A TOOLKIT FOR DIGITAL HEALTH DESIGNERS:

Facilitating Shared Design Goals Among Multiple Stakeholders Through Participatory Design

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Target Users

Values

Context

Deliverables

Impact

Project Plan

Interaction Qualities

Acknowledgement

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As I finally reach the acknowledgment section of my thesis, my heart is filled with excitement, reflecting on this journey that began in the summer of 2022 and culminated in the fall of 2024. These years have been filled with challenges and growth, and I am deeply grateful for everything I've experienced along the way.

I want to start by expressing my deepest appreciation to my parents. They knew little about Delft or the university before I came, yet they wholeheartedly supported my decision to study abroad. Their unwavering love has given me the courage to face various challenges and has helped me become more independent. Despite being thousands of miles away, their encouragement has been a constant source of strength. I truly appreciate everything they have done for me.

Next, I would like to thank my two incredible mentors, Armağan Albayrak and Tingting Wang. They have been always there for me when I needed guidance, encouraging me through moments of self-doubt. Their patience and support helped me navigate my research and find the resources I needed. Working with them in my final semester has been a privilege; I have learned so much from their dedication to academic rigor and their genuine care for students. Their belief in me has strengthened my resolve to pursue a PhD in healthcare design.

I also want to acknowledge the friends I made during my time abroad. Their companionship turned my experiences into something meaningful. In moments of difficulty, they offered support, whether academically or emotionally, and they made this foreign land feel like home. I am grateful for the bonds we formed. Their presence illuminated my journey.

Moreover, I extend my heartfelt thanks to friends living around the world, whether in China, Canada, or elsewhere. Their kindness during tough times has been invaluable to me.

Lastly, I must thank myself for persevering through it all. This journey has not been easy; I faced countless moments of frustration and sadness. Yet, through it all, I remained committed to my goals. Each challenge has strengthened my self-confidence, and I now understand that I am capable of overcoming any obstacle. Graduating signifies the end of one chapter and the beginning of another, filled with uncertainties. However, I believe I can navigate whatever lies ahead and find beauty even on the most challenging paths.

Looking back now, I am grateful for every step I took. Being at TU Delft was a fortunate choice made by a brave version of myself two years ago. Despite the challenges, I have gained so much clarity about my future direction, and I cherish all that I have experienced.

This time in the Netherlands has opened my eyes to a broader world and the kindness of people from diverse backgrounds. It taught me to embrace different cultures with an open heart, to appreciate life's beauty, and to cherish each moment. I have learned that life is not just about studying or working; it is a short journey where every day matters.

As I move forward, I am committed to living fully and authentically, embracing each day with joy and gratitude. I wish health and happiness to my family, teachers, friends, and everyone involved in this project who has supported me along the way.

My last tribute is to those who know I am not perfect but still love me.

Written on September 21, 2024, in Delft,

Yutong An

Contents

Executive Summary

The integration of digital technologies and design thinking is reshaping the healthcare industry, necessitating tools that can support designers in navigating complex, multi-stakeholder environments. This thesis presents the development of a toolkit specifically designed for digital health designers to facilitate shared design goals among diverse stakeholders. The toolkit addresses key challenges identified through case studies of 14 existing toolkits, as well as structured interviews with healthcare designers.

1. What design tools and toolkits are currently available to designers?

The research began by classifying current design toolkits, revealing that many focus primarily on ideation while offering limited support for earlier stages such as stakeholder alignment and goal definition. Existing toolkits often take a card-based format, though there is a growing trend towards digital tools, particularly in response to the shift towards remote collaboration.

2. What specific tools are required by digital health designers?

10 structured interviews with both novice and experienced digital health designers highlighted critical challenges in stakeholder engagement. These included difficulties in creating a common understanding, managing conflicting values, and setting realistic goals. The need for toolkits to facilitate clear communication, organize complex insights, and align expectations was emphasized. Participants also expressed preferences for toolkits that are easy to use, adaptable, and reusable, with many advocating for a digital version.

3. How to develop a toolkit based on the needs of digital health designers?

In response, this thesis developed a toolkit that addresses the complexities of coordinating multiple stakeholders in digital health design projects. The toolkit features a Honeycomb diagram structured around seven key dimensions, guiding designers through the process of defining clear, achievable design goals. It aids in co-creation and brainstorming sessions, organizes thoughts, and serves as a visual communication tool for tracking project progress and reviewing stakeholder alignment.

4. How to evaluate this design toolkit?

The toolkit was evaluated by six design students with digital health experience, who tested its usability and usefulness. Feedback indicated that the toolkit effectively facilitated collaboration, structured the design process, and improved confidence in managing stakeholder relationships. However, participants also suggested areas for improvement, including the development of a digital version and clearer instructions. In response, a final digital version of the toolkit was created, offering greater flexibility and enhanced support for remote collaboration. This toolkit aims to empower digital health designers in achieving cohesive, stakeholder-aligned design goals.

Introduction

This chapter introduces the thesis by outlining the project's problem statement, aim, research questions, and approach.

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1.1 Problem Statement

Emerging digital technologies (Jandoo, 2020; Kellermann & Jones, 2013) and design thinking (Kolko, 2015; Groeneveld et al., 2018; Tsekleves & Cooper, 2017) promise to shape the future healthcare industry. Digital health (DH) can enhance or provide a comparable patient experience (PEx) compared to some face-to-face healthcare services (Altinisik Ergur et al., 2022; Riley et al., 2021; Shaw et al., 2018; Whitten & Love, 2005).

While many researchers have been working on the theoretical knowledge and methodologies to enhance the digital PEx (T. Wang et al., 2022b; T. Wang, Giunti, et al., 2024), there remains a critical gap in applying them to design practices. Unlike most other design fields where designers can directly experience their products or services, healthcare design presents unique hurdles. Knowledge of the experience, held only by the patient, is unique and precious (Bate & Robert, 2006). In addition, more and more patients would like to actively participate in the design process to speak for themselves (Meskó & deBronkart, 2022). Consequently, increasing patient engagement and promoting co-design become paramount within this context. Existing literature reveal that designers expect to have more accessible, usable, and interactive healthcare-related design tools (Peters et al., 2021; Roy & Warren, 2019).

1.2 Project Aim

This project focuses on developing a toolkit for digital health designers. To accomplish this, we addressed five key research questions:

1. What is digital health and digital patient experience?

2. What design tools and toolkits are currently available to designers?

3. What tools do digital health designers need, and what key components should a toolkit include?

4. How to develop a toolkit based on the needs of digital health designers?

5. How to evaluate this design toolkit?

1.3 Project Approach

This project adheres to the Double Diamond design process model (The Double Diamond - Design Council, 2019), which comprises four main design stages: Discover, Define, Develop, and Deliver.

Discover

- The literature review (Chapter 2) focuses on addressing the first research question, aiming to understand existing theoretical knowledge and methodologies related to digital patient experience design.
- Design toolkit case studies (Chapter 3) aim to answer the second research question by identifying existing tools that designers can utilise.
- Interview with designers and design students (Chapter 4) is dedicated to addressing the third research question, aiming to ascertain the genuine needs of digital patient experience designers. This includes understanding the challenges they have encountered in their past design processes, and determining the support they hope to gain from the toolkit.

Define

- Based on the results of the literature review, case studies, and interviews, Chapter 5 defines the design direction.

Develop

- Ideate design concepts, and generate the first version of the toolkit prototype (Chapter 6)

Deliver

- Test with design students to evaluate its usability (Chapter 7).
- Design iterations and the final design (Chapter 8).
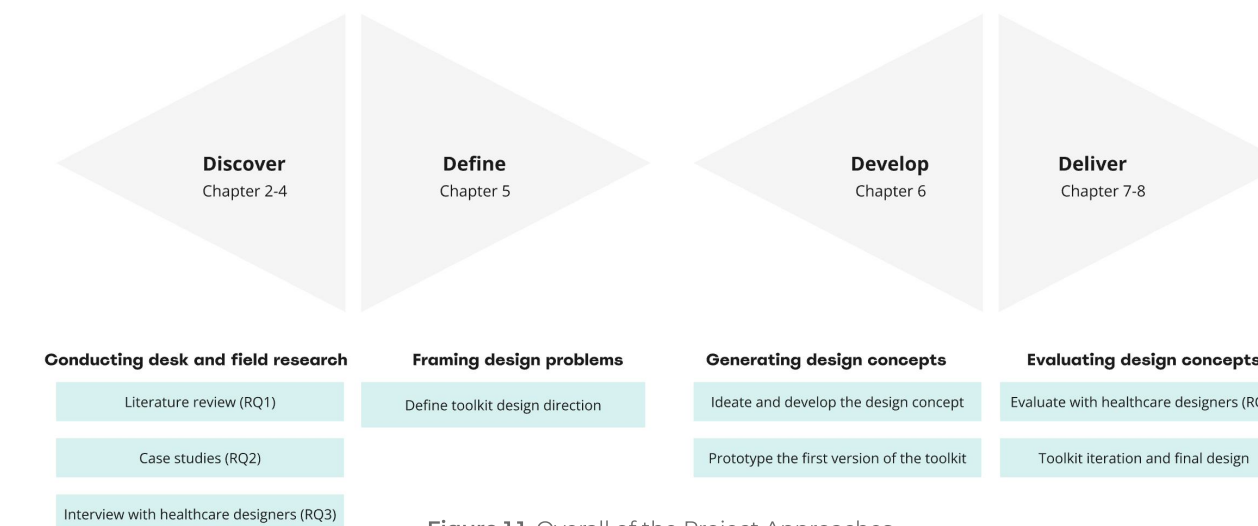- Project reflection and conclusion (Chapter 9)

Figure 1.1 Overall of the Project Approaches

Key Concepts

What is digital health and digital patient experience?

