	none of the teams selected **mindful** users **reluctant** users were selected more frequently **reluctant** users inspired the development of more ideas
behavior types cards	**using water for different purposes** and **performing activities and activity stages for long durations** inspired the development of more ideas	**ineffective scaling of water** inspired the development of more ideas	**running water without any purpose** and **ineffective scaling of water** inspired the development of more ideas
attitudinal determinants of behaviors cards	**visibility and clarity of water consumption** and **perception of time** inspired the development of more ideas **perception of hygiene for bathroom components** were targeted less for the development of ideas	**feeling oneself clean and refreshed** and **need for rinsing body and body parts** inspired the development of more ideas none of the teams selected **perception of hygiene for bathroom components**	**need for comfort** inspired the development of more ideas **disinfecting body and body parts** and **perception of hygiene for bathroom components** were targeted less
contextual determinants of behaviors cards	**each determinant** inspired the development of ideas evenly	**difficulty in controlling the tap** inspired the development of more ideas none of the teams selected **difficulty in cleaning bathroom components** and **deterioration of bathroom components and their replacement**	**difficulty in controlling the tap** and **difficulty in personalizing bathroom components** inspired the development of more ideas **deterioration of bathroom components and their replacement** were targeted less
design strategies	**informing** and **engaging** were the most frequently adopted design strategies **informing-engaging, guiding-determining** and **engaging-guiding-determining** were the most common combinations of design strategies	**guiding** and **determining** were the most frequently adopted design strategies **engaging-guiding, informing-motivating** and **guiding-determining** were the most common combinations of design strategies	design strategies were adopted evenly except the **motivating** strategy informing-**engaging, informing-motivating** and **engaging-guiding** were the most common combinations of design strategies

Each workshop session contributed to the development of a range of ideas for encouraging sustainable behaviors. As the duration of the generating stages were extended, the participants had an opportunity to refine all of the initial ideas. The utilized inspiration cards showed difference across each session, though participants adopted common approaches as selecting cards. Through the workshop sessions, the teams often focused on users with lower intentions towards adopting change *(i.e., reluctant and unconcerned)* believing that the environmental implications of these individuals' current behaviors need serious attention to be positively affected through design interventions. As switching user intentions during the second round of ideation; however, the common tendency was to target user intentions from the diverse ends of the spectrum *(e.g., doubtful and unconcerned, willing and reluctant)* rather than the adjacent ones. The reason for this choice was related to the teams' tendency to experience how users' diverse intentions would support the variety of ideas. During the first and the last workshop, the teams did not choose *mindful* users suggesting that their existing behaviors were already sustainable, and they would not need any further intervention to alter their behaviors. However, it should be noted that targeting mindful users might have a potential to inspire design interventions aiming to maintain their existing responsible behaviors.

During the workshop sessions, the teams targeted all of the *behavior types* from the card set. However, as the scope of the workshops changed, the most frequently considered behavior types cards showed differences. The focused personal care and hygiene activities and related behaviors that are responsible for intensive use of water also determined the selection of behavior types significantly. In the first workshop *using water for different purposes* and *performing activities and activity stages for long durations* inspired the development of more ideas which was directly related to the focused activity scenarios around the showering area. In the second workshop, most of the refined ideas were linked with the *ineffective scaling of water* considering the difficulties experienced while interacting with the washbasin tap for adjusting and controlling the flow of water. In the final workshop, *running water without any*

purpose and *ineffective scaling of water* were picked more often as generating ideas. The diversity of the targeted behavior types increased in the second generating stages as new user intentions inspired new behavioral aspects to be considered during ideation. Familiarization with the content of the card set might also have influenced this variety.

Participants' selection of *attitudinal determinants* showed differences across workshop sessions. Along with the scope of the workshops, the targeted behavior types were also influential in this diversity. In the first workshop, *visibility and clarity of water consumption* and *perception of time* was targeted more often through highlighting their significance for the showering activity and related behaviors for intensive use of water. In the second workshop, *feeling oneself clean and refreshed* and the *need for rinsing body and body parts* were the prominent determinants. The selection of these cards was linked to the activities performed around the washbasin area and individuals' related attitudes and concerns towards water consumption. In the final workshop, on the other hand, *need for comfort* contributed to the development of a significant number of ideas. Even each card was utilized quite successfully, what was in common between all three workshop sessions was the rare selection of *perception of hygiene for bathroom components* card. Since cleaning the showering and washbasin area is often considered as a complementary task performed during or at the end of the personal care and hygiene activities, the teams may not think of it as a significant part of the activities and did not recognize it as a relevant problem responsible for the intensive use of water.

Utilization of the *contextual determinants of behaviors* were also quite diverse among each workshop session. In the first two sessions, the card set contributed to the development of fewer ideas whereas in the final workshop the participants made use of it quite effectively. Sharing the inspiration cards before the workshop might have enabled the participants of the final workshop to familiarize with the cards and support their utilization. In the first workshop, each card was targeted quite evenly. In relation to the activities around washbasin and targeted behavior types, *difficulty*

in controlling the tap supported the development of more diverse ideas during the second workshop. Though, none of the teams picked *difficulty in cleaning bathroom components* and *deterioration of bathroom components and their replacement* as a significant contributor to water-consuming behaviors. This could be related to the unawareness about the implications of the post-use and maintenance behaviors on intensive use of water (e.g., calcification, water leakage). In the final workshop, *difficulty in controlling the tap* and *difficulty in personalizing bathroom components* were targeted more frequently while similar to the previous one *deterioration of bathroom components and their replacement* was utilized quite rarely.

Through the workshop sessions, even the distribution of design strategies showed differences among sessions, most of the refined ideas inspired from the *guiding* strategy (47 ideas), which is followed by *informing* (45 ideas), *engaging* (45 ideas), *determining* (43 ideas) and *motivating strategies* (13 ideas). The reason for the limited number of ideas associated with motivating strategy could be related to its incorporation into the card set during the second workshop session. In this doctoral study, the engaging strategy was proposed to fill a rarely mentioned strategy in the literature aiming to empower individuals to adapt and personalize design interventions in line with their needs and create a bond between the individual and a desired behavior. The effective adoption of the proposed strategy through the workshop sessions supports its significance for promoting behaviors for sustainability.

The analysis also revealed that selected design strategies were strongly influenced from the targeted user intentions for adopting sustainable behaviors. Even it is difficult to suggest a certain design strategy would be appropriate for a specific user intention, it is possible to talk about participants' common insights and tendencies while selecting design strategies in relation to user intentions. Considering the *willing* users' awareness about environmental problems and eagerness to alter their behaviors, *engaging* and *guiding* strategies were among the most preferred design strategies to empower them while interacting with their environments and to make

the activities easier to perform. For altering the behaviors of *doubtful* users, *guiding* and *determining* were the most frequently adopted strategies to encourage or force intended behaviors. Though, a significant amount of ideas were linked with *informing* and *engaging* strategies considering the potential contribution of increasing their awareness about the outcomes of their behaviors and creating a bond with the design interventions. *Reluctant* users' low awareness about the environmental issues makes the *informing* strategy preferable for this user category. Since they also find it quite difficult to alter their existing behaviors, *guiding* and *determining* strategies were also preferred either to make interactions easier, or simply to force or automatically perform water-effective behaviors without increasing their awareness. For the *unconcerned* users, who are one of the most challenging categories with their low awareness and concern about the environmental problems, and high resistance towards change, the participants adopted diverse approaches for stimulating change. *Informing* and *determining* strategies were among the most preferred techniques through which either users are informed about the consequences of their behaviors, or water is automatically utilized responsibly. Besides, rather than imposing a certain behavior, *engaging* and *guiding* strategies were also selected for longer lasting alterations in unconcerned users' behaviors. Since during the workshop sessions, a limited number of ideas were developed for the *mindful* users, it is difficult to talk about a certain tendency towards adopting design strategies.

Design strategies were often used together to ensure behavior change through providing various incentives. Participants mostly combined strategies that are adjacent or closer to each other in terms of users' power in the decision-making process for adopting change. *Informing-engaging, informing-motivating, engaging-guiding* and *guiding-determining* were the most preferred combinations of design strategies.

In overall, the analysis of the workshops revealed that the incorporation of the inspiration cards possesses great potentials for supporting design ideation for

developing solutions for influencing water-effective use behaviors as performing personal care and hygiene activities in the bathroom environment. The inspiration cards along with the proposed workshop procedure empower designers as *exploring* the problem area and the user*, generating* diverse ideas*, refining* the developed ideas*, reconsidering* the ideas for a different user intention, and *supporting* their design decisions.

CHAPTER 5

CONCLUSION

This doctoral research investigates the reasons of intensive use of water, identifies the users' diverse intentions to adopt responsible behaviors, and explore potential ways of influencing behaviors for the effective use of water through a study focusing on personal care and hygiene activities in the bathroom environment. With the aim of providing a knowledge source and guidance for design researchers and practitioners, the study asks the following main research question:

- How can we support designers to understand the reasons for intensive use of water, recognize the users' diverse intentions to adopt responsible behaviors, and generate ideas for influencing behaviors for the effective use of water?

To respond to this main question, it asks a range of sub-questions:

1. What are the diverse behaviors leading to intensive use of water while performing personal care and hygiene practices? What are the determinants that affect individuals to adopt these behaviors?
2. What are the individuals' diverse intentions for adopting behaviors for effective use of water while performing personal care and hygiene activities?
3. How can we communicate diverse techniques and strategies for behavior change to designers to inspire ideas for influencing sustainable behaviors?
4. How can we transfer the research findings and insights into the ideation to support generating diverse ideas for influencing behaviors for the effective use of water?

5. How does the incorporation of the proposed generative tool and the workshop procedure support the ideation process for developing solutions for the effective use of water?

Thus far, the findings from and insights into the research conducted within the scope this doctoral study have been presented. With the aim of fulfilling the particular aim of this doctoral study and answering the research questions, this chapter discusses the major conclusions and contributions of this research through reflecting on the literature. In the proceeding sections, firstly how the research questions have been answered will be discussed. Then, the contributions of the study to knowledge will be delivered through positioning this study within the existing literature. It will enclose with the limitations of the study and opportunities for further research.

5.1 Revisiting Research Questions

5.1.1 Q1: What are the diverse behaviors leading to intensive use of water while performing personal care and hygiene practices? What are the determinants that affect individuals to adopt these behaviors?

Household water consumption is part of a complex system that is shaped by a range of individual, social and contextual factors, and thus the behaviors responsible for water use and their reasons are quite difficult to understand (Ramli, 2021; Pullinger et al., 2013; Shove, 2003). Along with that, bathroom environment holds many challenges for the researchers to gain insights into individuals' behaviors that might be considered as private. In this study, to reveal individuals' diverse behaviors that are responsible for intensive water consumption as performing personal care and hygiene practices in the bathroom and to expose the determinants of these behaviors, a diary study and generative interview sessions were planned and facilitated with the incorporation of various projective generative tools and techniques (i.e., diaries,

mapping, card sorting, visualization, probing cards). The adopted *generative research approach* enabled me to acquire details about the contextual factors shaping participants' water consuming practices *(i.e., mapping)*, their behaviors and interactions with their surroundings *(i.e., diaries and card sorting)* and contextual and attitudinal reasons behind the performance of these behaviors *(i.e., card sorting, visualization and probing cards)* that are difficult to express solely through words.

The adopted methodology enabling individuals to share the details about their practices revealed a range of *behavior types* that are responsible for intensive use of water. Besides, probing into the individuals' needs, beliefs, attitudes and concerns about water use and exposing their strategies, enablers and constraints for adopting water consuming behaviors led to the understanding of various *attitudinal* and *contextual determinants of behaviors. Section 3.6 Findings from the User Research* presents the detailed descriptions of the reveled behavior types and determinants of behaviors through examples from the participants' statements shared during the generative interview sessions.

The analysis of the participants' descriptions of their behaviors through reflecting on the reasoning behind them revealed strong relations between the behavior types responsible for intensive use of water and attitudinal and contextual determinants of behaviors. For instance, due to the bathroom products' constraints to precisely adjust the temperature of water *(difficulty in controlling the tap [contextual determinants of behaviors]) and* individuals' desire to maintain a comfortable experience *(need of comfort [attitudinal determinants of behaviors])* without interrupting the flow of events, they hesitate to turn off the tap during the activity stages when the water is not directly used and waste water *(running water without any purpose [behavior types])*. Figure 5.1 presents a list of behavior types and determinants of behaviors and visualizes these relations based upon how participants' associate their water intensive behaviors with diverse attitudinal and contextual determinants.

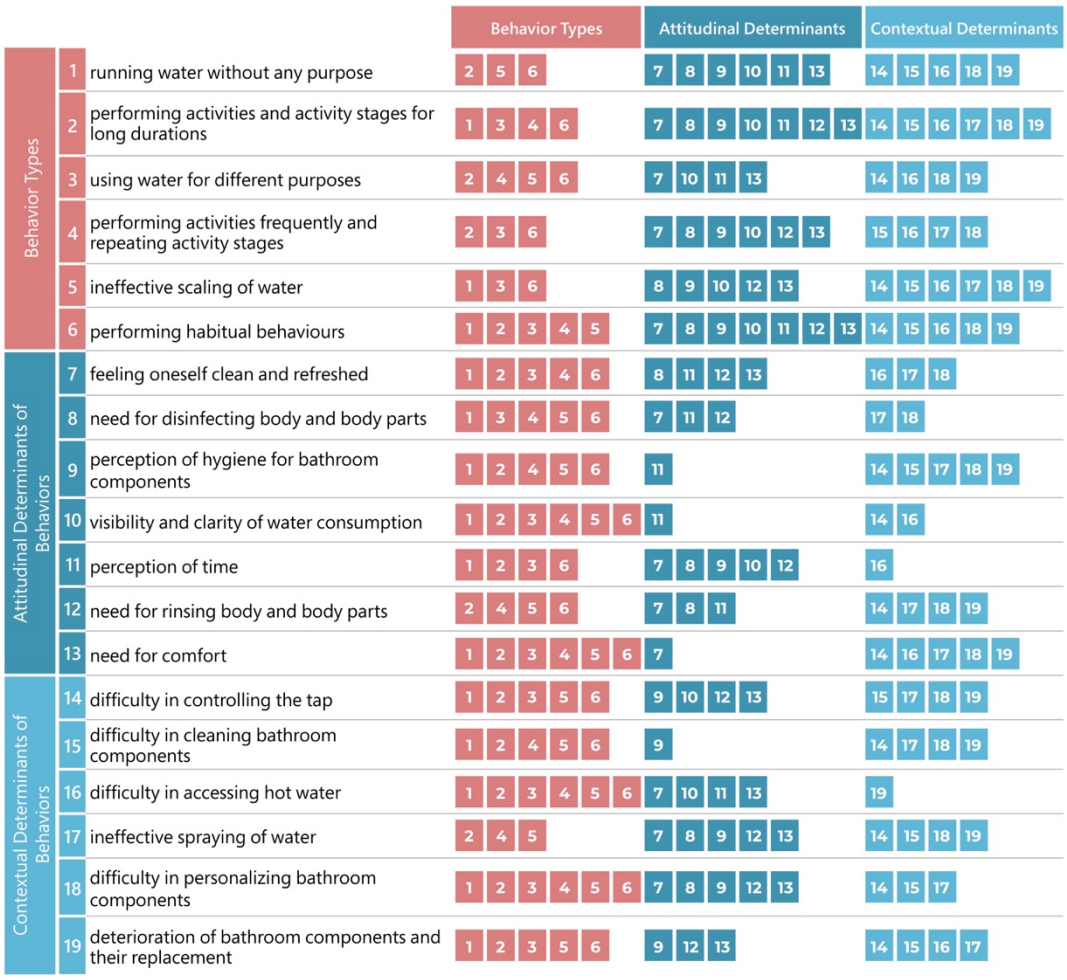


Figure 5.1: The relations between the behavior types and attitudinal and contextual determinants of behaviors

In this step of the doctoral study, the findings from the study (i.e., behavior types and attitudinal and contextual determinants of behaviors) provides a knowledge source for the design practitioners with a particular focus on household water consumption. When designers have a tight time schedule for a project, incorporating secondary user research findings would often be desirable for them. In that sense, the findings from the user research study would provide a valuable resource for them for the comprehensive exploration of the problem area.