This chapter presents the primary background knowledge covered in the thesis.

02

2.1 Digital Health and Digital Patient Experience

Digital patient experience

The sum of all interactions, affected by a patient's behavioural determinants, framed by digital technologies, and shaped by organisational culture, that influence patient perceptions across the continuum of care channelling digital health (T. Wang et al., 2022b).

Digital health

A wide range of concepts, including internet-oriented application programs, media, scientific terms, and technologies (Mathews et al., 2019).

Digital Health Design Framework

The Digital Health Design (DHD) framework (Figure 2.1), developed by Wang, et al. (2024) , serves as a guide for designers to navigate the design process, engage stakeholders, tackle design challenges, and devise strategies to enhance digital Patient Experience (PEx), drawing from the evolved Double Diamond framework (Melles et al., 2021; The Double Diamond - Design Council, 2019). In an ideal scenario, DH designers commence with a preparatory phase, wherein they define project requirements and constraints, and formulate project management plans in collaboration with clients, managers, and domain experts. Subsequently, they transition to the problem-thinking phase, wherein they identify design issues, uncover user needs through observation or interaction with patients and healthcare providers, and establish design insights and objectives. Following this, designers enter the problem-solving phase, engaging in brainstorming or co-creation activities to develop design concepts and conducting user testing on small-scale prototypes. Finally, designers collaborate with programmers and marketers during the implementation phase to develop and launch designs in the market. Periodically, designers may also engage in product maintenance or iteration post-release.

2.2 From Design Research to Design Practice

Emerging digital technologies (Jandoo, 2020; Kellermann & Jones, 2013) and design thinking (Kolko, 2015; Groeneveld et al., 2018; Tsekleves & Cooper, 2017) promise to shape the future healthcare industry. Many digital health theories have been proven effective and are expected to contribute to improving the digital patient experience. Despite the wealth of knowledge generated by academic design research, its impact on design practice often falls short of expectations (Zielhuis et al., 2022).

This project is built upon Wang et al.'s four studies, which aim to understand and enhance the patient experience, thereby serving as the cornerstone of this endeavour. The primary research conducted by Wang and colleagues provides valuable insights and actionable knowledge for digital health designers seeking to make enhancements in this field (T. Wang et al., 2022b, 2022a; T. Wang, Giunti, et al., 2024; T. Wang, Qian, et al., 2024).
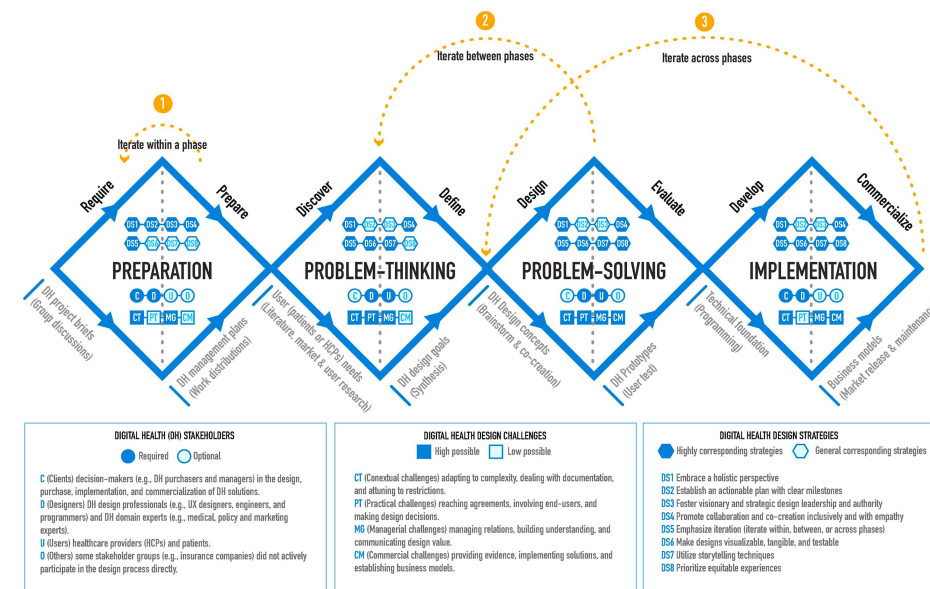

Figure 2.1 The Digital Health Design (DHD) framework (Wang, et al., 2024)

2.3 Participatory Design and Co-design

Participatory design is a design approach that actively engages the intended users in the development process to ensure the final product or service aligns with their needs. This approach seeks to involve users as much as possible throughout the design process.

A defining feature of participatory design is the use of physical artifacts as tools for thinking and collaboration during development (Sanders & Stappers, 2012).

Current literature highlights a growing demand for co-design education, emphasising the importance of instilling future designers with the mindset for collaborative design practices (Örnekoğlu-Selçuk et al., 2024).

In the realm of participatory design, the terms co-creation and co-design are increasingly discussed. However, there is often confusion or interchangeability between these terms:

- **Co-creation** is understood as any collective act of creativity involving two or more individuals, encompassing a wide range of applications from the physical to the metaphysical.
- **Co-design** specifically refers to collective creativity applied throughout the entire design process, encompassing both collaborating designers and individuals not formally trained in design.

Thus, co-design can be seen as a subset of co-creation, emphasising collaboration in the design development process (Sanders & Stappers, 2008).

The transition from user-centred design to co-design alters participant roles (Figure 2.2). In the former, users are passive subjects, researchers gather knowledge, and designers generate ideas. In co-design, users become "experts of their own experience," contributing to idea generation alongside researchers who provide expressive tools, while designers shape the concepts (Sanders & Stappers, 2008; Visser et al., 2005).
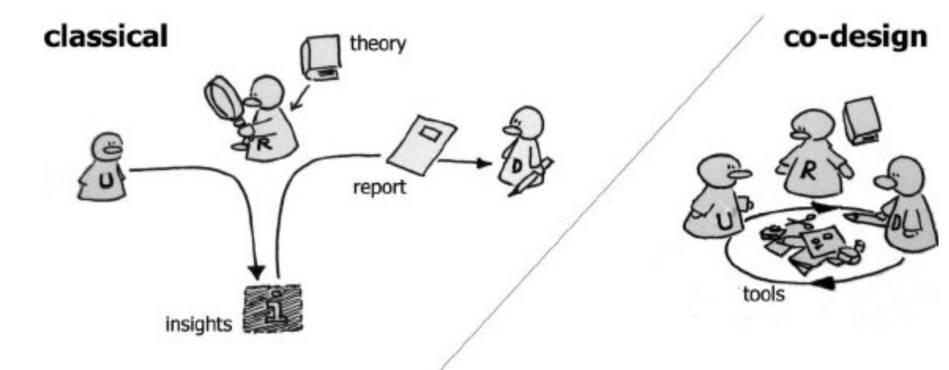

Figure 2.2 Classical roles of users, researchers, and designers in the design process (on the left) and how they are merging in the co-designing process (on the right) (Sanders & Stappers, 2008)

2.4 Stakeholders in healthcare design

According to Wang et al., three distinct stakeholder groups are involved in the design process (see Fig. 2.3). However, not all stakeholders participate in every project (Wang, et al., 2024).

1. Clients, comprises internal and external business customers who initiate design proposals.

2. Designers, includes design professionals (e.g., managers, designers, engineers, programmers) and domain experts (e.g., medical, policy, business experts, patient representatives) who collaborate on the project. While professional projects typically involve large design teams with both design professionals and domain experts, participants in student projects noted that instead of formal teams, they were supported by individuals such as supervisors, physicians, or patients.

3. Users, consists of direct and indirect users who contribute to testing design outcomes and provide insights into healthcare needs. Most participants work directly with patients or conduct observations. However, due to the vulnerability and privacy concerns of patient groups, designers often receive patient information (i.e., direct users) from doctors or nurses (i.e., indirect users).

4. Additionally, many participants highlighted that hospitals, companies, communities, and public sectors also influence the overall design process.
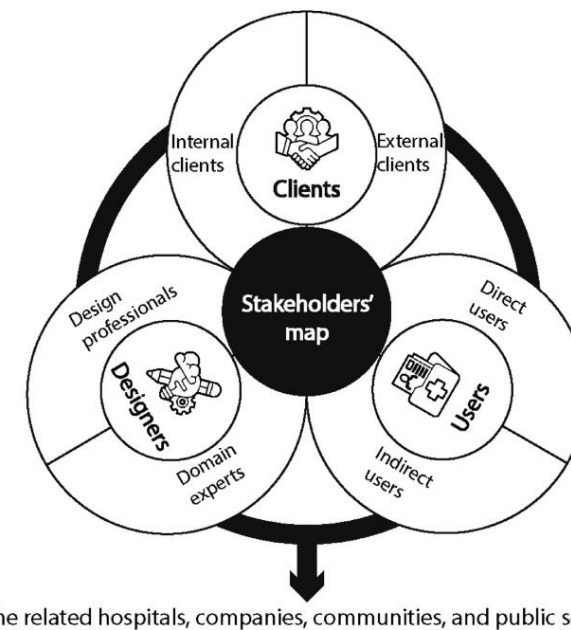

Figure 2.3 Stakeholders' map of healthcare design (Wang, et al., 2024)

Design Toolkit
Case Studies

What design tools and toolkits are currently available to designers?

This chapter clarifies the contents, elements, forms, usage methods, and contributions of widely recognized design toolkits from the past decade. It also proposes new classification methods, summarizes existing toolkit distribution, and explores design opportunities to support the development of toolkits for practical application.