Besides, the adopted research approach and developed tools and tasks are among the fundamental contributions of this user research study which allowed me to

extensively understand the reasons of intensive use of water. It also provides guidance for the design researchers who focus on sensitive contexts like bathroom environment with the potential tools and techniques to reveal individuals' behaviors, experiences and needs.

5.1.2 Q2: What are the individuals' diverse intentions for adopting behaviors for effective use of water while performing personal care and hygiene activities?

Understanding the different tendencies of users towards adopting change and transferring these into the early phases of the design process is very significant for increasing the possibilities of individuals to adopt design interventions. Though research on behavioral and social sciences suggest various factors affecting the motivation of performing behaviors (Klöckner & Blöbaum, 2010; Fogg, 2009; Stern, 2000; Ölander & Thøgersen, 1995; Ajzen, 1991; Triandis, 1977; Fishbein & Ajzen, 1975), within the context of this study factors that are found relevant to adopting pro-environmental behaviors (intentions, attitudes, awareness, beliefs and perceived behavioral control) were targeted to identify the significant intentions for adopting water effective use behaviors. As discussed in the previous chapters *(see Section 2.6, Significance of User Diversity for Influencing Sustainable Behaviors),* diverse user typologies developed by researchers focusing on sustainable behavior change support that diverse target behaviors reveal different user types. Therefore, in this study it was aimed to investigate and reveal the individuals' practice-specific tendencies for adopting change for the effective use of water which has not been explored before. Nonetheless, it was apparent that receiving individuals' intentions related to water consumption would be challenging given the existing concerns about the clarity of water consumption and its association with individuals' behavior. In line with these concerns, during the generative interview sessions *speculating stage* was planned which allows participants to reconsider and reconstruct their existing personal care and hygiene behaviors to identify opportunities for change to reduce

water consumption. During this stage, I addressed several questions to gain insights into the reasons behind their decisions. This stage enabled me to identify diverse intentions for adopting responsible behaviors for water consumption through the shared concerns, beliefs, constraints and strategies for and attitudes towards effective use of water. The comprehensive qualitative content analysis of the generative interview sessions revealed five diverse user intentions which are *mindful, willing, doubtful, reluctant* and *unconcerned* users (Figure 5.2). This new categorization of user intentions, as one of the contributions of the user research study, reflects the individuals' diverse tendencies towards adopting behaviors for effective use of water.

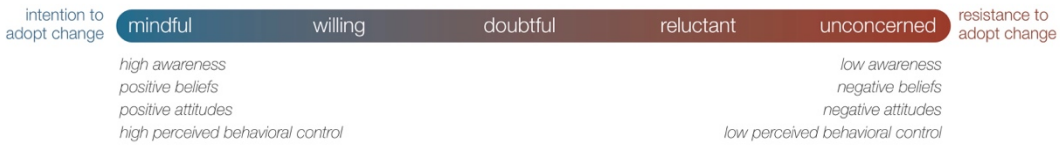


Figure 5.2: Five user intentions for adopting behaviors for effective use of water

Mindful user intention includes individuals with a high awareness and concern about the environmental problems, positive beliefs about the impacts of their individual acts, positive attitudes towards responsible behaviors, high perceived behavioral control and high intention to perform an intended behavior. Since they are already performing water-effective behaviors, they can be recognized as the easiest users to promote pro-environmental behaviors. *Unconcerned* users, on the other end of the spectrum, possess quite opposite characteristics. They have low or even not at all awareness and concern about the environmental issues, do not believe that their behaviors would make an impact on the environment, possess negative attitudes towards responsible behaviors, low perceived behavioral control and low intention to perform an intended behavior. They can be considered as the most challenging users to stimulate change. *Willing* users, with the high awareness and concern, positive beliefs and attitudes and high perceived behavioral control, possess high intention to change their behaviors which makes them easy to persuade. Even

doubtful users are aware and concerned about the environmental problems, they hold conflicting beliefs about the impacts of adopting responsible behaviors which directly affects their attitudes and intentions towards change. Along with the low awareness and concern about the environmental issues, most significant difference of *reluctant* users is their negative attitudes and low perceived behavioral control to alter their behaviors, and consequently they resist to change their behaviors.

The user intentions developed within the scope of this study are related to individuals' water consumption behaviors and they are identified based upon the behavioral patterns and insights of the participants of the conducted user research study. Since the participants of the study involved people from diverse socio-demographics including the occupancy type of households, age, gender and neighborhoods, this variety supported elaborating on diverse intentions. However, in other research studies, extending the targeted behavioral factors to include skills, knowledge and norms and reaching to a larger population might reveal diverse user intentions.

5.1.3 Q3: How to communicate diverse techniques and strategies for behavior change to designers to inspire ideas for influencing sustainable behaviors?

Design researchers investigating the possibilities for influencing pro-environmental behaviors have proposed a range of design strategies and developed varying categorizations for influencing behaviors (Coşkun, 2015; Yun et al., 2013; Lidman & Renström 2011; Froehlich et al., 2010; Tang, 2010; Lilley, 2009; Wever et al., 2008; Elias et al., 2007; Lilley et al., 2005). Though, the lack of common terminology among them and limited guidance for selecting suitable design strategies make it difficult to effectively integrate the design strategies into the ideation process. Based upon these concerns, *a new categorization of design strategies* was proposed through a comprehensive review and comparison of nine diverse categorizations involving

design strategies aiming to influence sustainable behaviors *(see Section 2.5.3 Proposed Categorization for Design Strategies)*. Proposed categorization includes five diverse inclusive strategies namely *informing, engaging, motivating, guiding* and *determining* which encompass various techniques for influencing behaviors. It places the strategies on a spectrum according to the degree of users' or products' power in decision making process for behavior change. At one end of the spectrum *informing* strategy provides information or feedback related to the environmental issues, and past, present and future consequences of a behavior to increase individuals' awareness to act responsibly. At the other end, *determining* strategy restrain undesired behaviors or minimize their impact through advanced technology without interfering with the individuals' behaviors. *Engaging* strategy which is one of the main contributions of this categorization highlights the significance of empowering people to adapt and personalize design interventions which is a neglected aspect in the related literature yet holds a considerable power to support individuals to adopt responsible behaviors. *Motivating* involves various motivational techniques (e.g., goal setting, comparison, rewarding, incentives, enabling communication) to influence environmentally responsible behaviors through triggering or provoking them. *Guiding* adopts affordances and constraints that either enable or limit individuals to perform an intended behavior or provides individuals with responsible choices.

The proposed design strategies are not specific to a particular practice or a behavior except they are suitable to be utilized to support generating ideas for behavior change on a variety of sustainability topics. This inclusive nature of strategies makes them valuable for design practitioners to adopt them into diverse projects aiming to influence individuals' behaviors. How the proposed design strategies are transferred to designers and supported them during generating ideas for promoting sustainable behaviors will be discussed through the following section.

5.1.4 Q4: How can we transfer the research findings and insights into the ideation to support generating diverse ideas for influencing behaviors for effective use of water?

Considering the main purpose of this doctoral study, I adapted a *research through design* approach to explore the ways of effectively communicating the research findings to designers. The findings and insights from the literature review and user research study formed the theoretical background of this study. Considering the designers' expectations from research findings, I designed a generative tool called *inspiration cards* and developed it through an iterative process. The proposed inspiration cards differ from the previously discussed ideation tools for stimulating change *(see Section 2.7 Idea Generation Tools for Influencing Sustainable Behaviors)* in terms of its *scope* (i.e., effective use of water), *content* (i.e., behavior types, attitudinal and contextual determinants of behaviors, a new classification of user intentions for adopting change, and a new categorization of design strategies), and *origins of the content* (i.e., including examples and statements from the user research study and literature review) which can be considered as one of the main contributions of this study to the design research and practice.

Inspiration cards as a comprehensive set of ideation cards brings together various dimensions to be considered as designing for behavior change emerged through the literature review and user research study including a range of (i) behavior types responsible for intensive use of water (6 cards), (ii) the *attitudinal* (7 cards) and *contextual* determinants (6 cards) that are responsible for their performance, (iii) *users' intentions* to adopt change (5 cards) and (iv) *design strategies* to stimulate change (5 cards) (Appendix E).

Each card set has its unique content. Apart from the name of the dimension and its definition, which was common among all cards, behavior types and determinants of behaviors included relevant examples from the user research study and a triggering question for ideation. User intention cards involved quotes from the participants of

the user research study and a scale representing the users' intentions or resistance towards change. Finally, design strategies incorporated various techniques suggested in the related literature to stimulate change, and images and explanations of relevant examples demonstrating how the proposed strategies are adopted in real-life cases. As transferring the research findings to the inspiration cards, preserving the level of detail was one of main concerns. Though, considering their effective integration in the ideation process in terms of their clarity and ease of use, a certain level of refinement and simplification was made. In this process, the definitions of the dimensions presented through the previous sections *(see Section 2.5.3 Proposed Categorization for Design Strategies & Section 3.6 Findings from the User Research)* were summarized and most relevant examples from the research findings were tried to be selected and integrated into the cards to further clarify each dimension.

Designing and facilitating design workshops was another significant part of this research through design process. Developing the generative tool would not be effective without a well formulated procedure to incorporate it into the ideation phase. In that sense, DUI workshops were designed to (i) guide designers during the process of generating ideas for influencing behavior change for sustainability, and (ii) alter the efforts for promoting pro-environmental behaviors from later to earlier stages of the design process with a particular emphasis on the users' intentions towards adopting change. The developed DUI workshops included a range of stages to support designers to familiarize with the problem area *(i.e., sensitizing stage and generating stages)*, explore the inspiration cards and the workshop procedure *(i.e., introducing stage)*, consider users diverse intentions to adopt change *(i.e., generating stages)*, follow a certain procedure as designing for behavior change *(i.e., generating stages)*, share their ideas for further improvement *(i.e., sharing stages)* and assess the tool's and the workshop procedure's effects on developing ideas *(i.e., evaluating stage)* (Figure 5.3). Along with the inspiration cards several online tools (i.e., individual timeline, workshop canvas and team canvases) were also designed and

incorporated into the workshop sessions to support individual and collaborative ideation tasks.

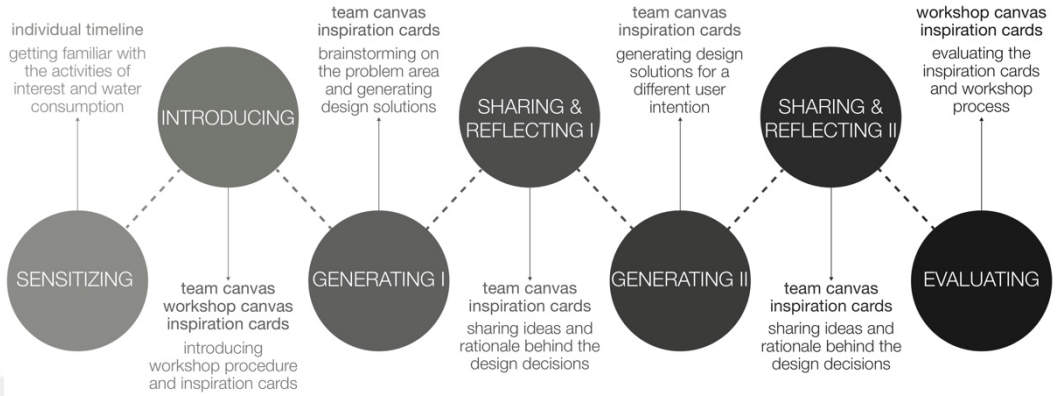


Figure 5.3: The workshop procedure, incorporated tools and intended outcomes

Within the context of this study, three DUI workshops were developed and facilitated. Two of the workshops were incorporated into education projects while one was conducted in a design conference. Based upon the findings from and reflections into each session, both the inspiration cards and the workshop process were revised and refined to effectively support designers as generating ideas for behavior change.

The inspiration cards along with the proposed procedure have the potentials to be used in design projects aiming to promote pro-environmental behaviors. The card set can be incorporated into ideation as a whole or based upon the scope of the projects, diverse categories (e.g., user intentions cards or design strategies cards) can be adopted separately. For instance, in a design project targeting behaviors for reducing household energy consumption, design strategies cards would provide valuable guidance to designers with the techniques and examples it provides for sustainable behavior change whereas the rest might be irrelevant since they include practice-specific aspects for effective use of water. On the other hand, in design projects on effective use of water where the design team has limited time to conduct user

research, incorporating behavior types, determinants of behaviors and user intentions cards have potentials to familiarize designers with the problem area and user types that would support their quick transition to idea generation stage.

5.1.5 Q5: How does the incorporation of the proposed generative tool and the workshop procedure support the ideation process for developing solutions for effective use of water?

The analysis of the workshop outcomes and participants evaluations of the inspiration cards revealed that the proposed generative tool supports designers in various ways *(i.e., exploring, generating, refining, reconsidering and supporting).* (Figure 5.4). The card set empowered designers for the purposes of *exploring,* including empathizing with the users, exploring and elaborating on the problem area, building a use scenario and identifying significant problems to be incorporated into ideation. For *generating* ideas, the diverse components of the card set supported designers to determine potential solution areas, follow a procedure for ideation, develop diverse initial ideas through adopting diverse techniques for stimulating behavior change, assess the ideas' relevance with the problem space and select ideas for further development. As *refining* the ideas, card set was used to detail the selected ideas and visualize them. Since one of the particular intentions of the inspiration cards and adopted procedure was to guide designers to think about how individuals' diverse intentions would inform the diversity of ideas, the card set was also utilized for the purposes of *reconsidering*. It allowed designers to reevaluate the problem area and design strategies for diverse users and to adapt previously generated ideas or develop new ones accordingly. Finally, the card set enabled designers while *supporting* their design decisions through justifying their relevance to influencing behaviors for the effective use of water.