03

3.1 Abstract

In the field of design, there is a growing diversity of tools and toolkits, yet the definitions of design tools and toolkits remain ambiguous and overlapping. Furthermore, there is a lack of systematic and effective classification methods for the tools and toolkits developed in design research and practice. This chapter aims to contrast these concepts, clarify the potential contents of design toolkits, and analyse the constituent elements, forms, usage methods, and main contributions of representative design toolkits widely recognized or utilised in academia or industry over the past decade. Additionally, this chapter will propose new classification methods, summarise the distribution characteristics of existing toolkits, and explore potential design opportunities to provide theoretical and case-based support for the development of toolkits for application in design practice.

3.2 Introduction

It has shown a rapid adoption of methods of doing research into design processes (Sanders & Stappers, 2014). Despite the availability of numerous meticulously designed and often well-researched tools, the understanding of these resources is hampered by disciplinary silos, a lack of consistent terminology, and limited dissemination. This makes it challenging for designers to select or compare tools based on their actual features (Peters et al., 2021).

Design tools and design toolkits

At a broad level, we define a design tool as 'something that provides materials with which a designer interacts to create a situation that talks back to the designer. (Yamamoto & Nakakoji, 2005; Peters et al., 2021)

Dan Lockton (2017) defines design toolkits as 'a collection of 'ways of doing things' during the design process in the context concerned. However, the term "toolkit" is broadly employed in the design industry and can encompass a wide range of forms, including physical artifacts, digital tools, software components, instructional books, and online resources (Lockton, 2017).

Sanders et al. assert in their research that methods and tools for making empower both designers and non-designers to envision future objects, concerns, and opportunities, as well as to envision future experiences and ways of living (Sanders & Stappers, 2014).

Card-based Design Tools

Many card-based design tools have been produced, initially to aid creativity and user participation in design, with an upsurge post-2000 when numerous card decks were developed (Roy & Warren, 2019).

Roy et al. summarised the multifaceted utility of card decks as a design tool within their research. They highlighted several strengths, including 1) their capacity to foster innovative combinations of information and ideas, 2) their role in establishing a shared framework for comprehension and communication within teams, and 3) their ability to furnish tangible, external representations of design components or data. 4)Additionally, card decks serve as convenient repositories for condensed yet valuable information or methodologies, positioning themselves as semi-structured tools that strike a balance between the flexibility of blank Post-it notes and the rigidity of detailed instruction manuals (Carneiro et al., 2012; Roy & Warren, 2019).

However, despite these advantages, card decks are not without their shortcomings. 1) They risk overwhelming users with an excess of information, 2) potentially oversimplifying complex concepts due to spatial constraints, and 3) may pose challenges for users in terms of comprehension and application. 4) Furthermore, the inherent difficulty in modifying or updating card decks adds another layer of complexity to their utility within design processes (Casais et al., 2016; Roy & Warren, 2019).

Previous works

In the past decade, there have been reviews of various types of design tools. Generally, these reviews have examined limited samples of tools and are often specific to a particular type of tool, such as only reviewing and analysing card-based design tools (Roy & Warren, 2019; Wölfel & Merritt, 2013), or only including physical design tools and toolkits (Peters et al., 2021).

1. Wölfel and Merritt conducted a review of 18 card-based design tools with the aim of understanding their potential benefits for designers. They categorized these card-based tools based on five design dimensions, which include the intended purpose and scope of use, duration of use, methodology, customization, and formal/material qualities (Figure 3.1). Additionally, they identified three archetypes of existing tools: general purpose/ repository cards, customizable cards, and context-specific cards (Wölfel & Merritt, 2013).
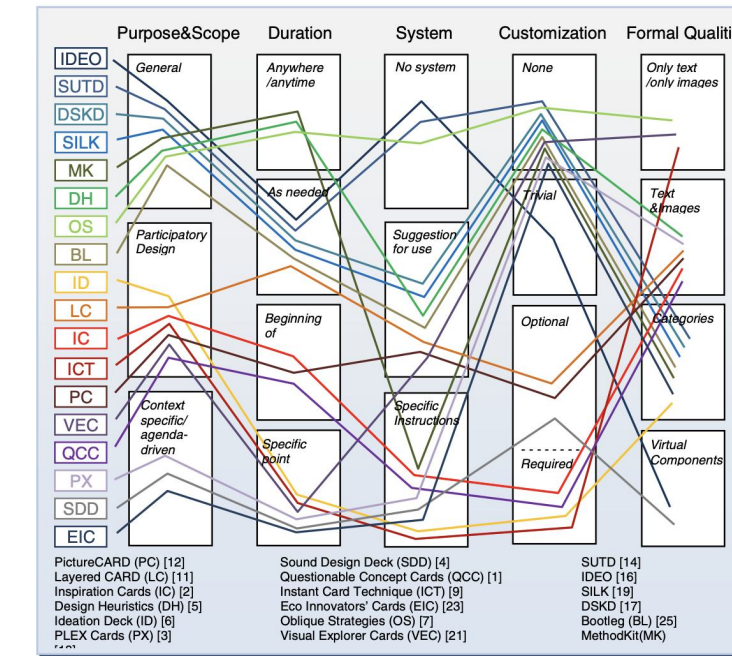
2. In a study by Dorian Peters et al. (2021), they investigated analogue tools for collaborative ideation in both design and human-computer interaction literature, as well as in commercial practices. They examined 76 tools, kits, and games that met their review criteria. Innovatively, they classified these tools according to 10 descriptors, including a novel taxonomy that distinguishes 7 types of tools: methods, prompts, components, concepts, stories, embodiment, and construction. The aim of their research is to assist designers and design teams in selecting, customising, critiquing, analysing, and/or building tools to support collaborative designerly inquiry (Peters et al., 2021). However, this study's limitation lies in its focus solely on physical analogue design tools, excluding digital tools (such as websites) and hybrid tools from consideration.

Figure 3.1 Classification of method cards for design (Wölfel & Merritt, 2013)

Figure 3.2 a Classification of 155 card-based design tools. The area of each block represents the proportion of card decks in each of six main categories, **b** Breakdown of the six main categories of card deck into domains or discipline areas. (Roy & Warren, 2019)

3. In a study by Dorian Peters et al. (2021), they investigated analogue tools for collaborative ideation in both design and human-computer interaction literature, as well as in commercial practices. They examined 76 tools, kits, and games that met their review criteria. Innovatively, they classified these tools according to 10 descriptors, including a novel taxonomy that distinguishes 7 types of tools: methods, prompts, components, concepts, stories, embodiment, and construction. The aim of their research is to assist designers and design teams in selecting, customising, critiquing, analysing, and/or building tools to support collaborative designerly inquiry (Peters et al., 2021). However, this study's limitation lies in its focus solely on physical analogue design tools, excluding digital tools (such as websites) and hybrid tools from consideration.
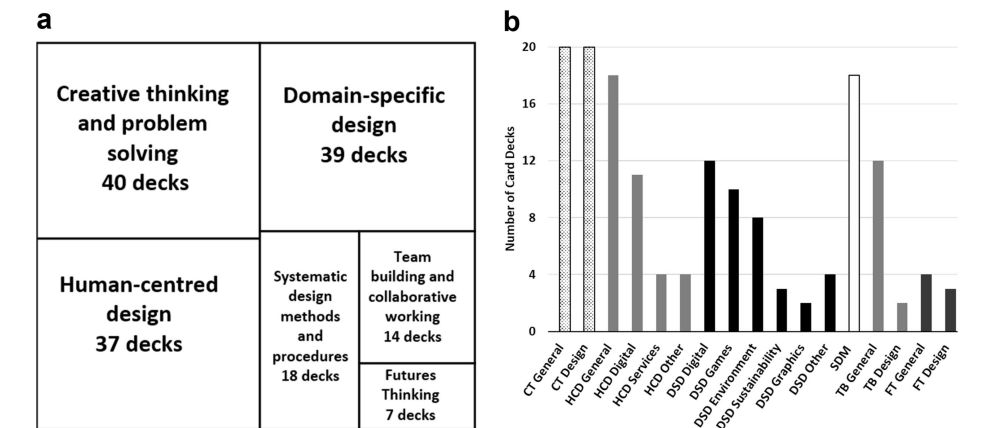
Research Aim

Previous research has laid the foundation for my study by categorising design tools, although some classifications are still overly general or not consistently categorised along the same dimensions. For example, Warren's six categories (Figure 3.2) may overlap, as seen in card tools within the field of Human-Centred Design (HCD), which may also facilitate creative thinking.

Therefore, the objective of this chapter is to understand the current applications of design toolkits and propose a more systematic and effective way of classification. This will provide guidance for future development of toolkits for designers.

3.3 Methods

Search process

The case study retrieval period spanned from March to April 2024, encompassing searches on open-access journals or conference papers available on platforms such as Google Scholar, ACM Digital Library, Scopus, ProQuest, and ResearchGate. This included toolkits publicly disclosed by design education institutions (e.g., the Inclusive Design Toolkit from the University of Cambridge), widely used toolkits published by design agencies (e.g., the IDEO Design Kit), as well as influential design toolkits mentioned on design websites and blogs (e.g., Lego Serious Play). The web search aimed to identify tools provided by commercial, non-profit, and governmental sources, rather than solely focusing on academic backgrounds (Peters et al., 2021). Example search keywords and phrases included "design toolkit," "design tools," "design method," and "ideation tools," ultimately resulting in the inclusion of 14 cases.

Inclusion and Exclusion Criteria

The following criteria guided the inclusion and exclusion of tools in the review:

Inclusion:

- Self-identified as a "toolkit" or contains various types of "design tools" (such as card decks combined with canvas).
- Includes toolkits for general design processes and methods or is specifically designed for use in certain design stages such as discovery, ideation, validation, or implementation.
- Includes toolkits available in digital formats (such as websites), in physical formats (such as card decks), or in hybrid formats (such as resources available on websites but also featuring physical cards or books).
- Tools that are publicly accessible and available in English.