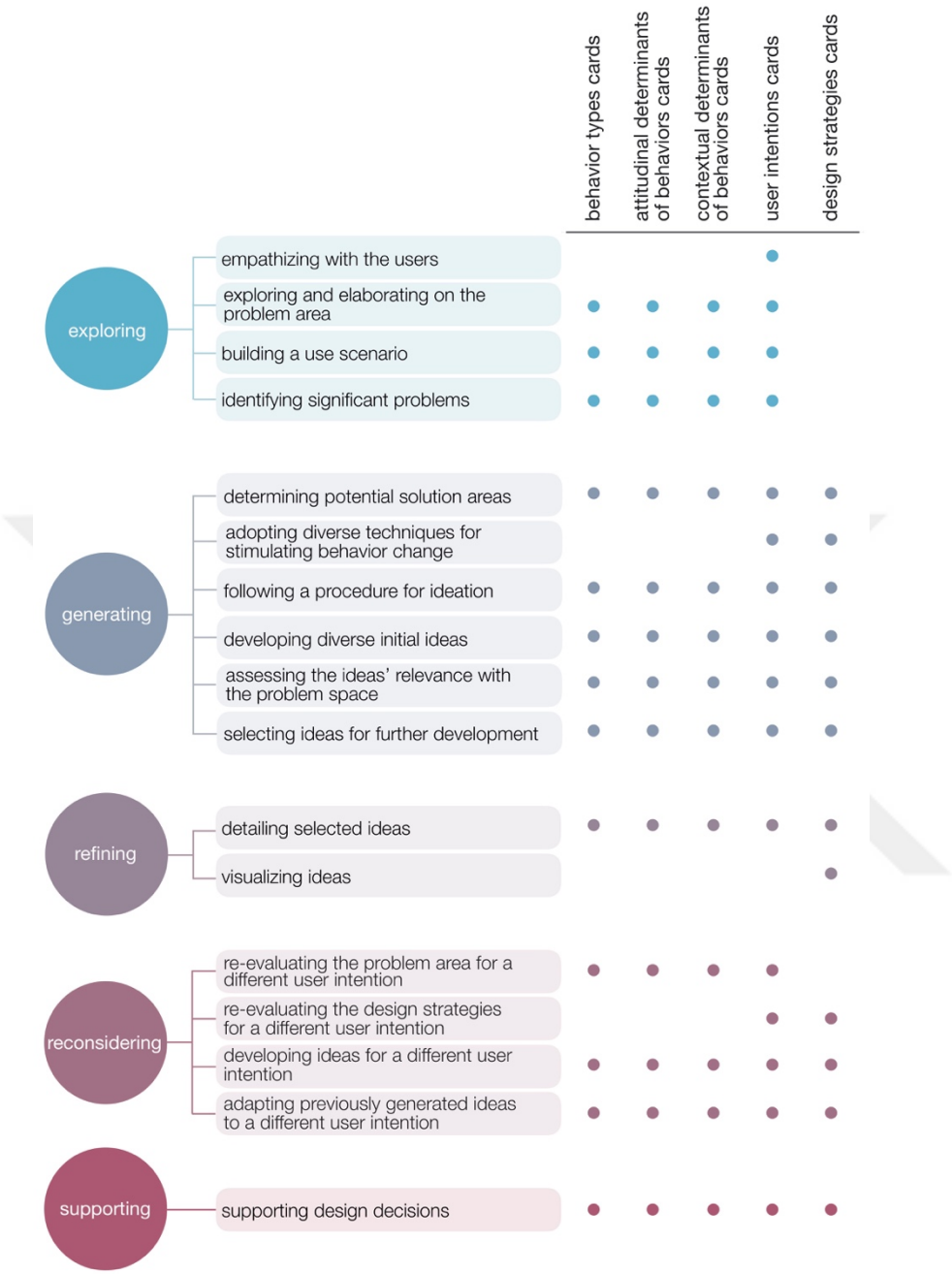


Figure 5.4: Purposes of the utilization of the inspiration cards

Participants found the inspiration cards clearly defined, well categorized, easy to utilize and stimulating for brainstorming and generating ideas for behavior change. The adoption of the inspiration cards strengthened the communication between team members through creating a sharing understanding among the problem area. It also

supported the development of various ideas for the purposes of effective use of water. Table 5.1 demonstrates the total number of refined ideas that each card from the generative tool inspired through all three workshop sessions.

Table 5.1: The total number of refined ideas developed through the adoption of inspiration cards in DUI workshop sessions

Behavior Types		Attitudinal Determinants		Contextual Determinants		User Intentions		Design Strategies	
performing activities and activity stages for long durations	41	need for comfort	36	difficulty in controlling the tap	36	reluctant	29	guiding	47
running water without any purpose	38	perception of time	34	difficulty in personalizing bathroom components	25	willing	24	informing	45
ineffective scaling of water	38	feeling oneself clean and refreshed	31	ineffective spraying of water	22	doubtful	24	engaging	45
performing activities frequently and repeating activity stages	36	visibility and clarity of water consumption	28	difficulty in accessing hot water	13	unconcerned	23	determining	43
using water for different purposes	29	need for rinsing body and body parts	27	difficulty in cleaning bathroom components	11	mindful	6	motivating	13
performing habitual behaviors	27	need for disinfecting body and body parts	21	deterioration of bathroom components and their replacement	6				
		perception of hygiene for bathroom components	10						

Through the workshop sessions, the design strategies were adopted quite successfully which shows the proposed categorization's value for guiding designers as designing for promoting behaviors for sustainability. Diverse design strategies were often utilized together with the aim of providing individuals with diverse incentives to ensure behavior change. Design strategies that are adjacent or closer to each other in terms of users' power in the decision-making process for adopting change were among the mostly preferred combinations which are *informing-engaging, informing-motivating, engaging-guiding* and *guiding-determining*.

Participants also adopted diverse approaches as selecting design strategies in relation to the targeted user intentions. This supported them to generate diverse ideas in response to design briefs focusing on effective use of water, and also revealed diverse tendencies towards adopting design strategies for diverse user intentions *(see Section 4.7 Summary and Discussion).* However, this does not mean that the suggested design strategies would reveal the most appropriate and effective design interventions for the users with diverse intentions towards change. Though, they provide guidance and inspiration for designers and design researchers to recognize the common tendencies while selecting design strategies in relation to user intentions as designing for behavior change.

During the workshops, all of the behavior types and determinants of behaviors cards were targeted at least once. Though, the *perception of hygiene for bathroom components* card among attitudinal determinants of behaviors cards and the *difficulty in cleaning bathroom components* and *deterioration of bathroom components and their replacement* from the contextual determinants of behaviors cards were adopted quite rarely. Particular reasons for this tendency was linked to individuals' unawareness about the implications of the post-use and maintenance behaviors on intensive use of water (e.g., calcification, water leakage, removing stains).

Similarly, even all of the user intentions were selected by the participants at least once, *mindful* users were targeted rarely considering their already adopted responsible behaviors leave a little space for further intervention. However, this does not mean the existence of mindful users is unnecessary in the card set, since they hold potentials to inspire design interventions to support this user category to maintain their existing behaviors. Overall, the proposed user intentions enabled designers to recognize the diversity of attitudes towards change in the early phases of the design process. Though, in future adaptations, as integrating user intentions into the ideation for ensuring behavior change, they can be complemented with personas to increase the depth of the users through the enriched description of their needs, expectations, and requirements. Supporting user intentions with personas may

enhance the diversity of users and the depth of the use scenarios and contribute to the variety and detail of the generated ideas through recognizing diverse factors shaping water consumption behaviors.

Design interventions developed through adopting inspiration cards, reflected the tacit knowledge gathered through the exploration of individuals' practices, behaviors, constraints, needs, attitudes and intentions in relation to water consumption. Directing designers towards a specific problem area and equipping them with the relevant design strategies with the utilization of inspiration cards supported them to generate ideas for behavior change with a particular focus on sustainability. In overall, participants stated that they would incorporate the generative tool into their own workflow for future design projects on the similar topics. This suggests that the generative tool was developed to a form that designers recognize it as a valuable resource to include into their design processes.

The incorporation of the generative tool (i.e., inspiration cards) and the generative method (i.e., DUI workshops) into education projects during the last two workshop sessions had revealed various *learning outcomes*. Besides utilizing inspiration cards as a supporting tool for ideation, the experience gathered from the DUI workshop II, provided participants with the guidance on how to transfer user research findings into idea generation tools and how to develop a procedure for the integration of those findings and insights into the early phases of the design process. In the later stages of the graduate course, the workshop participants successfully transferred their research findings (i.e., user observations and interviews) and insights related to different problem areas on sustainability (i.e., household food waste, repurposing and repair behaviors) into ideation cards that they designed, and organized generative co-design workshops bringing together designers and users for the purposes of influencing individuals behaviors towards sustainable directions. During the workshop III, the inspiration cards and the workshop procedure were mainly utilized as an idea generation method through which they explored the problem space and developed diverse ideas on the selected bathroom environments. In the following

stages of the undergraduate course, participants focused on the ideas that they generated through the workshop sessions and developed them further throughout their projects. Considering the learning outcomes of these two cases from the perspectives of design students, in an educational context the generative tool and the generative method delivered two significant contributions to (i) *support the idea generation process through offering diverse dimensions for behavior change* and (ii) *provide guidance on the ways of communicating research findings to diverse stakeholders*. It should be noted that the proposed generative tool also served as a *teaching material* through contributing to the students' awareness about the user intentions and design strategies for stimulating behavior change.

Through the adoption of the inspiration cards and the DUI workshops, it is not claimed that the emerging design solutions will be more effective than any other idea. In fact, since the main focus of the inspiration cards is on reducing water consumption, it may lack recognizing the related environmental consequences of behaviors such as reducing electricity consumption and waste. In order to explore the ways of mitigating the environmental impacts of behaviors in a more holistic way, inspiration cards can be supported with complementary tools involving different sustainability considerations.

5.2 Contributions of the Dissertation

Through answering the research questions, this doctoral study contributed to knowledge that presents value for both *design research* and *design practice* in various ways (i.e., the research methodology, research findings, the generative tool and the generative method).

Methods for investigating use behaviors in sensitive environments and communicating research findings to designers

A contribution to knowledge in design research has been made through the *generative approach* adopted in the first step of this doctoral study through the incorporation of various projective tools and tasks, and *research through design* cycles of the generative tool and workshop procedure development in the second step of this doctoral research.

In the first step of this study, various projective tools and tasks has been developed and incorporated into the research process to reveal the behaviors and their reasons leading to intensive water use in the bathroom environment, and the different understandings and intentions of users towards water consumption as performing personal care and hygiene practices, all of which hold many limitations for user observations in terms of privacy. Within the scope of this step, (i) the *mapping stage*, which includes two-dimensional representational bathroom components that support the discussions about the constraints and possibilities in the bathroom environment; the *sharing stage,* supporting users to enact and share their experiences and behaviors by placing their statement cards on a timeline; the *reflecting stage*, which allows elaborating on the individuals' understandings of water consumption related to their experiences through a visualization exercise; and the *speculating stage*, that enables to reconsider and reconstruct existing behaviors through the integration of a timeline and probing cards, are among the main methodological contributions of this study. Each stage with the inclusion of well-considered generative tools and tasks conduces significantly to reveal individuals' experiences, behaviors, belief, attitudes and intentions that are difficult to express through acts or words. The developed tools and tasks have potentials to be adapted to different research areas and contexts, providing a valuable source of knowledge for researchers who will conduct user research in sensitive environments such as bathrooms.

In the second step of this doctoral study, the adopted *research through design approach* including three cycles of designing, implementing, evaluating and revising inspiration cards and workshop procedure contributed to the exploration of potential ways of communicating research findings to designers with the arising insights and suggestions from each session *(see Section 4.1 Research Design: Research through Design).* This iterative approach, practiced through a series of workshops, provides an original contribution to the literature on how to transfer research findings to designers and the tool development with the aim supporting ideation for behavior change.

A knowledge source for influencing sustainable behaviors

The findings from and insights into the user research and literature review facilitated in this doctoral study provided a valuable knowledge source for household water consumption in relation to personal care and hygiene practices in the bathroom environment. Through adopting a holistic approach, the study focuses on and brings together a range of dimensions related to behavior change that have not been brought together in previous studies including (i) the reasons for intensive use of water through the *behavior types* and their *attitudinal* and *contextual* reasons, (ii) the *user intentions* towards adopting water effective use behaviors, and (iii) a new categorization of *design strategies* for stimulating behavior change. Designers, design researchers and other stakeholders interested in behavior change for sustainability can consult the results of this study which provides a detailed source to explore the existing problems related to water consumption, empathize with the users and recognize diverse approaches for promoting behavior change. Even behavior types, attitudinal and contextual determinants of behaviors and user intentions mainly reflect the findings in relation to water effectiveness in the bathroom environment, it can be transferred to diverse areas and activities in the households (e.g., kitchen area, laundry practices, etc.) to support the development of design interventions to reduce household water consumption, and enable potential environmental gain through design. Owing to the inclusive content of the new

categorization of the design strategies; though, they can be adapted into various projects focusing on diverse sustainability topics to support generating ideas for behavior change.

A generative tool to support designers while developing ideas for influencing sustainable behaviors

There is a value in supporting designers with a guidance to empower them to explore diverse strategies around influencing behaviors. One way to achieve this is presenting insights from research studies in the form of ideation tools. As previously discussed, design researchers developed various ideation tools with the aim of enabling designers to familiarize with the potential ways of stimulating change *(see Section 2.7 Idea Generation Tools for Influencing Sustainable Behaviors)*. Though, none of them targets household water consumption as the main problem or includes practice-specific dimensions to be considered to stimulate change. Through adopting a research through design approach, this thesis proposed a new generative tool called *inspiration cards* and evaluated its implications on developing ideas for influencing behaviors for effective use of water among individuals with diverse intentions. The developed tool is one of the first examples in this area in terms of *its scope, content* and *level of detail* which incorporates *behavior types and attitudinal and contextual determinants of behaviors* that are responsible for intensive use of water, *user intentions* for adopting water-effective use behaviors and a new categorization of *design strategies* to inspire generating ideas for sustainable behavior change. Even though each component of the inspiration cards contributes maturing this field, its comprehensiveness through incorporating diverse dimensions from literature review and user research study in a holistic manner makes it novel.

The inspiration cards provide a valuable resource for the design practice and are intended to be incorporated into diverse projects aiming to promote sustainable behaviors. The findings from the workshop study supported that the generative tool, which is developed for and developed with the designers, is an effective ideation tool

for *exploring, generating, refining, reconsidering* and *supporting* ideas aiming to influence sustainable behaviors. Even, the content of the proposed generative tool mainly supports and enriches the area of water effectiveness in the bathroom environment, diverse components of the card set holds potentials to be adapted into diverse areas in the households (e.g., user intentions cards for exploring water consumption in the kitchen environment) and diverse problems areas in relation to sustainability (e.g., design strategies cards for inspiring change for reducing food waste). The developed guideline in Figure 5.5 demonstrates the purposes of each component of the inspiration cards, their descriptions, and recommendations for design practitioners and researchers for their utilization and transference into diverse research areas and design projects.