Exclusion:

- Toolkits that are available only in physical formats and can only be obtained through purchase.
- Toolkits that are technology-oriented, such as those used in the field of Human-Computer Interaction (HCI) or for software development.

No.	Toolkit Name	Author/ Sources	Domain	Format
1	IDEO Design kit	https://www.designkit.org/case-studies.html	Human-centred design	Website, book, templates
2	This is Service Design Doing	https://www.thisisservicedesigndoing.com/methods	Service design	Website, book
3	Perswedo	(Ren et al., 2017)	Persuasive Technology (PT)	Card deck
4	TTP TOOLKIT	(Mehta et al., 2023)	Privacy management	Card deck, canvas or maps
5	Inclusive Design Toolkit	https://www.inclusivedesigntoolkit.com/	Inclusive design	Wearables
6	Design with Intent	(Lockton et al., 2010)	Human-centred design	Card deck, canvas or maps
7	Metaphor Cards	(Logler et al., 2018)	Generative design	Card deck
8	Use2Use Design Toolkit	(Rexfelt & Selvefors, 2021)	User-centred Circular design	Card deck, canvas or maps, templates
9	Toolkit for Co-Designing towards Community-Based Active Ageing	(G. Wang et al., 2022)	Behaviour change design; community-based design	Card deck, canvas or maps
10	CoCo Tool Kit	(Väisänen, 2023)	Service Design	Card deck, board games
11	IoT Service Kit	https://www.service-design-network.org/headlines/iot-service-kit-futurice-gmbh	Internet of Things (IoT)	3d shapes, board games
12	Lego Serious Play	https://www.lego.com/en-nl/themes/serious-play/about	General design process	Construction kits
13	Triggers	https://www.trytriggers.com/	Human-centred design	Card deck
14	The Innovation Toolkit	https://apphaus.sap.com/toolkit	Human-centred design	Canvas or maps, website, 3d shapes, templates

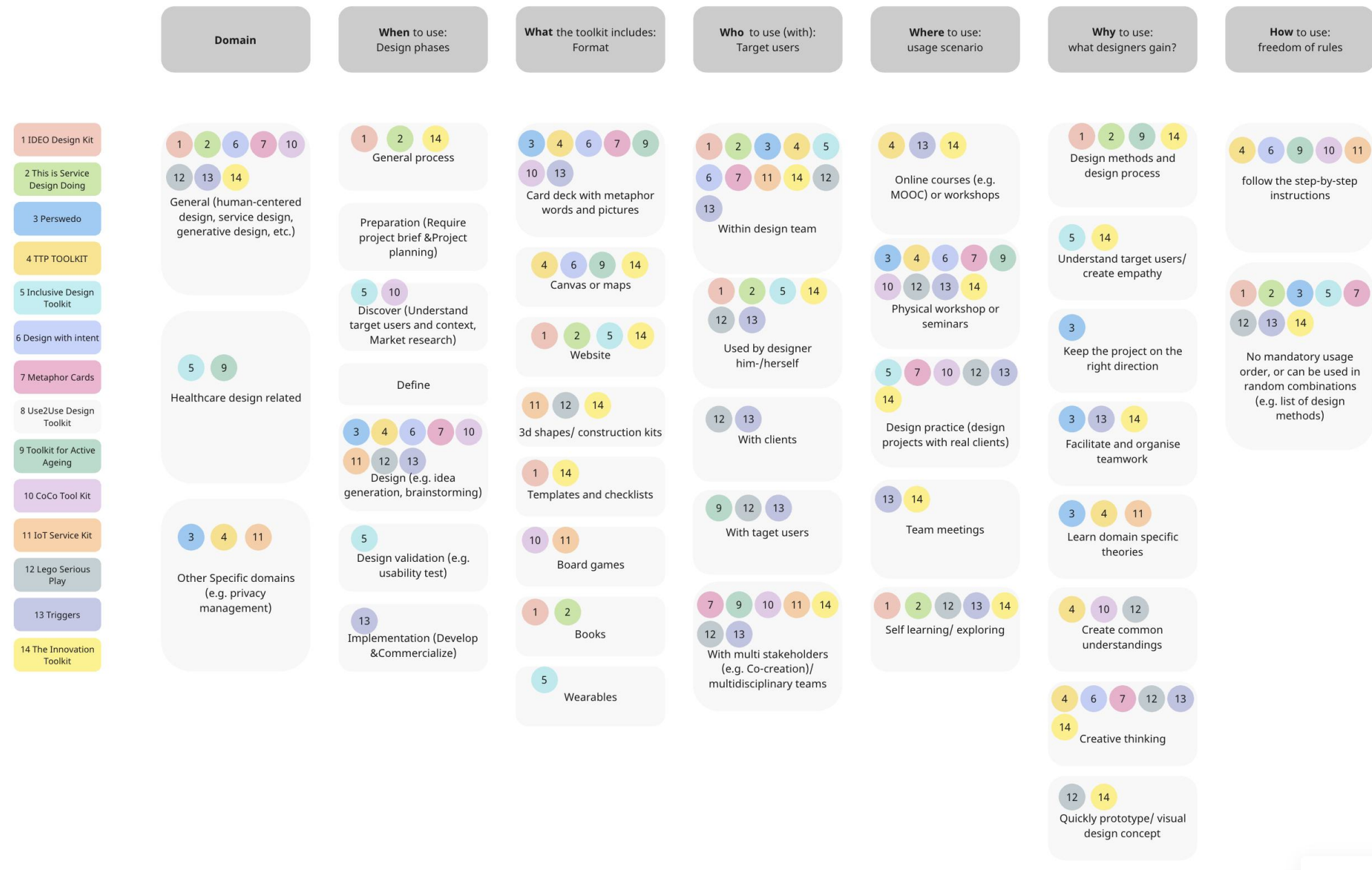**Table 3.1** Toolkit cases extraction table

3.4 Results

Table 3.1 provides an overview of 14 reviewed toolkit cases, including the toolkit names, authors/sources, domain, and format.

The author proposes new dimensions for classifying toolkits, including Domain, When to use- Design phases, What the toolkit includes- Formats, Who to use (with)- Target users, Where to use- Usage scenario, Why to use- What designers gain, and How to use - Freedom of rules.

As most design toolkits encompass more than one tool, categorizing them individually poses a challenge, as a single toolkit may correspond to multiple elements within the same dimension. For instance, Case 13 Triggers can be used by designers individually, within design teams, or during co-creation sessions with various stakeholders (such as clients, target users, etc.). Additionally, a toolkit may include multiple formats; for example, Case 14 Innovation Toolkit comprises canvas, a website, 3D shapes, and templates, and offers both purchasable physical versions and downloadable PDF versions to suit different application scenarios.

Therefore, a single table cannot effectively illustrate the focus of different design tools and toolkits across various categories. Hence, Figure 3.3 was created to facilitate a more intuitive summary and observation of the distribution and cross-influence factors of toolkits across different dimensions.

Figure 3.3 Diagram

Domain

Left column labels
1 IDEO Design Kit
2 This is Service Design Doing
3 Perswedo
4 TTP TOOLKIT
5 Inclusive Design Toolkit
6 Design with intent
7 Metaphor Cards
8 Use2Use Design Toolkit
9 Toolkit for Active Ageing
10 CoCo Tool Kit
11 IoT Service Kit
12 Lego Serious Play
13 Triggers
14 The Innovation Toolkit

Domain

1 2 6 7 10
12 13 14
General (human-centered design, service design, generative design, etc.)

5 9
Healthcare design related

3 4 11
Other Specific domains (e.g. privacy management)

When to use: Design phases

1 2 14
General process

Preparation (Require project brief &Project planning)

5 10
Discover (Understand target users and context, Market research)

Define

3 4 6 7 10
11 12 13
Design (e.g. idea generation, brainstorming)

5
Design validation (e.g. usability test)

13
Implementation (Develop &Commercialize)

What the toolkit includes: Format

3 4 6 7 9
10 13
Card deck with metaphor words and pictures

4 6 9 14
Canvas or maps

1 2 5 14
Website

11 12 14
3d shapes/ construction kits

1 14
Templates and checklists

10 11
Board games

1 2
Books

5
Wearables

Who to use (with): Target users

1 2 3 4 5
6 7 11 14 12
13
Within design team

1 2 5 14
12 13
Used by designer him-/herself

12 13
With clients

9 12 13
With taget users

7 9 10 11 14
12 13
With multi stakeholders (e.g. Co-creation)/ multidisciplinary teams

Where to use: usage scenario

4 13 14
Online courses (e.g. MOOC) or workshops

3 4 6 7 9
10 12 13 14
Physical workshop or seminars

5 7 10 12 13
14
Design practice (design projects with real clients)

13 14
Team meetings

1 2 12 13 14
Self learning/ exploring

Why to use: what designers gain?

1 2 9 14
Design methods and design process

5 14
Understand target users/ create empathy

3
Keep the project on the right direction

3 13 14
Facilitate and organise teamwork

3 4 11
Learn domain specific theories

4 10 12
Create common understandings

4 6 7 12 13
14
Creative thinking

12 14
Quickly prototype/ visual design concept

How to use: freedom of rules

4 6 9 10 11
follow the step-by-step instructions

1 2 3 5 7
12 13 14
No mandatory usage order, or can be used in random combinations (e.g. list of design methods)

Figure 3.3 Design toolkit category dimensions

Domain

Among the selected cases, a majority of the toolkits (n=8) are applicable to the general field of Human-Centred Design. Two cases are specifically tailored for the healthcare domain: Case 5, the Inclusive Design Toolkit, and Case 9, the Toolkit for Co-Designing towards Community-Based Active Ageing. Additionally, three cases are designed for other specific domains, such as Case 3, Perswedo, primarily applied in Persuasive Systems Design (PSD) and Persuasive Technology (PT), and Case 4, the TTP Toolkit, designed for the Tangible Privacy Management field.