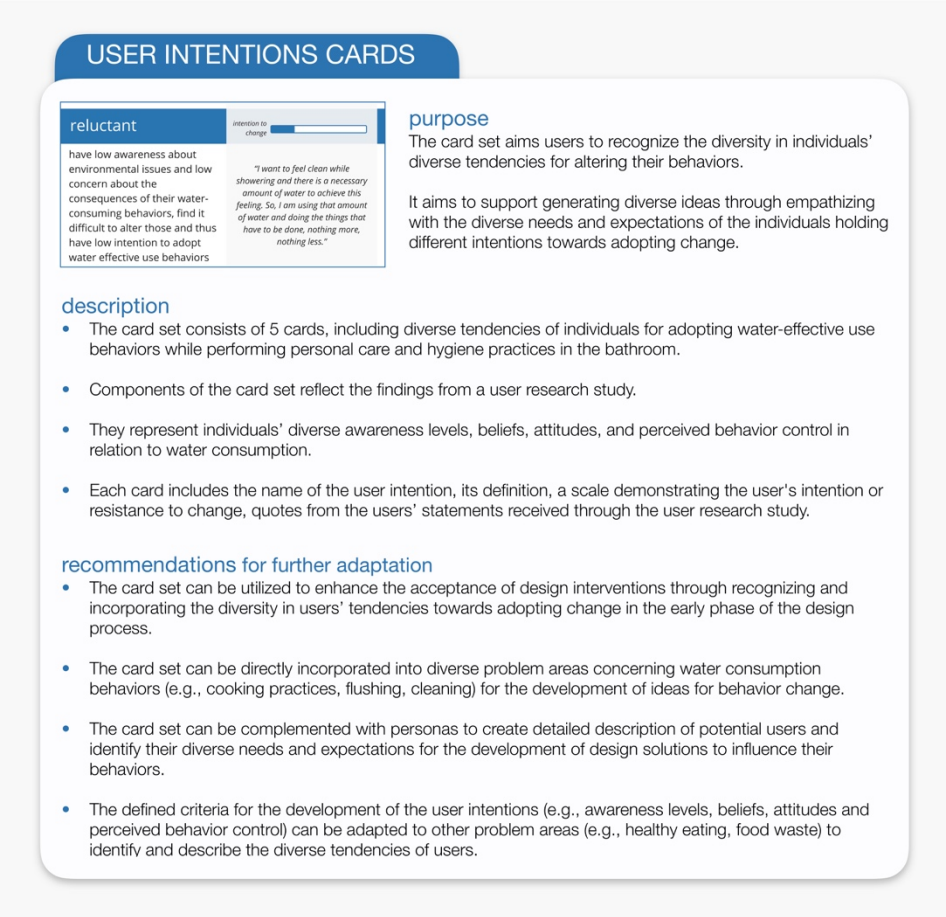


Figure 5.5: A guideline for introducing the inspiration cards

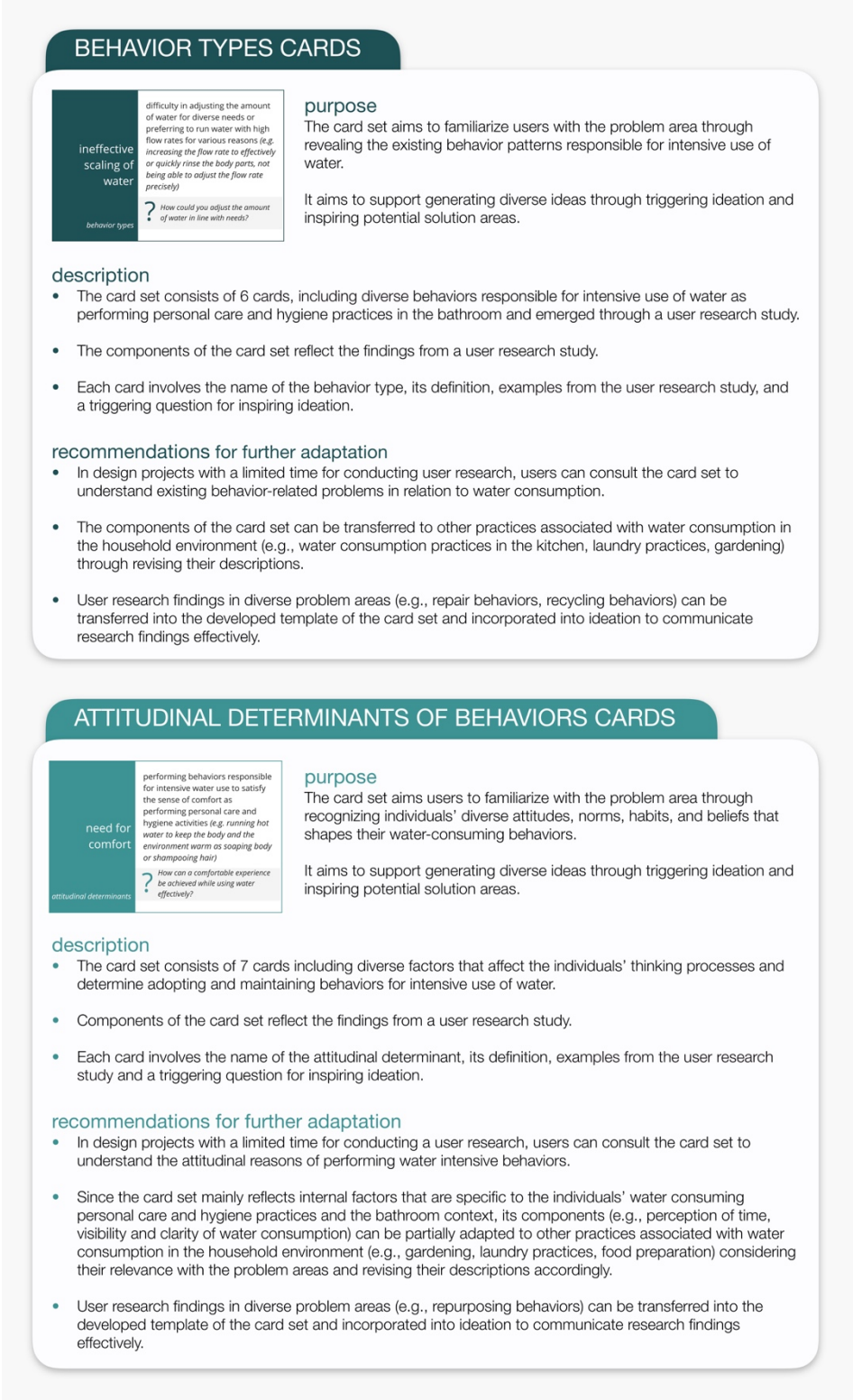


Figure 5.5: A guideline for introducing the inspiration cards (continued)

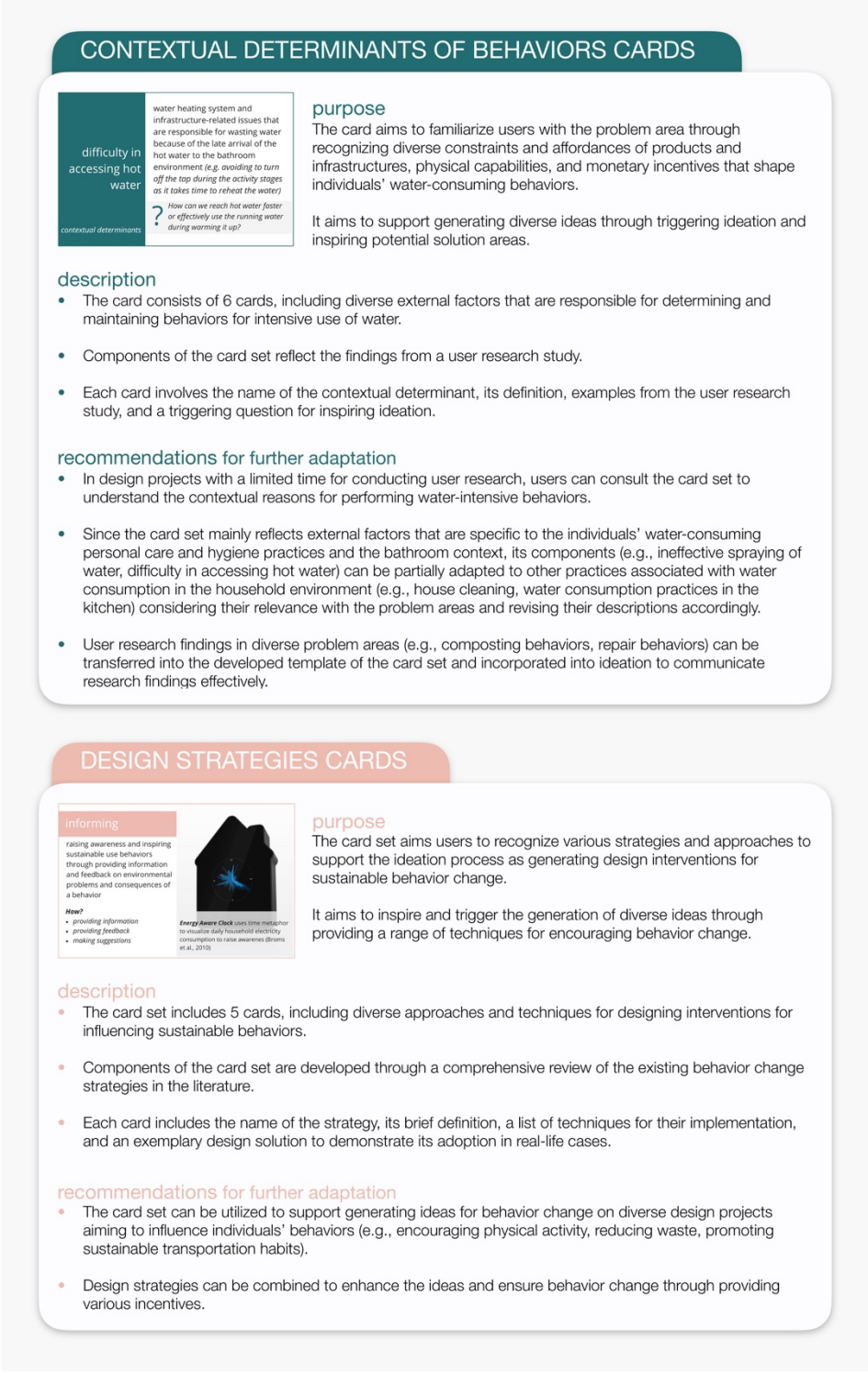


Figure 5.5: A guideline for introducing the inspiration cards (continued)

A generative method as a guidance to develop ideas for diverse user intentions

This study proposes a workshop procedure called *DUI workshops* for the effective integration of the proposed inspiration cards into ideation *(see Section 4.3 Workshop Procedure).* DUI workshops including complementary ideation and reflection stages and tools to collaboratively brainstorm on the problem area and generate ideas for influencing sustainable behaviors have been a successful guidance for designers to effectively incorporate different dimensions into the process of developing ideas for behavior change.

Although the doctoral study proposes seven successive stages *(sensitizing, introducing, generating I, sharing and reflecting I, generating II, sharing and reflecting II, and evaluating)* for the implementation of the workshop procedure, the order of the stages may change or be combined with each other or diverse task might be included (e.g., switching team members and activity stages) depending on the scope and context of the workshop sessions. This flexible nature of the workshop procedure supports its thematic adaptation into diverse educational and professional design projects to meet the different needs and expectations of the project briefs. The purposes of the DUI workshop stages, their descriptions, adopted tools and task in each stage and recommendations for design practitioners and researchers for their facilitation and adaptation into diverse research areas and design projects are presented through Figure 5.6. in the form of guidelines.

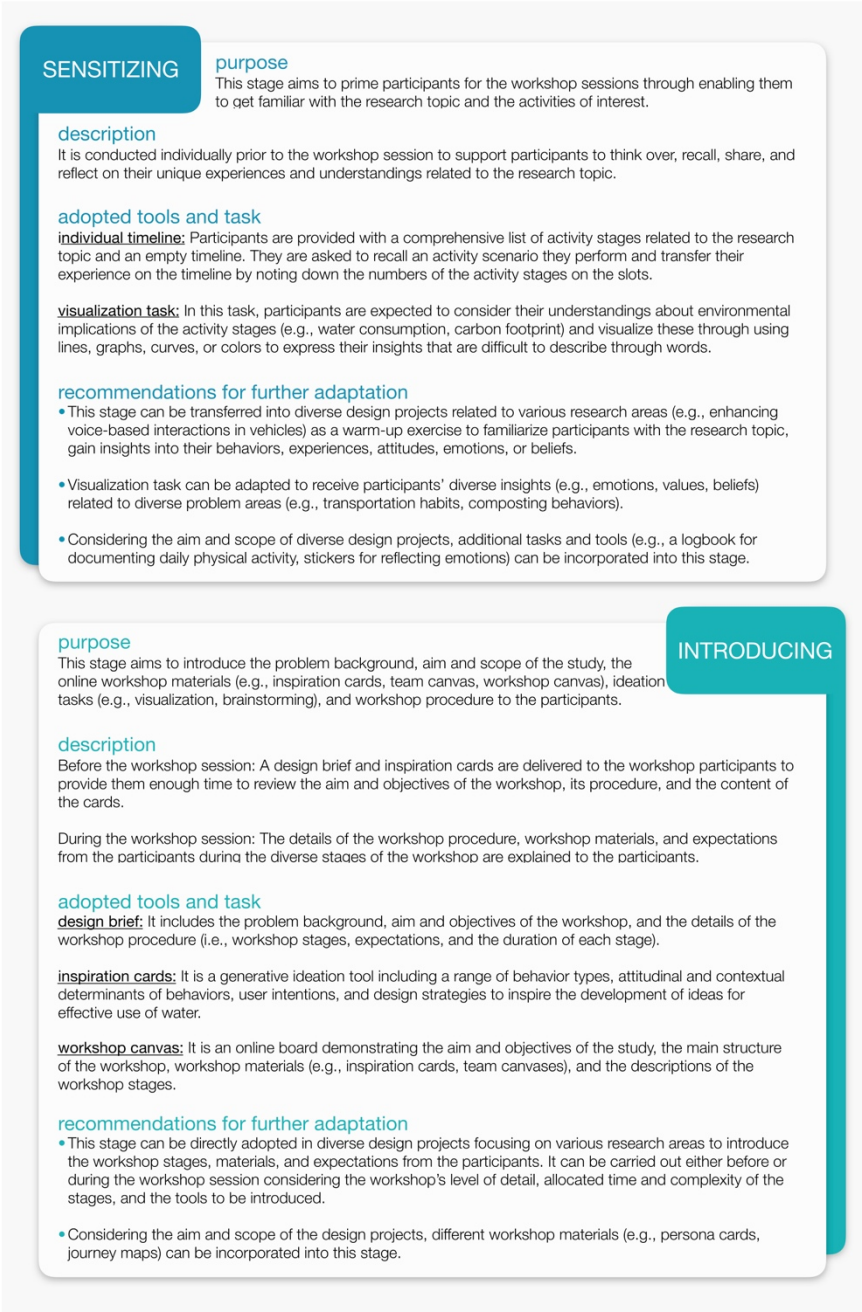


Figure 5.6: A guideline for introducing DUI workshop stages

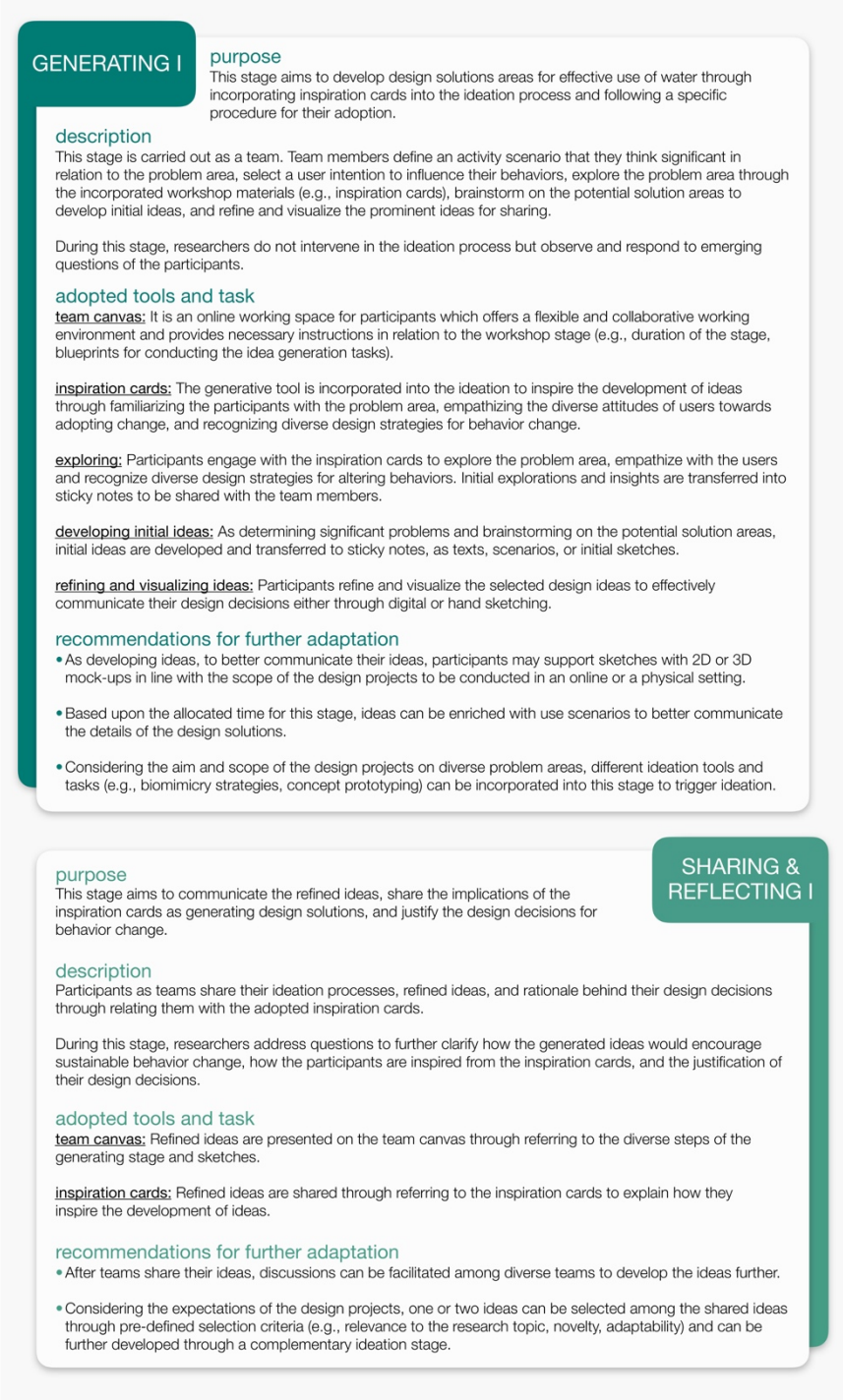


Figure 5.6: A guideline for introducing DUI workshop stages (continued)