When to use - Design phases

This dimension categorises toolkits based on the stages of the design process. It is noteworthy that the majority of cases are concentrated in the design ideation stage (n=8), involving activities such as brainstorming. Three cases encompass the general design process (cases 1, 2, 14). Two toolkits address the discovery stage of the design process, such as Case 5, the Inclusive Design Toolkit (Figure 3.4), used for understanding target users during this phase. Additionally, this toolkit is the only one suitable for usability testing during the validation stage. Furthermore, one case involves tools for the implementation stage; Case 13, Triggers, includes tools and knowledge related to branding and commercialization.

What the toolkit includes - Formats

Half of the toolkits (n=7) include card decks with metaphorical words and pictures. Additionally, four cases contain canvas or maps with guiding methodologies, while four cases present design toolkits through websites. Three toolkits incorporate 3D shapes or construction kits, with Case 12, Lego Serious Play (Figure 3.5), being particularly representative and widely recognized in the industry. Moreover, a small portion of cases include templates and checklists (n=2), board games (n=2), and books (n=2). Only Case 5, the Inclusive Design Toolkit, utilises wearables as a format for the toolkit.

Who to use (with) - Target Users

The vast majority of toolkit cases support usage within design teams (n=11), while half of the toolkits can also be used for collaboration with other stakeholders (n=7), such as in co-creation sessions or multi-disciplinary teams involving participants without a design background. Some toolkits are designed for independent use by designers (n=6).

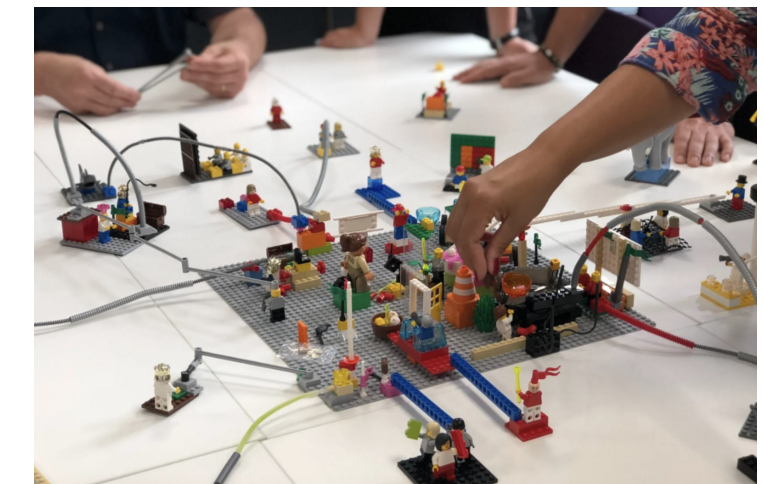**Figure 3.4** Inclusive Design Toolkit (IDT Home, n.d.)

Figure 3.5 Lego Serious Play (LEGO® SERIOUS PLAY, n.d.)

Where to use - Usage scenario

More than half of the toolkits indicate that they can be applied in offline workshops or seminars (n=9), with these workshops and seminars primarily oriented towards educational purposes. Additionally, nearly half of the toolkits can be used in design practice, such as in design projects with real clients (n=6). It is noteworthy that several cases specifically mention that their toolkits offer digital versions that can be utilised in online courses or workshops (n=3). For example, Case 4, the TTP Toolkit, mentions that due to the impact of the pandemic, they developed a version that can be used in Miro to adapt to online teaching. Furthermore, two toolkits are suitable for team meetings.

Why to Use - What designers gain

While some toolkits mention that they aim to support creative thinking (n=6), others indicate that they are beneficial for facilitating the design process and providing explanations of design methods (n=4), organising teamwork (n=3), learning domain-specific theories (n=3), and establishing common understandings with other stakeholders (n=3). Certain cases mention that their development purpose is to help designers understand target users or foster empathy (n=2), or to facilitate the rapid prototyping or visualisation of design concepts (n=2). One case mentions that they hope the toolkit can help designers keep the project on the right track.

How to use - Freedom of rules

This dimension comprises two types: step-by-step tools with strict usage processes and instructions (n=5); and those with no mandatory usage order or can be used in random combinations (n=9).

3.5 Limitations

Due to the limited selection of 14 cases in this study, there may be inherent selection biases. However, efforts were made during the screening process to prioritise toolkits that have been utilised in either industrial or academic settings, or those that have been recently released.

The distribution presented in Figure 3.3 does not represent the entire landscape of design tools but rather explores and summarises patterns and experiences by selecting representative tools and toolkits.

In the case selection process, only online search methods were utilised, potentially overlooking cases that have not been publicly disclosed on websites or in journals. Additionally, some cards or kits that are only available in paid physical versions were difficult to access, leading to their exclusion from the case study choices.

3.6 Takeaways

Existing toolkit features

General design domain

Many toolkits are applicable to broad fields such as Human-Centered Design and service design, incorporating a variety of methods and processes typical of these disciplines (e.g., cases 1, 2, 14).

Focus on the ideation phase

Most existing design toolkits primarily focus on the design ideation phase, with tools specifically for the project preparation and definition phases being relatively rare.

Card-based tools remain mainstream

Card-based design tools remain the dominant format within toolkits.

What designers want

Provide editable space

Flexibility is essential within these toolkits. For example, in Case 3, designers recommended including editable spaces to accommodate their specific interests.

Create digital versions

There is a notable shift from physical card sets and canvases to online versions, driven by the increased prevalence of online courses, particularly during the pandemic. For instance, Case 4's TTP Toolkit developed an online remote seminar version.

Reduce technical language

Several cases (e.g., cases 3, 9) highlighted designers' preferences for reducing technical language, increasing visual information, and minimizing text within these toolkits.

Towards multi stakeholders

While many toolkits are still aimed at those with a design background, there is a growing trend of toolkits designed for co-creation processes with stakeholders from different backgrounds, particularly target users, to collect ideas and create shared understandings.

User Research

What tools do digital health designers need, and what key components should a toolkit include?

Structured interviews with 6 design students and 4 experienced designers identified stakeholder engagement as a key challenge in digital health design, highlighting the need for toolkits to create common understanding, manage conflicts, and align expectations, especially for less experienced designers.

04

4.1 Expert and Novice Designers

It is generally known that expert and novice designers work in different ways and engage in different behaviour during the design process (Christiaans & Dorst, 1992; Cross et al., 1994). Chen et al. investigated the distinctions between expert and novice behaviour (Chen et al., 2022). The specific characteristics and respective strengths and weaknesses are summarised in Table 4.1.

	Novice	Expert
Description	Individuals who are new to the area.	Individuals who have acquired knowledge in a specific professional field through long-term experience or training (Chi et al., 1981)
Differences	Novices always get stuck in the information gathering process	Experts prefer to represent the structure of a problem in their own way at the beginning of a task (Ho, 2001)
Strengths	- More willingness to learn new methods - Full of passion - Familiarity with new technologies and trends	- More experience and domain related knowledge - Familiar with design process and methods - More social connections (e.g. with medical experts, patients, healthcare provider) - Effective at framing design problems and make quick decisions (Kim & Ryu, 2014)
Weaknesses	- Lack of confidence - Lack of experience and related knowledge - Easy to lost design directions	Structure of a problem in their own way may lead to bias

Table 4.1 Design novice and design expert

4.2 Interview with digital health designers and design students

Interview Preparation

To address the research questions, the interviews were structured and guided by an interview guide (see Figure 4.1), comprising three main sections:

Figure 4.1 Interview guide

1. **General Information:** This section gathers basic information about the interviewees, including their work experience and/or educational background, professional field, especially any experience in healthcare design, as well as their primary sources for acquiring healthcare design knowledge.

2. **Project Sharing:** Interviewees were invited to share a digital health design-related project, detailing the overall design process, stakeholders involved, project duration, target users, and specific challenges encountered during the project.

3. **Reflective Exercise:** The third section involved reflecting on the digital health design project mentioned in the previous section using a canvas on Figma (see Figure 4.2). This exercise was the focal point of the entire interview. The canvas encompassed different assessment dimensions (when, what, who, where, why, how) derived from the case study discussed in Chapter 3. None of the sections had fixed answers. Instead, to inspire interviewees, each section of the canvas provided keywords and examples. Interviewees were also encouraged to provide their answers and explanations.
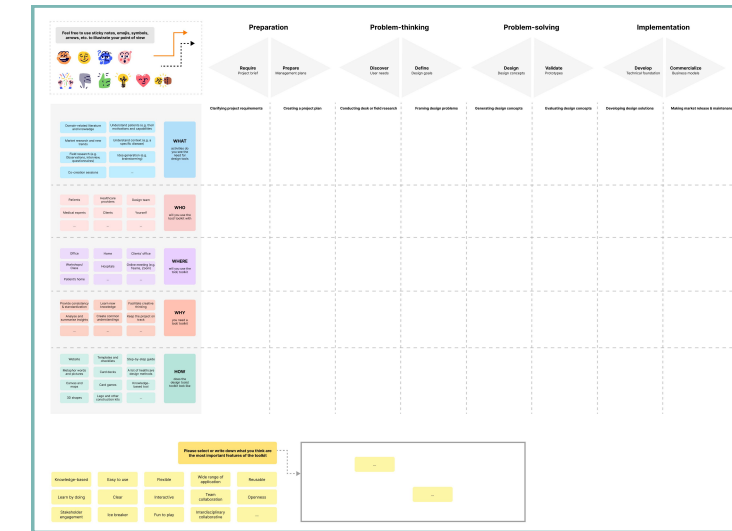

Figure 4.2 Interview materials (See appendix for clear version)

When (four grey diamonds): Participants were prompted to recall the design stages involved in The Digital Health Design (DHD) framework (Wang et al., 2024).