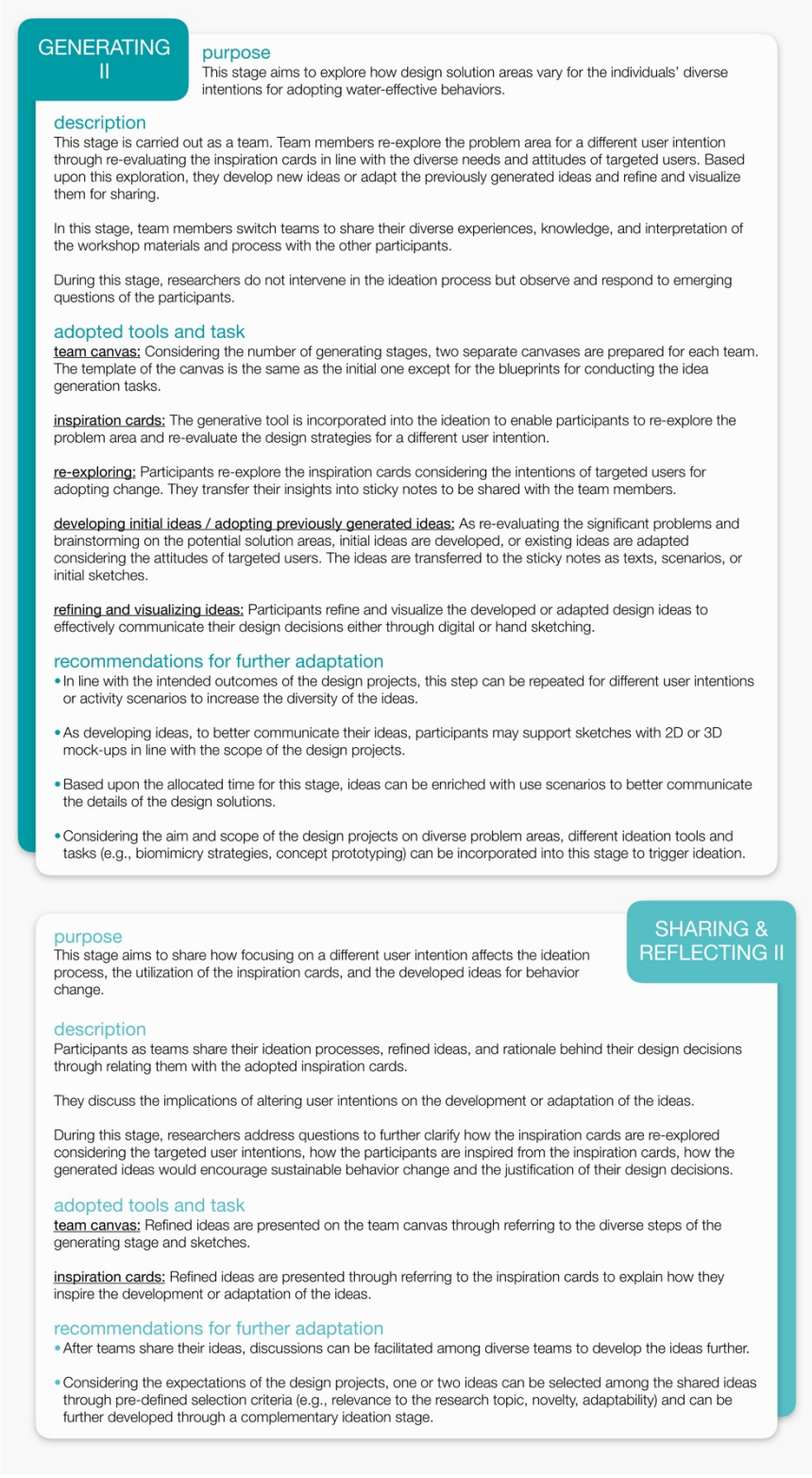


Figure 5.6: A guideline for introducing DUI workshop stages (continued)



Figure 5.6: A guideline for introducing DUI workshop stages (continued)

5.3 Limitations and Opportunities for Further Research

Within the scope of this doctoral study, to support designers to understand the reasons of intensive use of water, recognize the users' diverse intentions to adopt responsible behaviors, identify diverse design strategies for behavior cahnge, and generate ideas for influencing behaviors for the effective use of water, certain research questions were addressed. As responding these questions, the research

process and findings revealed several limitations. These limitations, however, inspired potential directions for future research which will be discussed through the below sections.

Targeting diverse pro-environmental behaviors

The developed generative tool offers practice-specific findings, as it includes individuals' behaviors, constraints, needs, attitudes and intentions for effective use of water shaped around personal care and hygiene practices in the bathroom environment, which are specific to cultural and geographical context of this doctoral study. Within the scope of this study, research findings, that are specific to the targeted practices and context, served its purpose quite successfully and supported the development of problem-focused ideas during the idea generation processes in DUI workshops. Though, it should be recognized that the developed design interventions through the inspiration cards which might be successful and appropriate to promote change in that context may not be relevant elsewhere.

For further research, the generative tool's potentials in terms of *its adaptability* to other *household practices responsible for water consumption* (e.g., laundry, food preparation, gardening) and *diverse research topics on sustainable behavior change* (e.g., household food waste, repair behaviors) worth exploring. Different problem areas would probably reveal diverse behavior types, determinants and user intentions that needs to be supported with user research or existing research findings from the related literature. Though, design strategies cards would be easily adapted to diverse problem areas due to its inclusive nature. Similarly, workshop procedure with its flexible structure enabling to include diverse tasks and tools for the diverse needs would support its adaptation to diverse research areas.

Diversity of the participants for DUI workshops

DUI workshop sessions were facilitated through the participation of undergraduate and graduate design students. Even though the sample supported receiving insights into how the generative tool is utilized and answered the expectations of the design

students, the findings are limited to the skills, interests and backgrounds of these participants. Thereby, it is very valuable to enable *diverse stakeholders* to utilize the generative tool and the workshop procedure and evaluate their diverse implications for supporting design for behavior change. In future research, facilitating *participatory sessions* where designers work in collaboration with users and people from other disciplines is believed to support receiving diverse insights in relation to the utilization of the generative tool and the workshop procedure, and to understand how individuals' different approaches and backgrounds would affect the generated ideas, which would support the further development of the inspiration cards and the workshop procedure.

Exploring the further implications of the generated ideas

Considering the main purpose and time constraints of this doctoral study, it was mainly intended to investigate how research findings with a particular focus on water consumption could be conveyed to the designers during the early phases of the design process and to evaluate how this information would support the development of ideas for the effective use of water. In future research, (i) incorporating this knowledge in the early stages of the ideation as part of a longitudinal study, (ii) investigating how the generated ideas in the ideation phase would evolve throughout the further stages of the design process, and (iii) evaluating the implications of the ideas for influencing behavior change for sustainability through experimentations with users in real life contexts is believed to provide a valuable knowledge to the field.

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APPENDICES

A. Consent Form for the Participants of the Diary Study and Generative Interview Sessions

KATILIMCI İZİN FORMU

Araştırmacı
Araş. Gör. Dilruba Oğur
ODTÜ Mimarlık Fakültesi, Endüstri Ürünleri Tasarımı Bölümü
dilrubaogur@gmail.com

Doktora Tez Danışmanı
Doç. Dr. Çağla Doğan
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dcagla@metu.edu.tr

Bu araştırma, Orta Doğu Teknik Üniversitesi Endüstri Ürünleri Tasarımı Bölümünde yürütmekte olduğum doktora çalışmam kapsamında gerçekleştirilmektedir. Araştırmanın amacı, banyo ortamında su tüketimi ile ilişkilendirilen kişisel bakım ve hijyen pratiklerinin, alışkanlık haline gelmiş kullanıcı davranışlarının, tercihlerin, ihtiyaçların ve kullanıcı deneyimlerinin detaylı bir şekilde alınmasıdır. Bu anlayış, suyun verimli kullanılmasın destekleyecek tasarım çözüm alanlarının keşfedilmesine ve geliştirilmesine girdi sağlayacaktır.

Kullanıcı deneyimlerinin ve görüşlerinin detaylı bir şekilde alınması amacıyla çalışma iki aşamalı olarak kurgulanmıştır. Birinci aşamada, katılımcılardan araştırmacının temin edeceği günlük aracılığıyla, kişisel bakım ve hijyen pratiklerine yönelik notlar alması beklenmektedir. İkinci aşamada ise günlük aracılığıyla kaydedilen davranışların derinlemesine anlaşılması ve su tüketimine yönelik anlayışların alınması amacıyla bire bir görüşmeler yapılacaktır.

Çalışma sırasında elde edilen veriler yalnızca bilimsel amaçlarla, tasarım sürecinde, tez araştırmalarında, bilimsel yayınlarda ve sunuşlarda kullanılacaktır. Katılımcıların kimlik bilgileri saklı tutulacaktır. İzniniz ve haberiniz dahilinde görüşme sırasında görüntü ve ses kaydı alınacaktır. Görüşme yaklaşık olarak bir saat sürecektir.

Bu formu imzalayarak yapılacak araştırma konusunda size verilen bilgiyi anladığınızı ve çalışmanın yapılmasını onayladığınızı belirtmiş oluyorsunuz. Formu imzalamış olmanız yasal haklarınızdan vazgeçtiğiniz ya da araştırmacıların ve ilgili kuruluşun yasal sorumluluklarından feragat ettiği anlamına gelmemektedir. Çalışmaya katılım gönüllülük esasına dayanır. Çalışmanın başlangıcında veya herhangi bir aşamasında açıklama yapılmasını isteyebilirsiniz. İstediğiniz zaman gerekçe belirtmeksizin çalışmayı sonlandırmayı ya da talep edebilirsiniz. Araştırmaya katkıda bulunduğunuz için teşekkür ederim.

Katılımcının	**Araştırmacının**
Adı Soyadı	Adı Soyadı
Tarih / İmza	Tarih / İmza

B. Interview Guideline for the Generative Interview Sessions

INTERVIEW GUIDELINE											
I. MAPPING Creating the bathroom environment and reflecting on the bathroom components In this step, we will create your bathroom environment and talk about your experience related to bathroom components and water heating system.											
Creating the bathroom plan: Let's start to recreate the plan of your existing bathroom by attaching the two-dimensional representative bathroom components such as shower, bathtub and sink on the scaled plan.											
1. What type of faucet do you use in your washbasin (e.g., two-handle, single handle, sensor-operated, etc.)? Do you have any complaints about the faucet you are using (e.g., adjusting the water temperature, adjusting the flow rate, cleaning, etc.)? Could you briefly mention them?											
2. What type of faucet do you use in your showering / bathing area (e.g., two-handle, single handle, sensor-operated, etc.)? Do you have any complaints about the faucet you are using (e.g., adjusting the water temperature, adjusting the flow rate, cleaning, etc.)? Could you briefly mention them?											
3. What type of shower head system do you use in your showering / bathing area (e.g., hand shower, sliding shower head, rain shower, etc.)? Do you have any complaints about the shower head you are using (e.g., adjusting the water flow rate, height adjustment, cleaning, etc.)? Could you briefly mention them?											
4. Which water heating system is used in your house (e.g., central heating system, combi boiler, solar water heater, etc.)? Do you have any complaints about the heating system (e.g., access to hot water, etc.)? Could you briefly mention them?											
II. SHARING Inquiring into individuals' water consuming behaviors and exploring the reasoning behind them In this step, we will talk about your existing use behaviors and their reasons through reviewing your activity steps and behaviors recorded on the diary study.											
	☐ showering	☐ bathing	☐ washing body	☐ washing feet	☐ washing hair	☐ washing hands	☐ washing face	☐ brushing teeth	☐ ablution	☐ other
5. Considering the activity scenario recorded on the diary, could you describe your …. activity by enacting each step in-detail? Meanwhile, you can attach the statement cards (which includes activity steps recorded on the diary) on the timeline. If you recall any further steps, we may include them through writing them down on blank cards. ! *Note: Probing questions will be asked to understand the causes of the activity steps and related behaviors.*											
6. How often do you perform …… activity (the frequency of the activity recorded on the diary will be mentioned)?	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
7. How long does the …… activity last (the duration of the activity recorded on the diary will be mentioned)?	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	showering	bathing	washing body	washing feet	washing hair	washing hands	washing face	brushing teeth	ablution	other
8. How the frequency and duration of the ……. activity is affected from seasonal (summer, winter, etc.) or situational (busy working days, illness, etc.) changes? Why do you think these changes occur?	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

III. REFLECTING

Receiving individuals' understandings and perception about water consumption

In this step, we will talk about your insights and understandings about water use and how you relate your behaviors to water consumption.

	showering	bathing	washing body	washing feet	washing hair	washing hands	washing face	brushing teeth	ablution	other
9. In the diary study, you linked the …… activity with …… (intense, normal, low, etc.) water consumption. Could you briefly explain why you think so?	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
10. Let's think about the activity steps we discussed earlier. How do you think the water consumption changes throughout the activity steps you attached on the timeline? Could you show these changes (increases, decrease, etc.) on the timeline? You can use lines, graphs, curves, colors to express these alterations.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
! *Note: Probing questions will be asked to understand the reasons behind individuals' understandings and perception about water consumption.*										
11. Which steps of your activity do you think lead to intensive water consumption? Could you briefly explain why you think so?	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
12. Which steps of your activity do you think consume water unnecessarily? Could you briefly explain why you think so?	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

IV. SPECULATING

Inquiring into strategies and potential behaviors for effective use of water

In this step, we will talk about your strategies for effective use of water and speculate over potential solution areas to reduce water consumption as carrying out personal care and hygiene practices.

	showering	bathing	washing body	washing feet	washing hair	washing hands	washing face	brushing teeth	ablution	other
Existing strategies 13. When you reconsider your …… activity in general, do you think that there is a need to reduce water consumption? Why?	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

14. What are the strategies or methods you have developed or used to reduce water consumption as performing …… activity? If there is any, could you briefly mention them?	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
15. What are the factors that constraint or prevent you to consume water more effectively as performing the …. activity? If there is any, could you briefly mention them?	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Reconstructing existing behaviors and speculating (Probing cards that includes statistical data on environmental problems and behavior, product and infrastructure related issues related to water consumption will be shared with the participants.) 16. Let's rethink your …. activity and your behaviors leading to water consumption. If you happen to reconsider and reconstruct your existing routine, what changes would you like to make to reduce water consumption and how would you do it?	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

! Note: Questions from 5 to 16 will be repeated for each activity recorded on the diary. Activities performed successively can be combined.