What: Interviewees were asked to recall what design activities within different design stages they found challenging and required intervention of design tools or toolkits (e.g., co-creation sessions, understanding domain-related literature and knowledge, understanding patients).

Who: This section explored whom interviewees wished to collaborate with using the toolkit (e.g., clients, patients, healthcare providers, within the design team, or use by themselves).

Where: Designers were prompted to identify where they envisioned using the toolkit (e.g., office or classroom, patient's home, hospitals, clients' office, or online meetings).

Why: This dimension delved into the reasons or purposes for which designers needed to use the toolkit (e.g., provide consistency & standardisation, analyse and summarise insights, create common understandings, facilitate creative thinking, learn new knowledge, keep the project on track).

How: Interviewees were asked to identify the forms of the toolkit they preferred to use (e.g., metaphor words and pictures, canvas and maps, 3D shapes, card deck, templates and checklists, a list of healthcare design methods, website, card game).

Keywords: Interviewees were then invited to select or write down the most important features of the toolkit (e.g., knowledge-based, easy to use, clear, stakeholder engagement, icebreaker, flexible, interactive, fun to play, wide range of application, team collaboration, interdisciplinary collaboration, reusable, openness).

Recruiting

The answers were audio recorded to facilitate transcription and coding for later data analysis with the consent of the informants. Data is collected after approval by the HREC (Human Research Ethics Committee) TUDelft.

Drawing from the arguments presented in section 4.1 regarding novices and design experts, it is evident that designers with varying levels of experience possess distinct requirements for design toolkits throughout the design process. In order to investigate the diverse needs and preferences towards design toolkits among designers with differing levels of experience, a sample of 10 design students and designers with prior involvement in digital health projects was recruited. The selection process leveraged the research team's network and employed a snowball sampling approach to ensure a varied and representative participant pool.

Due to time and geographical constraints, a combination of face-to-face interviews and online video conferencing via Teams or Tecent Meeting was employed to conduct interviews, each lasting an average of 60 minutes. To further explore the impact of design experience on the preferences for different toolkit formats and content, interviews were divided into two groups: a student group (n=6), comprising design students who had recently entered the healthcare design field and had participated in at least one digital health design project, and a designer group (n=4), consisting of designers with more knowledge and experience in healthcare design, typically more than one-year working experience and involvement in 4-8 healthcare design projects. Table 4.2 presents the information and characteristics of the participants.

4.3 Data Analysis

The data analysis procedure followed the six steps of thematic analysis proposed by (Braun & Clarke, 2006). I transcribed the interview recordings using Microsoft Teams and Whisper Transcription and conducted the analysis using ATLAS.ti and Miro. I generated initial codes for all transcripts separately after becoming familiar with the data (Figure 4.3). Subsequently, I integrated the codes, searched for themes, and categorised and arranged them by theme. The final themes were established after several rounds of theme review and revision.

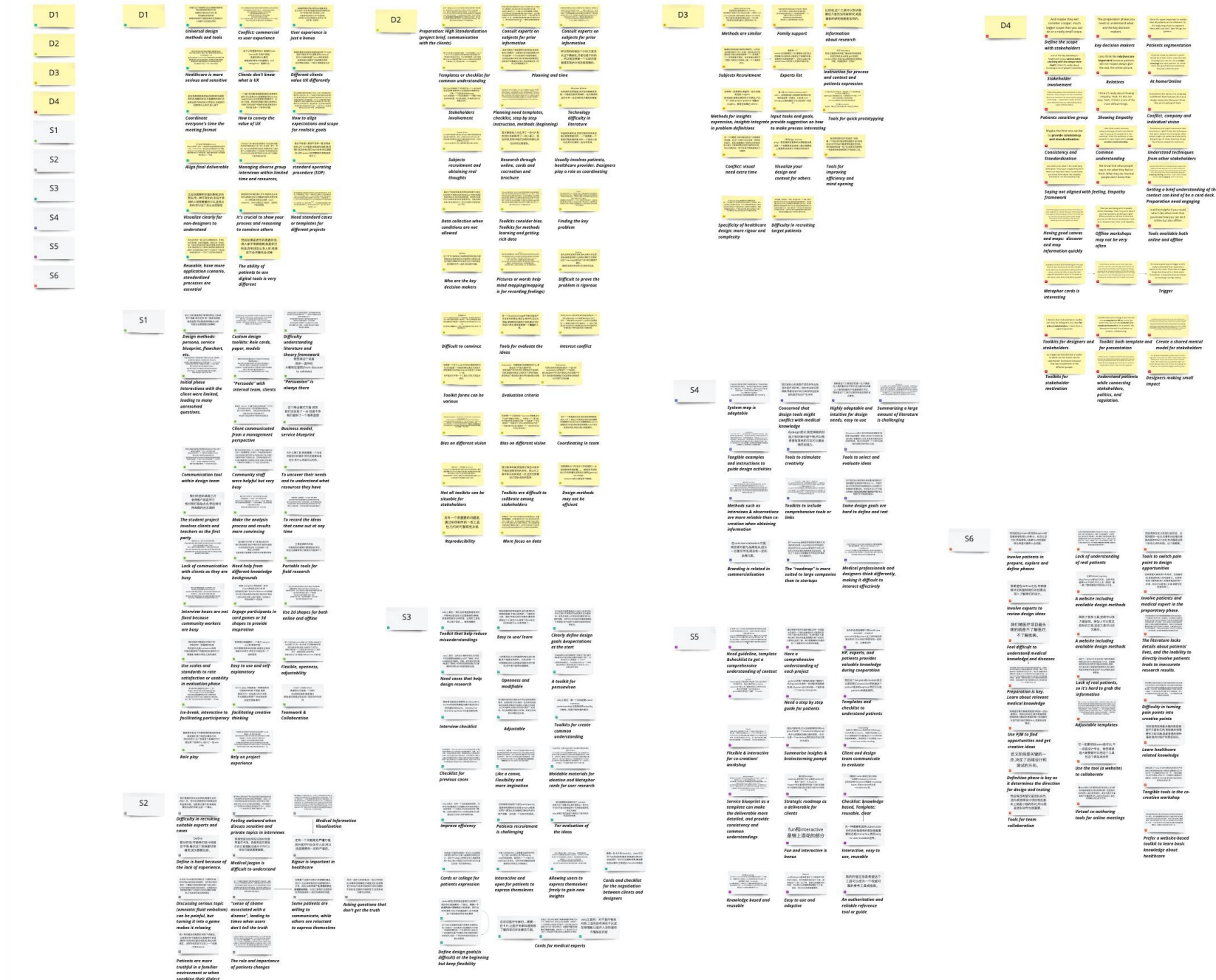|	Experience in digital health design	Career	Major/ Work field	The places they learned healthcare design
Student 1 (S1)	3 projects	Master student	User behaviour research and design tool design	China
Student 2 (S2)	2 projects	Bachelor student	Interaction & Digital Media Design	Macao, China
Student 3 (S3)	1 project	Master student	Design for Interaction	the Netherlands
Student 4 (S4)	3 projects and an internship	Master student	Strategic Product Design	the Netherlands
Student 5 (S5)	2 projects	Master student	Strategic Product Design	China, the Netherlands
Student 6 (S6)	2 projects	Master student	Interaction and Experience Design	China
Designer 1 (D1)	>5 projects	Designer	User Experience Research	China, the Netherlands
Designer 2 (D2)	4 projects	Designer	User Experience Design	the Netherlands
Designer 3 (D3)	6 projects	Designer	User Experience Design	the Netherlands
Designer 4 (D4)	7-8 projects	Designer	Product Owner	the Netherlands, Spain

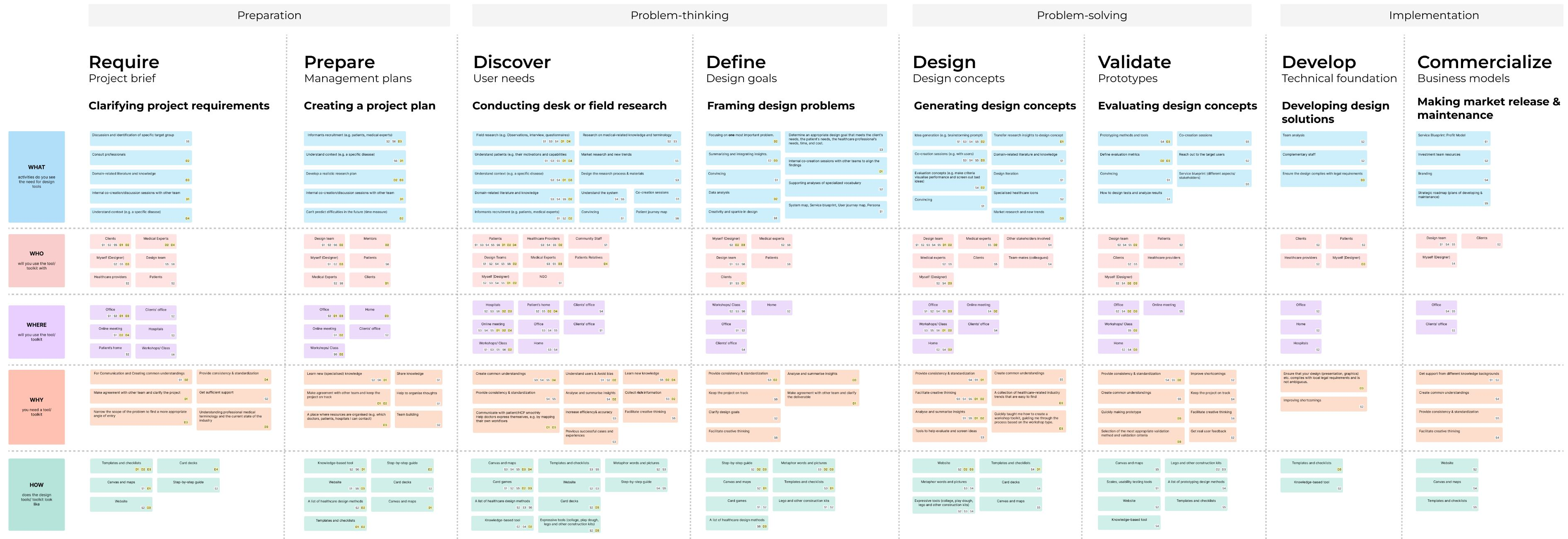**Table 4.2** Participant Characteristics

Figure 4.3 209 initial codes

Require
Project brief

Prepare
Management plans

Discover
User needs

Define
Design goals

Design
Design concepts

Validate
Prototypes

Develop
Technical foundation

Commercialize
Business models

Clarifying project requirements

Creating a project plan

Conducting desk or field research

Framing design problems

Generating design concepts

Evaluating design concepts

Developing design solutions

Making market release & maintenance

WHAT activities do you see the need for design tools							
WHO will you use the tool/ toolkit with							
WHERE will you use the tool/ toolkit							
WHY you need a tool/ toolkit							
HOW does the design tools/ toolkit look like							

Figure 4.4 Interview results (see appendix B for clear version)

Figure 4.5 Materials completed by 2 different participants

4.4 Findings

Theme 1: Stakeholder Engagement in Healthcare Design

1-1 The Complexity of Stakeholder Involvement

Healthcare design projects are inherently complex, involving multiple stakeholders with diverse perspectives and expertise. Successful project outcomes are heavily dependent on the continuous and active engagement of these stakeholders.

· "one of the key takeaways in healthcare is you cannot solve anything with the design team itself. It's really about involving a lot of people constantly" (D4).

This sentiment is echoed by another interviewee, who emphasizes that

· "in most cases, projects are not executed by a single person...there are managers, professors, and colleagues within the design team or project group" (D2).

· "The inclusion of stakeholders with varying backgrounds and knowledge bases is crucial, as different stakeholders contribute unique insights that enrich the design process" (S1).

1-2 Creating Common Understanding Among Stakeholders

The presence of diverse stakeholders introduces the challenge of aligning their different mental models and perspectives. The need for creating common understanding among stakeholders is frequently cited as a significant challenge in healthcare design. For example, several interviewees mention,

· "we designers have our way of thinking...we put things in personas, journeys...other people don't think like that at all" (D4).

· "For designers, system maps and service blueprints may be considered very basic tools rather than innovative approaches. But when you show these tools to people from non-design backgrounds, such as clients, they may be suspicious and confused about what you are doing" (S4).
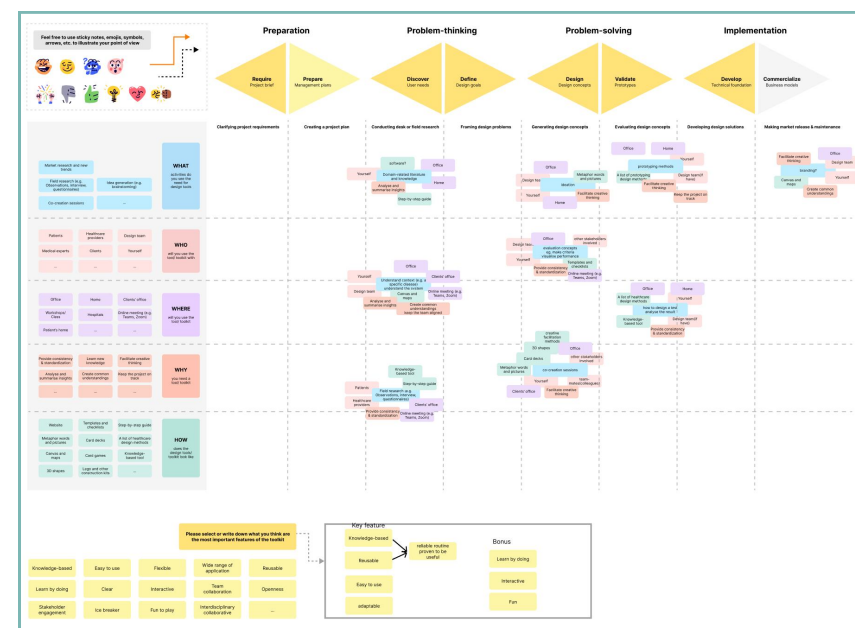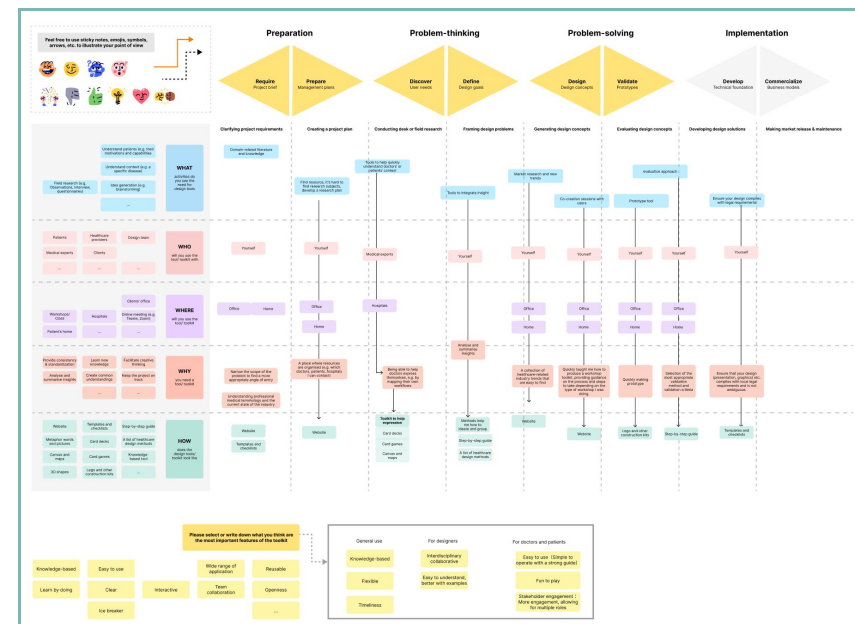
This divergence in thought processes necessitates the use of tools and strategies to facilitate shared understanding and collaboration.

· "the goal is to achieve a shared understanding to ensure that the project can proceed smoothly" (D2).

The importance of synthesis and the creation of common understanding is emphasized as critical to the success of design processes in healthcare, where stakeholders may have different priorities and methods of thinking.

1-3 Managing Value and Interest Conflicts

Conflicts in values and interests among stakeholders are inevitable in healthcare design projects, often requiring a key decision-maker to resolve disputes.

· "you ultimately have to choose one dimension...usually it is about maximizing the core user's values and interests" (D2).

· "Persuasion and negotiation are essential skills in this context, as stakeholders frequently have differing opinions that need to be reconciled to move the project forward" (S1).

The decision-making process can be particularly challenging when multiple stakeholders are involved, as

· "Design is, after all, subjective. Having too many voices in the decision-making phase can lead to less accurate outcomes" (D2).
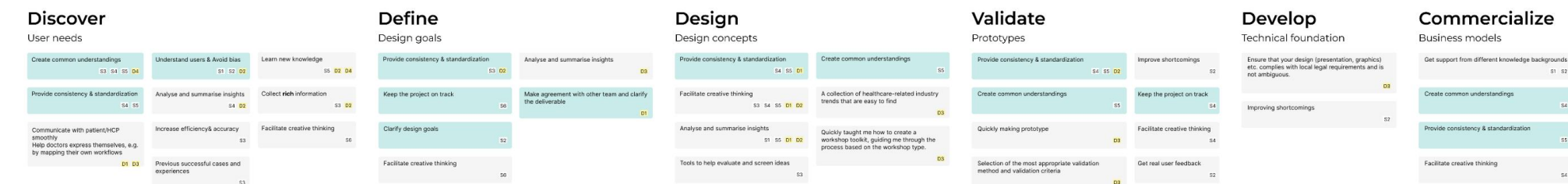
1-4 Aligning Expectations and Scope for realistic Goals

One of the most challenging aspects of healthcare design is aligning the expectations of stakeholders with the project's scope and goals. Designers often face difficulties in communicating the value of their work to clients, who may have unrealistic or conflicting expectations.

· "They (clients) have no idea what we (UX designers) can do... The biggest issue is communicating the value of user experience to internal stakeholders or clients...They either underestimate what we can do or have unrealistic expectations" (D1).

· "This misalignment can lead to challenges in defining and testing design goals, especially in a field as complex as healthcare, where goals may be multifaceted and difficult to measure" (S4).

Another designer stressed the importance of clear communication at the project's outset:

· "At the beginning, it's essential to clarify design goals to avoid constant changes during the project. However, flexibility is also necessary to make adjustments when problems arise." (S3).

Figure 4.6 Interview results: The main reasons why designers need toolkits in the design process

Theme 2: Specificity in the context of healthcare design

2-1 Recruitment and Engagement of Informants

Recruiting suitable informants, such as patients, healthcare providers, and experts, is a significant challenge in healthcare design. The sensitivity of medical topics makes it difficult to engage real patients, which can result in a lack of critical insights needed for the design process.

One interviewee emphasized the importance of involving real patients and experts early in the project:

- "I wish I had patients and experts involved in the early stages...real patient feedback is crucial. Second-hand literature does not describe the details of a diabetic's daily life, such as waking up and injecting insulin." (S6).