17. There are some activities that you have not filled out in your diary. Do you perform these activities in diverse situations and seasons? Or do you simply not perform them? If so, could you please briefly mention why you do not carry them out.

THANK YOU FOR YOUR PARTICIPATION!

C. The Generative Tool Incorporated in DUI Workshop I



Figure C.1: Inspiration cards for DUI workshop I - Part 1



Figure C.2: Inspiration cards for DUI workshop I - Part 2



Figure C.3: Inspiration cards for DUI workshop I - Part 3

D. The Generative Tool Incorporated in DUI Workshop II

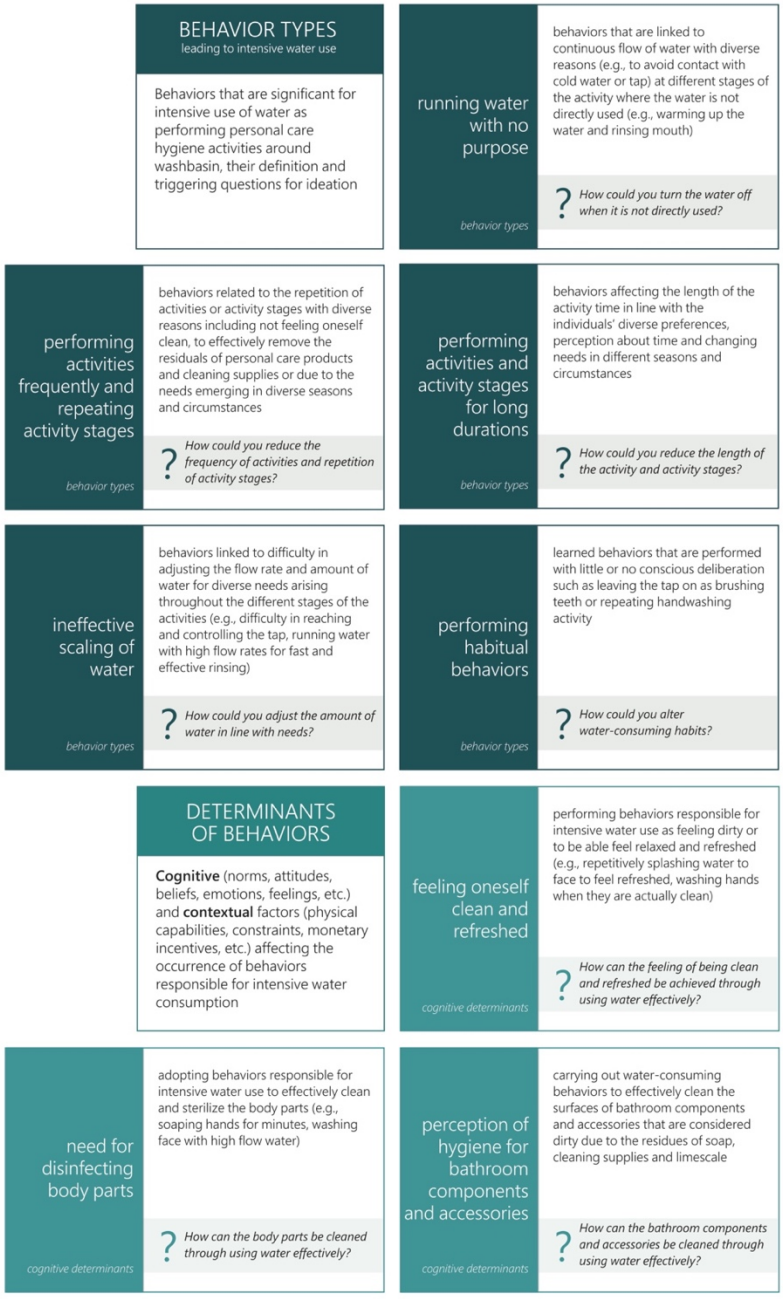


Figure D.1: Inspiration cards for DUI workshop II - Part 1

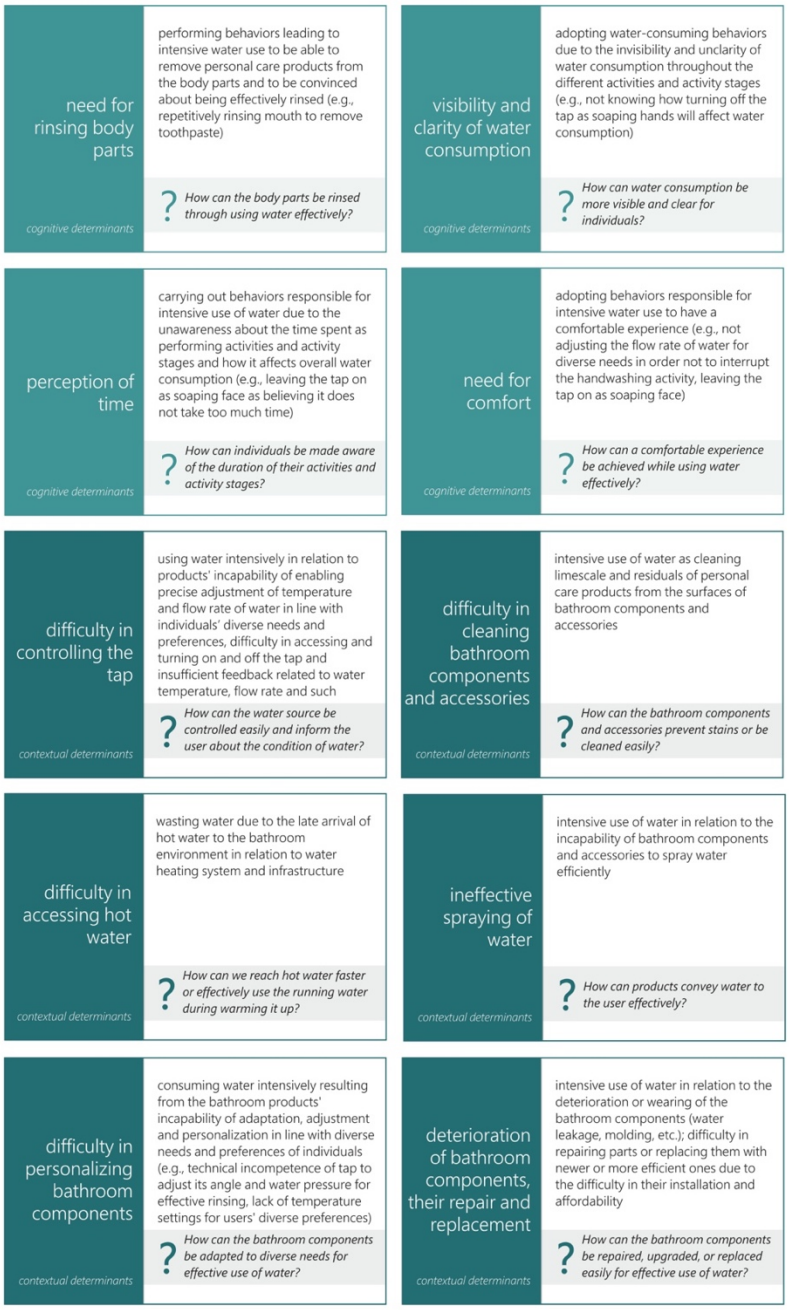


Figure D.2: Inspiration cards for DUI workshop II - Part 2



Figure D.3: Inspiration cards for DUI workshop II - Part 3

E. The Generative Tool Incorporated in DUI Workshop III



Figure E.1: Inspiration cards for DUI workshop III - Part 1



Figure E.2: Inspiration cards for DUI workshop III - Part 2

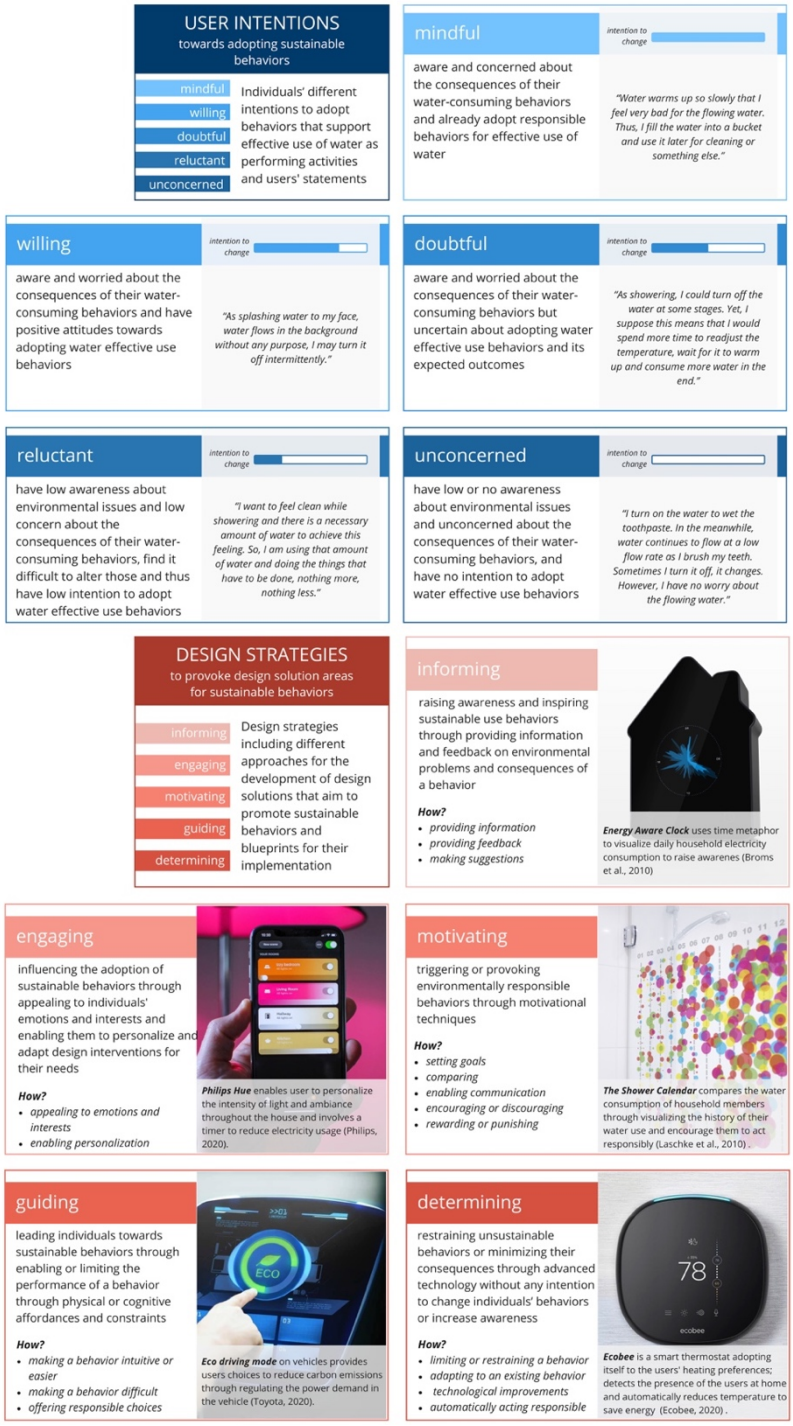


Figure E.3: Inspiration cards for DUI workshop III - Part 3

F. Online Consent Form for the Participants of the DUI Workshops

KULLANICI EĞİLİMLERİ İÇİN TASARIM ÇALIŞTAYI I:
KATILIMCI İZİN FORMU

Çalıştay Yürütücüleri:
Araş. Gör. Dilruba Oğur Aydın, ODTÜ Mimarlık Fakültesi, Endüstriyel Tasarım Bölümü
Doç. Dr. Çağla Doğan, ODTÜ Mimarlık Fakültesi, Endüstriyel Tasarım Bölümü
Öğr. Gör. Alper Karadoğaner, ODTÜ Mimarlık Fakültesi, Endüstriyel Tasarım Bölümü

10 Eylül, 2020, Perşembe 09:00 - 14:00
iletişim: dilrubaogur@gmail.com

Bu çalıştay, sürdürülebilir davranış değişikliği için kulanıcı eğilimlerinin potansiyelini irdeleyen ve Doç. Dr. Çağla Doğan danışmanlığında Dilruba Oğur Aydın tarafından Orta Doğu Teknik Üniversitesi Endüstri Ürünleri Tasarımı Bölümünde yürütülmekte olan doktora çalışması kapsamında gerçekleştirilmektedir. Çalıştayın amacı, yıkanma sırasında suyun verimli kullanılmasını destekleyecek tasarım çözüm alanlarının keşfedilmesidir.

Bir seri fikir geliştirme ve değerlendirme aşamalarından oluşan çalıştay yaklaşık olarak dört saat sürecek şekilde kurgulanmıştır. İzniniz ve haberiniz dahilinde çalıştay sırasında ekran kaydı alınacaktır. Çalıştay sırasında elde edilen veriler yalnızca bilimsel amaçlarla, tasarım süreçlerinde, tez araştırmalarında, bilimsel yayınlarda ve sunuşlarda kullanılacaktır. Katılımcıların kimlik bilgileri saklı tutulacaktır.

Bu formu imzalayarak yürütülecek çalıştay konusunda size verilen bilgiyi anladığınızı, çalıştay çıktılarının, görsellerinin ve yaptığınız yorumların tez çalışmalarında ve diğer yayınlarda kullanılmasını onayladığınızı belirtmiş oluyorsunuz. Formu imzalamış olmanız yasal haklarınızdan vazgeçtiğiniz ya da araştırmacıların ve ilgili kuruluşun yasal sorumluluklarından feragat ettiği anlamına gelmemektedir. Çalıştaya katılım gönüllülük esasına dayanır. Çalıştayın başlangıcında veya herhangi bir aşamasında açıklama yapılmasını isteyebilirsiniz. İstediğiniz zaman gerekçe belirtmeksizin katılımı sonlandırmayı talep edebilirsiniz. Çalışmaya katkıda bulunduğunuz için teşekkür ederiz.

Katılımcının Adı / Soyadı
……..

Tarih
….. /….. /…..

Çalışmaya katılmayı
☐ kabul ediyorum
☐ kabul etmiyorum
☐ ……

Figure F.1: Online consent form for DUI Workshop I

DESIGN FOR USER INTENTIONS WORKSHOP II: CONSENT FORM

Workshop Facilitators:
Res. Assist. Dilruba Oğur Aydın
Assoc. Prof. Dr. Çağla Doğan
Assist. Prof. Dr. Senem Turhan

Tuesday, December 2, 2020, 09:00 -12:30
Tuesday, December 9, 2020, 09:00 -10:00
contact: dilrubaogur@gmail.com

Design for User Intentions workshop explores the potentials of user intentions in generating ideas for sustainable behavior change and it is carried out within the scope of a doctoral research conducted by Dilruba Oğur Aydın under the supervision of Assoc. Prof. Dr. Çağla Doğan in the Department of Industrial Design, Middle East Technical University. The aim of the workshop is to explore design solution areas that will support the effective use of water while performing personal care and hygiene practices around the washbasin. The outcomes of the workshop will inform the development of design tools that aims to support designers to provoke solutions for influencing sustainable behaviors.

The workshop, which consists of a series of idea generation and evaluation stages and incorporates several design tools, has been planned to last approximately in four hours. The workshop process will be video recorded with your permission. The data obtained during the workshop will only be used for scientific purposes, design processes, thesis research, scientific publications, and presentations. Participants' identities will be kept confidential.

By approving this form, you indicate that you understand the information given to you about the workshop to be conducted and that you approve the use of workshop outputs, visuals, and insights in thesis studies and other publications. Your approval of the form does not mean that you have waived your legal rights or that the researchers and the relevant organization waived their legal responsibilities. Participation in the workshop is on a voluntary basis. You can request clarification at any stage of the workshop. You can request to withdraw from the workshop at any time without stating a reason. Thank you for contributing to the research.

Participant's Name Surname

……..

Date

….. /….. /…..

I understand the terms indicated above and give my consent.

☐ Yes

☐ No

☐ ……..

Figure F.2: Online consent form for DUI Workshop II

DESIGN FOR USER INTENTIONS WORKSHOP III: CONSENT FORM

Workshop Facilitators:
Res. Assist. Dilruba Oğur Aydın
ID 302 Studio Team

Thursday, May 6, 2021, 09:00-17:00
contact: dilrubaogur@gmail.com

Design for User Intentions workshop explores the potentials of user intentions in generating ideas for sustainable behavior change and it is carried out within the scope of a doctoral research conducted by Dilruba Oğur Aydın under the supervision of Prof. Dr. Çağla Doğan in the Department of Industrial Design, Middle East Technical University. The aim of the workshop is to explore design solution areas that will support the effective use of water while performing personal care and hygiene practices in the bathroom environment. The outcomes of the workshop will inform the development of design tools that aims to support designers to provoke solutions for influencing sustainable behaviors.

The workshop, which consists of a series of idea generation and evaluation stages and incorporates several design tools, has been planned to last approximately in seven hours. The workshop process will be video recorded with your permission. The data obtained during the workshop will only be used for scientific purposes, design processes, thesis research, scientific publications, and presentations. Participants' identities will be kept confidential.

By approving this form, you indicate that you understand the information given to you about the workshop to be conducted and that you approve the use of workshop outputs, visuals, and insights in thesis studies and other publications. Your approval of the form does not mean that you have waived your legal rights or that the researchers and the relevant organization waived their legal responsibilities. Participation in the workshop is on a voluntary basis. You can request clarification at any stage of the workshop. You can request to withdraw from the workshop at any time without stating a reason. Thank you for contributing to the research.

Participant's Name Surname

……..

Date

….. /….. /…..

I understand the terms indicated above and give my consent.

- ☐ Yes
- ☐ No
- ☐ .....

Figure F.3: Online consent form for DUI Workshop III

G. Workshop Brief for DUI Workshop II

DESIGN FOR USER INTENTIONS WORKSHOP

Workshop facilitators:

Res. Assist. Dilruba Oğur Aydın
Assoc. Prof. Dr. Çağla Doğan
Assist. Prof. Dr. Senem Turhan

Problem Background

Though water is a renewable resource, various reasons including increasing pollution due to chemical wastes, growing population, and excessive use threaten the water reserves in the world. Water scarcity affects more than 40% of the world population which makes preserving water resources one of the prominent global environmental issues.

Turkey is defined as a water-stressed region where the average annual water consumption per person is 1386 cubic meters. When compared to industrial (18.4%) and agricultural water use (71.3%), household water consumption (10.3%) appears to be insignificant. However, it holds many opportunities for design where every individual can relate to. In households, even products and systems related to water consumption have become technologically more efficient, the consumption they are responsible for is largely determined by use behaviors. Considering the diversity of activities and their impacts on overall water consumption, the bathroom environment will be the main concern of this study to influence behaviors through design interventions.

The aim of the workshop

This workshop aims to explore design solution areas for influencing individuals to adopt behaviors for effective use of water as performing personal care and hygiene activities around washbasin (i.e. washing hands, washing face, brushing teeth, washing hair, and washing feet). As generating ideas, individuals' diverse intentions to perform sustainable behaviors will be considered to enhance the acceptance of the design interventions. The outcomes of the workshop will inform the development of the proposed design tools that aim to support designers to provoke solutions for influencing sustainable behaviors.

Figure G.1: Workshop brief for DUI Workshop II - Part 1

Workshop procedure

1 — 15 min.
Sensitizing: Prior to the workshop, you will individually observe and record your personal care and hygiene activities around the washbasin, and consider and share your understandings about water consumption through a visualization task. This stage will prime you for the workshop through enabling you to get familiar with the activities of interest and water consumption.

2 — 15 min.
Introducing: At the beginning of the workshop session, a brief introduction will be made explaining the workshop procedure and incorporated design tools.

3 — 60 min.
Generating I: You will be asked to generate design solution areas as pairs through incorporating diverse design inspiration cards (i.e. behavior types, cognitive and contextual determinants, user intentions, and design strategies) into the ideation process. You will use post-it notes, scenarios, and sketches to communicate your ideas and process.

4 — 40 min.
Sharing & Reflecting I: You will describe your ideas as pairs through explaining the behavior types, cognitive and contextual determinants, user intentions, and design strategies you have inspired from and the rationale behind your decisions.

5 — 45 min.
Generating II: As pairs, you will be re-exploring the behavior types, cognitive and contextual determinants of behaviors, and design strategies for a different user intention you will be selecting. You will generate ideas through using post-it notes, scenarios, and sketches.

6 — 45 min.
Sharing & Reflecting II: You will describe your ideas as pairs through explaining the behavior types, cognitive and contextual determinants, user intentions, and design strategies you inspired from and the rationale behind your decisions.

7 — 60 min.
Evaluating: You will be sharing your insights and suggestions for the development of the incorporated design tools (i.e. inspiration cards) aiming to provoke the ideation process and the online workshop process.

Figure G.2: Workshop brief for DUI Workshop II - Part 2

H. DUI Workshop Guideline

DESIGN FOR USER INTENTIONS WORKSHOP GUIDELINE
SENSITIZING
Imagine your personal care and hygiene activities around the bathroom environment that are associated with water consumption (i.e., showering, bathing, partial body cleaning [washing body, washing feet, washing hair], washing hands, washing face, brushing teeth and performing an ablution). (i) Consider a scenario where you perform these activities separately or together and note it down. (ii) Try to recall the activity stages, your behaviors and interaction with the products in the scenario you have selected. Then transfer your experience on the timeline through noting down the numbers of the activity stages provided in the list. You may add new stages to the list and repeat stages more than once. In this exercise, you are expected to record at least three diverse personal care and hygiene activities. (iii) As recording the activity stages, think about how water consumption changes throughout these stages and try to visualize these changes. You may use lines, bars, curves or colors to express your understanding.
GENERATING I
Generate design solution areas as a team through incorporating diverse inspiration cards into the ideation process. Use sticky notes, scenarios, and sketches to communicate your ideas and process. While generating ideas please follow these steps: (i) define an activity scenario (e.g., washing hands and face to feel clean and refreshed as entering home) (ii) select one of the user intentions to influence sustainable behaviors (iii) select a behavior type(s) to change (iv) select attitudinal and contextual determinants of behavior (at least one from each category) (v) brainstorm on the potential design solution areas, use design strategies to inspire ideation (vi) generate ideas (at least three) for effective use of water as performing personal care and hygiene activities in the bathroom environment
SHARING & REFLECTING I
While participants describing the generated ideas in relation to the adopted inspiration cards and activity scenarios, address the following questions for further clarification. 1. What were the main considerations for selecting or identifying an activity scenario? 2. How did your choice of activity scenario affect the selection process for the behavior types, determinants of behaviors and user intentions? 3. To what extent the behavior types and determinants were connected to each other? 4. How did the selected inspiration cards support you while exploring the problem area and generating ideas? 5. When and how did you select the design strategies? To what extent did you link the strategies with the user intentions, behavior types and determinants of behaviors? 6. What are the generated design solutions? How are they linked with the inspiration cards? 7. How do the generated ideas support individuals to adopt behaviors for effective use of water?

GENERATING II

As a team, you will be re-exploring the behavior types, attitudinal and contextual determinants of behaviors, and design strategies for a different user intention. You will generate ideas through using sticky notes, scenarios, and sketches.

(i) select another user intention to influence sustainable behaviors

(ii) re-explore the behavior types, attitudinal and contextual determinants of behaviors, and design strategies for a different user intention

(iii) brainstorm on the potential design solution areas, use design strategies to inspire ideation

(iv) generate ideas (at least three) for effective use of water as performing personal care and hygiene activities in the bathroom environment

SHARING & REFLECTING II

While participants explaining how focusing on a different user intention affected their ideation process and the utilization of the inspiration cards referring to the generated ideas, address the following questions for further clarification.

1. What were the main considerations for targeting this user intention?

2. How did your choice of a different user intention affect the re-exploration of the behavior types, determinants of behaviors and design strategies?

3. How did the selected inspiration cards support you while re-exploring the problem area and generating ideas?

4. What are the generated/adapted design solutions? How are they linked with the inspiration cards?

5. How do the generated ideas support individuals to adopt behaviors for effective use of water?

EVALUATING

Behavior Types and Determinants of Behavior

1. What do you think about the names and the definitions of the behavior types and determinants of behaviors cards? (You may evaluate their clarity, comprehensiveness, etc.)

2. How did the probing questions support the ideation process?

3. How did these cards support you to understand the reasons for intensive use of water?

4. How did you integrate these cards into ideation? How did they inspire the development of diverse ideas for behavior change?

5. What are your suggestions for the further improvement of the behavior types and determinants of behaviors cards?

User Intentions

1. What do you think about the names and the definitions of the user intentions cards? (You may evaluate their clarity, comprehensiveness, etc.)

2. What do you think about the distinction between the diverse user intentions?

3. How did these cards support you to understand the individuals' diverse tendencies for adopting change?

4. How did you integrate these cards into ideation? How did they inspire the development of diverse ideas for behavior change?

5. What are your suggestions for the further improvement of the user intentions cards?

Design Strategies

1. What do you think about the names and the definitions of the design strategies cards?

2. What do you think about the distinction between the diverse design strategies?

3. How did these cards support you to understand different approaches and techniques for promoting behavior change?

4. How did the examples on implementing the strategies help you to understand the strategies and incorporate them into the design process?

5. How did you integrate these cards into ideation? How did they inspire the development of diverse ideas for behavior change?

6. What are your suggestions for the further improvement of the design strategies cards?

Workshop Process

1. What are your overall reflections on the workshop process considering the stages, tools and techniques that we have used?

2. How did the sensitizing phase help you to get familiar with the activities and water consumption?

3. How did switching user intentions during the generating stages support the development of diverse ideas?

4. What do you think about the workshop process (clarity of the definitions of the steps, expectations from the participants, etc.)?

5. How do you think the workshop brief supported the understanding of aim and objectives of the workshop?

6. What are your suggestions for the further improvement of the workshop process?

Other

1. If you have any further comments or suggestions that we have not covered, please mention them.

I. Online Questionnaire for Evaluating Stage of the DUI Workshop III

EVALUATING

This survey is the final stage of the Design for User Intentions (DUI) workshop and it aims to gain insights into your experiences with and suggestions for the online workshop process and incorporated inspiration cards.

The survey will take approximately 15 minutes to complete and your answers will be kept strictly confidential and anonymous. For further questions you may contact dilrubaogur@gmail.com.

Inspiration Cards

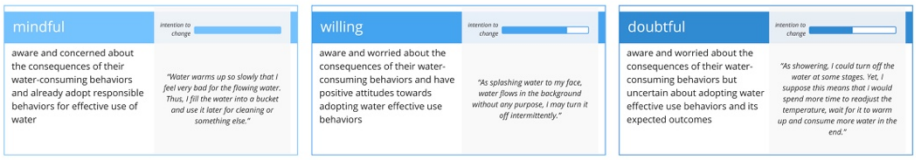
1. Below statements are related to the behavior types and determinants of behavior cards.



	strongly disagree	disagree	neutral	agree	strongly agree
the names and the definitions of the cards were clear	○	○	○	○	○
they were useful to understand the reasons for intensive use of water	○	○	○	○	○
it was easy to integrate them into ideation	○	○	○	○	○
they inspired generating diverse ideas for behavior change	○	○	○	○	○

2. What are your comments and suggestions for further improvement of the behavior types and determinants of behavior cards?

3. Below statements are related to the user intentions cards.



	strongly disagree	disagree	neutral	agree	strongly agree
the names and the definitions of the cards were clear	○	○	○	○	○
the distinction between the diverse user intentions were clear	○	○	○	○	○
they were useful to understand users' diverse tendencies for adopting change	○	○	○	○	○
it was easy to integrate them into ideation	○	○	○	○	○
they inspired generating diverse ideas for behavior change	○	○	○	○	○

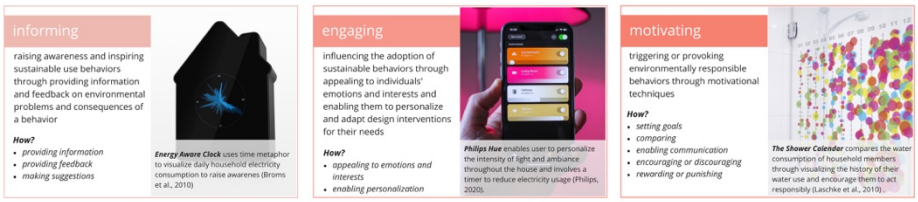
4. What are your comments and suggestions for further improvement of the user intentions cards?

_____

_____

_____

5. Below statements are related to the design strategies cards.



	strongly disagree	disagree	neutral	agree	strongly agree
the names and the definitions of the cards were clear	○	○	○	○	○
the distinction between the diverse strategies were clear	○	○	○	○	○
the product examples were helpful to understand the strategies	○	○	○	○	○
they were useful to understand different approaches for promoting sustainable behaviors	○	○	○	○	○
it was easy to integrate them into ideation	○	○	○	○	○
they inspired generating diverse ideas for behavior change	○	○	○	○	○

6. What are your comments and suggestions for further improvement of the design strategies cards?

_____

_____

_____

Workshop Process

7. Below statements are related to the workshop process.

	strongly disagree	disagree	neutral	agree	strongly agree
the sensitizing stage was helpful to get familiar with the activities and water consumption	○	○	○	○	○
switching the user intentions during the generating stages was helpful to develop diverse ideas	○	○	○	○	○
switching the activity scenarios for the showering and washbasin areas during the generating stages was helpful to develop diverse ideas	○	○	○	○	○
workshop brief was helpful to understand the aim of the workshop	○	○	○	○	○
workshop procedure was clear and easy to follow	○	○	○	○	○

8. What are your overall reflections on the workshop process considering the workshop stages, adopted tools and techniques?

_____

_____

_____

9. What are your suggestions for the further improvement of the workshop?

_____

_____

_____

10. If you have any further comments or suggestions, please mention them?

_____

_____

_____

J. Project Brief in ID 302 Design Industrial Design IV Course

Middle East Technical University Faculty of Architecture Department of Industrial Design
Spring 2020-21 – ID 302 Industrial Design IV

Assoc. Prof. Dr. Çağla Doğan, Asst. Prof. Dr. Senem Turhan, Inst. Aernout Kruithof, Res. Asst. Koray Canlar, Res. Asst. Ayşe Kaplan, Res. Asst. Zeynep Yalman Yıldırım, Res. Asst. Itır Güngör Boncukçu

19 April 2021, Monday

Sustainable Design Scenarios and Solutions for Encouraging Water Effectiveness in Bathroom Environments.

Among the United Nations Sustainable Development Goals, "clean water and sanitation (Goal 6)" emphasizes the importance of safe access for everyone to clean water resources (United Nations Development Program, 2020). Domestic water consumption (10.3%) appears to be insignificant compared to industry (18.4%) and irrigation (71.3%) areas where water is used. However, the household water consumption influenced by user behaviors and attitudes, and mainly resulted from diverse activities in the bathroom environment can be addressed by various **design interventions for effective use of water**.

With the increased effects of the pandemic situation, we can experience water shortages in the near future in Turkey. Acute crisis situations such as a pandemic can negate a crisis such as water shortage, which is comparatively less visible (Bouman et al., 2020). The increasing water consumption in this condition is also closely related to the hygiene perception of the individuals. This change, which can be easily observed in daily practices, may cause problems with the adequacy and accessibility of clean water resources, especially in the long term (Cheval et al., 2020).

The frequent use of the bathroom environments for personal care, hygiene practices, and the perception of hygiene transformed during the pandemic can lead to a significant increase in domestic water consumption. The aim of the project is to **explore and develop sustainable design solutions which focus on the effective use of water mainly affected by user needs, preferences and behaviors in the bathroom environment through considering attitudinal and contextual factors** in the following two specific areas:

- **showering area:** shower sets consist of a hand shower, shower bar, shower hose, other related accessories, and controls and displays for adjusting the flow and temperature of the water, and
- **sink area:** bathroom sink taps, other related accessories, and controls and displays for adjusting the flow and temperature of the water.

The bathroom is a shared environment accommodating diverse users' needs and attitudes, which would have a significant effect on water consumption in relation to the perception of hygiene, and the frequency and duration of daily routines of diverse users or personas such as:

- people with diverse needs (elderly, people with disabilities)
- extended family
- families with children
- young professionals

With our design solutions, we will aim to develop:

- sustainable design scenarios and considerations for the effective use of water,
- responsive product-user interactions and experiences for visible and precise control of water (flow, temperature, etc),

- inclusive and engaging product-user interactions to meet the needs and preferences of diverse user groups (elderly, children, adults, etc.),
- easy to clean and aesthetically appealing forms and surfaces,
- affecting behaviors of individuals in sustainable ways.

The project phases for grading and evaluation will involve the following:

- Design research: literature search and user observation % 25
- Preliminary jury: scenario board and conceptual prototyping % 30
- Final jury % 45

REFERENCES

Bouman, T., Steg, L., & Zawadzki, S. J. (2020). The value of what others value: When perceived biospheric group values influence individuals' pro-environmental engagement. *Journal of Environmental Psychology, 71*, 101470.

Cheval, S., Mihai Adamescu, C., Georgiadis, T., Herrnegger, M., Piticar, A., & Legates, D. R. (2020). Observed and potential impacts of the COVID-19 pandemic on the environment. *International Journal of Environmental Research and Public Health, 17*(11), 4140.

United Nations (2015). Sustainable Development Goals. https://www.un.org/sustainabledevelopment/sustainable-consumption-production/

PROJECT SCHEDULE

Week	TOPICS	MONDAY	THURSDAY
1-5	**PROJECT 1**		
6	**DESIGN RESEARCH / LITERATURE SEARCH** What is the project brief? How to collect data for the literature search? What should we do in the field research and user observations via Experience Chart? How to conduct user interviews?	19 April 2021 Project II Project brief and calendar Literature search brief User research (Experience Chart Guide) brief Setting up teams for design research	22 April **SCHEDULED CRITS:** **Literature search topics** Compiling findings **The Experience Chart (EC) Guide** Preparing research questions Conducting EC Guide
7	**DESIGN RESEARCH/EC GUIDE** How to organize and present findings and insights via Literature Search and User Observations?	26 **Miro Board preparation** for literature search and user observations presentations (teamwork)	29 April **Miro Board preparation** for literature search and user observations presentations (teamwork)
8	**DESIGN RESEARCH / DESIGN FOR USER INTENTIONS (DUI) WORKSHOP** What are the attitudes and behaviors for water consumptions? How are the potential design solution areas to focus on?	**3 May** **PRESENTATIONS: LITERATURE SEARCH / USER OBSERVATIONS**	**6 May** **DESIGN FOR USER INTENTIONS (DUI) WORKSHOP by Dilruba Oğur Aydın** developing design solution areas and design considerations (strategies) for diverse users **DUI WORKSHOP PRESENTATIONS** Each team member will present the DUI workshop Design Solution Areas

9	**TERM BREAK**	**10 & 13 MAY 2021 TERM BREAK**	
10	**IDEATION** Idea generation emerged from the Design for User Intentions (DUI) workshop	17 May **DUI WORKSHOP FEEDBACK** Feedback on the DUI method **IDEA GENERATION** Scenario building and Lo-Fi prototypes (developing diverse ideas)	20 May **SCHEDULED DESIGN CRITS** Developing and compiling ideas
11	**DESIGN DEVELOPMENT/REFINING, COMPILING, and Lo-Fi PROTOTYPING** This is the scenario we work with. This is how our idea is supposed to work and how it fits our scenario!	24 May **CONCEPT PROTOTYPING** **User Testing** Preparation for user testing the design solution including UX (developing alternatives for product parts and user interface)	27 May **DESIGN CRITS** Refining and compiling ideas considering UX Proof of concept prototype and testing the design concept Gaining insights and revising ideas
12	**DESIGN DEVELOPMENT/REFINING, COMPILING, and Lo-Fi PROTOTYPING** **PRE-JURY**	31 May **Miro Board preparation** for preliminary jury	3 June PRELIMINARY JURY Presenting design solutions
13	**DESIGN DETAILING**	7 June Preparation for 3D modeling and technical details	10 June **DESIGN CRITS** Preparation for 3Dmodeling and technical details
14	**DESIGN DETAILING**	14 June Preparation for 3D modeling and technical details	17 June **DESIGN CRITS** Preparation for 3Dmodeling and technical details
15	**DESIGN DETAILING/2D-3D MODELLING**	21 June Final screening	24 June FINAL JURY

K. Workshop Brief for DUI Workshop II

DESIGN FOR USER INTENTIONS WORKSHOP

Workshop facilitators:
Res. Assist. Dilruba Oğur Aydın
ID 302 Studio Team

Problem Background

Though water is a renewable resource, various reasons including increasing pollution due to chemical wastes, growing population, and excessive use threaten the water reserves in the world. Water scarcity affects more than 40% of the world population which makes preserving water resources one of the prominent global environmental issues.

Turkey is defined as a water-stressed region where the average annual water consumption per person is 1386 cubic meters. When compared to industrial (18.4%) and agricultural water use (71.3%), household water consumption (10.3%) appears to be insignificant. However, it holds many opportunities for design where every individual can relate to. In households, even products and systems related to water consumption have become technologically more efficient, the consumption they are responsible for is largely determined by use behaviors. Considering the diversity of activities and their impacts on overall water consumption, the bathroom environment will be the main concern of this study to influence behaviors through design interventions.

The aim of the workshop

This workshop aims to explore design solution areas for influencing individuals to adopt behaviors for effective use of water as performing personal care and hygiene activities around shower and washbasin (i.e. showering, bathing, partial body cleaning [washing body, washing feet, washing hair], washing hands, washing face, brushing teeth and performing an ablution). As generating ideas, inspiration cards will be used to explore the problem area, understand and incorporate the individuals' diverse intentions to perform sustainable behaviors and stimulate ideation.

Figure K.1: Workshop brief for DUI Workshop III - Part 1

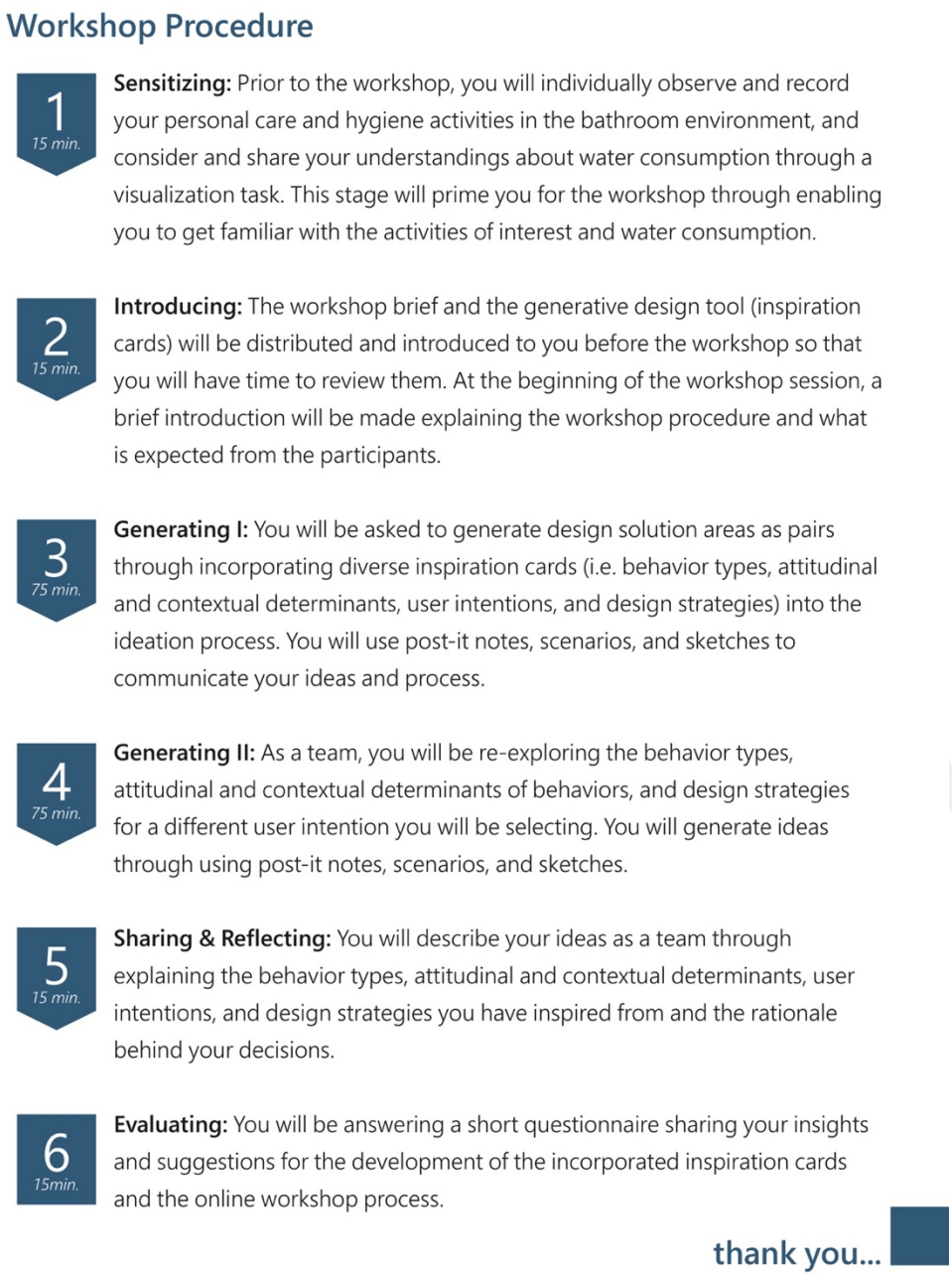


Figure K.2: Workshop brief for DUI Workshop III - Part 2

CURRICULUM VITAE

PERSONAL INFORMATION

Surname, Name: Oğur Aydın, Dilruba
Nationality: Turkish (TC)

EDUCATION

Degree	Institution	Year of Graduation
MS	METU Industrial Design	2014
BS	METU Industrial Design	2011
Erasmus Exchange Student	Politecnico di Torino, Industrial Design	2010
High School	Ankara Atatürk Anadolu High School	2006

WORK EXPERIENCE

Year	Place	Enrollment
2015-Present	METU Dept. of Industrial Design	Research Assistant
2014-Present	Sustain Design Research Lab, METU Department of Industrial Design	Researcher

FOREIGN LANGUAGES

Advanced English, Elementary Italian

PUBLICATIONS

Journal Publications

1. Turhan, S., **Oğur Aydın, D.**, Doğan, Ç., & Kulaksız, M. (2020). Yaşlı Bireylerin Banyo Ortamında Kullanım Alışkanlıkları, Tercihleri ve İhtiyaçlarının Anlaşılması. *Tasarım + Kuram, 16*(31), 80-96. DOI: 10.14744/tasarimkuram.2020.76094

2. Bakırlıoğlu, Y., **Oğur, D.**, Doğan, Ç., & Turhan, S. (2016). An Initial Model for Generative Design Research: Bringing Together Generative Focus Group (GFG) and Experience Reflection Modelling (ERM). *Design and Technology Education: An International Journal, 21*(1), 40-50.

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3. Kulaksız, M., Güngör-Boncukçu, I., **Oğur, D.**, Paksoy, Y., Turhan, S., & Doğan, Ç. (2019). "Generative Design Research for Sustainability: Exemplary Cases for the Adaptation of the EC Guide Tool and the ERM Method." In G. Muratovski and C. Vogel (Eds.), Re:Research – Design and the Creation of Social Value (vol.3, pp. 109-130), Bristol, UK: Intellect. ISBN: 978-1-78938-135-1

4. Turhan, S., Bakırlıoğlu Y., Doğan, Ç., & **Oğur, D.** (2019). "Görüşmeler ve Katılımcı Tasarım Yöntemleri." In Ç. Doğan (Ed.), *Elektrikli Ev Aletleri için Sürdürülebilir Tasarım Ölçütleri: Bakım, Onarım ve Kaynakların Verimli Kullanımı* (pp. 13-59). Ankara: METU Faculty of Architecture Press.

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6. Bakırlıoğlu Y., Doğan, Ç., & **Oğur, D.,** (2019). "Elektrikli Ev Aletleri için Sürdürülebilir Tasarım Ölçütleri." In Ç. Doğan (Ed.), *Elektrikli Ev Aletleri için Sürdürülebilir Tasarım Ölçütleri: Bakım, Onarım ve Kaynakların Verimli Kullanımı* (pp. 105-142). Ankara: METU Faculty of Architecture Press.

7. Töre Yargin, G., Karadoğaner, A. & **Oğur, D.** (Ed.). (2018). *UTAK2018 3. Ulusal Tasarım Araştırmaları Konferansı Bildiri Kitabı: Tasarım ve Umut.* Ankara: ODTÜ Mimarlık Fakültesi Yayınları.

Conference Proceedings

8. Kulaksız, M., Güngör-Boncukçu, I., **Oğur, D.**, Paksoy, Y., Turhan, S., & Doğan, Ç. (2017). Generative Design Research for Sustainability: Exemplary Cases for the Adaptation of the EC Guide Tool and the ERM Method. In *Proceedings of the IASDR 2017, Re: Research Conference*, 31 October-3 November, Cincinnati, Ohio.

9. **Oğur, D.**, Bakırlıoğlu, Y., Doğan, Ç., & Turhan, S. (2015). Towards Sustainable Use and Post-Use: Design Considerations for Small Household Appliances. In *Proceedings of the Sustainable Innovation 15, State of the Art, Sustainable Innovation and Design, Towards Sustainable Product Design: 20th International Conference*, 9-10 November, Center for the Creative Arts, Epsom, Surrey, UK, 172-185.

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