However, recruiting patients and healthcare workers is particularly challenging due to the sensitive nature of medical topics and privacy concerns.

- "Medical topics, whether involving patients or doctors, are particularly difficult to access. Similar challenges exist when addressing key issues, such as interviewing feminists or transgender individuals." (D2).

Moreover, finding healthcare professionals with sufficient relevant experience can be equally difficult.

- "We need highly specialized cases and expert interviewers. They must have access to real stakeholders, but participation rates are low, making it hard to recruit suitable experts." (S2).

Coordinating schedules and determining the meeting format is another barrier to recruitment. One designer noted,

- "Often, you have to coordinate your time, the patient's time, and possibly the time of stakeholders who want to observe the interview, as well as decide whether to meet online or in person." (D1).

Physicians, in particular, often struggle to find time for co-creation activities due to their demanding schedules:

- "Doctors, in practice, don't have time for co-creation; their schedules are too tight." (D2).

Additionally, managing diverse group interviews within limited time and resources adds to the complexity.

- "Interviewing just one patient is fine, but the challenge is managing a group of diverse participants within limited time, energy, and resources—from scheduling to conducting interviews, whether online or offline, to potentially compensating them afterward." (D1).

Furthermore, when engaging with community members, their time is often very limited due to their busy schedules.

- "We expected to have 15 to 30 minutes, but it really depended on how much free time they had. They often received phone calls or were approached by residents with questions, so they were frequently interrupted. Their work is often spontaneous, responding to immediate needs." (S1).

2-2 The Sensitivity of Healthcare Topics

Patients pose unique challenges in healthcare design due to the emotional and private nature of their experiences. One interviewee highlighted the emotional intensity often encountered when dealing with patients:

- "I think with patients, the information is more sensitive. Sometimes lots of emotions come up that people start crying... I've experienced this a few times because they are really talking about super sensitive topics." (D4).

The difficulty in addressing sensitive topics was further illustrated by another participant who shared,

- "I had experience in gynecological interviews, but it would be extremely awkward if a male designer were to ask these questions. It was uncomfortable to ask such personal questions in an environment where everyone was female. It's especially hard to ask about intimate areas; you feel like you can't even voice the question. Having a female handle it might be better." (S2).

Addressing serious medical conditions can be emotionally taxing for both patients and designers. For instance, one designer mentioned,

- "Discussing topics like amniotic fluid embolism can be particularly painful." (S2).

Besides, the sensitivity of these discussions can lead to patients withholding information due to a "sense of shame associated with a disease," which sometimes results in patients not telling the truth.

- "There's an issue with the 'sense of shame' surrounding illness, leading to moments when users don't tell the truth. As designers, we need to get close to real users and respect them and their families. Even when they sign consent forms, when it comes to discussing their pain points, they may still hold back. This results in designs that don't fully address their real needs." (S2).

- "We know that what people say isn't always what they feel, think, or do. Ordinary people might not realize this." (D4).

Moreover, the environment plays a critical role in how honest patients are willing to be.

- "Patients sometimes speak more truthfully in familiar environments... When we spoke in the local dialect, patients were more open and authentic." (D2).

Showing empathy towards patients is essential yet difficult when dealing with sensitive healthcare topics. As one participant noted,

- "It's really about showing empathy... It's not easy. I think it's one of the more difficult aspects." (D4).

2-3 The Professional Complexity of Healthcare Topics

Healthcare design often requires close collaboration with healthcare providers, medical specialists, and patients. These collaborations are essential for gaining the necessary knowledge to design effectively.

- "Collaborating with healthcare providers, medical specialists, and patients allows you to learn from them." (S5).

Medical jargon presents another layer of complexity in healthcare design.

- "Doctors often use medical terminology during interviews. While they understand these terms, they may require explanation for those not in the field." (S2).

This issue can lead to misunderstandings, as another participant noted,

- "When we worked on a colorectal cancer project, there were frequent misunderstandings about the patient journey. I hope to reduce these misunderstandings and improve accuracy." (S3).

The need for specialized knowledge in healthcare projects can be a significant barrier for designers.

- "If you're working on a healthcare project, you need to understand the relevant medical knowledge, but for those unfamiliar with medicine, this can be challenging. A toolkit could help, especially when communicating with medical personnel who might assume you already know this information. Without that knowledge, misunderstandings can arise." (S3).

Another participant echoed this sentiment:

- "The biggest headache in healthcare projects is the lack of understanding of medicine and diseases... particularly, I feel that when working on healthcare-related designs, you really need to learn the basics of medical knowledge." (S6).

2-4 Normality and Rigour

Healthcare design differs significantly from other fields due to its strict regulations and high stakes. One interviewee highlighted this distinction:

- "First, it's stricter and more focused on regulations and launch metrics. Secondly, if you really want to fully understand the business, the coordination process is more complex than in other industries. It takes a long time to fully understand the business, with many nodes and no 100% certain process." (D3).

Another participant emphasized the importance of rigor in healthcare:

- "The issue of rigor is significant because the healthcare industry deals with human lives, so there needs to be a certain level of rigor." (S2).

Finally, the unique nature of healthcare projects, compared to other design fields, was summarized by one participant:

- "In healthcare, it's not just about a design idea; it involves compliance, politics, policies, and other sensitive, intersecting areas. It's much more than just a single design concept." (D1).

Another participant added,

- "If you're a student, you might focus on optimizing the patient experience and understanding them fully, which is great, but in the end, it's all about stakeholders, politics, and regulations." (D4).

Theme 3: Desired Features of the Toolkit

The most valued characteristics of the toolkit for designers and design students are "ease of use" (n=9) and the ability to be "reusable" across different projects (n=7), followed by being "knowledge-based" (n=6). Additionally, 4 respondents (n=4) consider "openness" and "clarity" as important features.

3-1 Easy to Use (n=9) and clarity (n=4)

Ease of use is crucial for the toolkit. One participant noted,

- "It needs to be very simple to learn because the project itself is already difficult—I can't spend time learning a complex tool. It should be clear when and how to use it to avoid mistakes." (S3).

Another echoed this sentiment:

- "It's important that the toolkit is easy to use. I shouldn't need extensive skills or knowledge to operate it. It should have a degree of self-evidence." (S1).

Clarity is also essential:

- "I hope the toolkit is straightforward and helps me understand its purpose...I believe that's the most important thing." (S5).

3-2 Reusable and Adaptive (n=7)

The ability to reuse and adapt the toolkit across different projects is also highly valued. As one participant mentioned,

- "In a corporate environment, it's beneficial if the toolkit can be reused for similar cases." (S5).

Another added,

- "It's important that the toolkit can be reused, applied in more scenarios, and standardized." (D1).
- "I hope the toolkit adapts to my design activities, rather than me having to adapt to the toolkit." (S4).

3-3 Openness and Adjustability (n=4)

Participants emphasized the importance of the toolkit being open and adjustable. One noted,

- "Standardized content might not always meet the needs of real-life scenarios. While standardization offers past experiences and successful cases to help you get started, you need to adjust it based on your specific patients and scenarios." (S3).
- "The toolkit should be flexible, allowing adjustments based on my situation rather than being rigid. For instance, give me a questionnaire template that I can modify according to project needs, instead of only providing a standard template." (S3).

3-4 Knowledge-Based and Comprehensive (n=6)

The toolkit should also be knowledge-based, providing comprehensive guidance. One participant expressed the need for thorough coverage:

- "When designing research materials, you might not know which aspects to cover or be unaware of others' design experiences and successes. Previous successful cases and insights can make the design and preparation of research materials more comprehensive." (S3).

Practical examples and guides are needed within the toolkit to produce high-quality outcomes.

- "I hope there are different examples or guides that can specifically direct me on what to do, so I can produce quality results." (S4).

Theme 4: Purpose and Functionality of the Toolkit

4-1 Digital Innovation vs. Inclusivity in Healthcare Tools

The feedback on desired features of digital design tools for healthcare reveals significant variation in attitudes among participants. One key theme is the shift towards online collaboration, with some respondents noting both the benefits and challenges of this transition. For example, D4 expressed skepticism about the frequency of in-person workshops, stating,

- "You're lucky if you have projects, workshops, right? Where people are all face to face... But I doubted how often it still happens." (D4).

This highlights the growing reliance on online platforms due to the limitations of face-to-face interactions.

D4 also emphasized the benefits of online tools in patient research, particularly in creating a sense of safety for patients, noting,

- "Nowadays you can do a lot of online meetings also with patients... sometimes they feel a little bit safer."(D4).

This suggests that digital tools can enhance patient comfort, especially in remote settings.

Some respondents advocated for the broader use of online toolkits for collaboration in digital healthcare. S6 argued that digitizing toolkits could be practical, as

- "Digital healthcare itself is inseparable from digitalization, so turning these physical toolkits into online versions is feasible."(S6).

However, not all designers are fully optimistic about digital toolkits. Since patients, compared to other groups, may require more inclusive design, some—such as older adults or those from lower socioeconomic backgrounds—may have relatively low digital literacy. There are notable challenges, particularly with older patients who may struggle with technology.

D1 pointed out the limitations in digital tool usage for elderly patients, saying,

- "For elderly patients, they don't even use phones. If you call them, how can multiple people listen to the phone?" (D1).

This indicates that traditional communication methods may still be necessary for this demographic.

4-1 Organizing Thoughts and Insights

The toolkit should help organize thoughts and insights. One participant described it as a cognitive tool:

- "It could be a thinking tool … the first thing I'd want is something that can record your thoughts, perhaps through metaphors, images, or abstract concepts, to anchor key ideas during analysis." (D2).

4-2 Convincing and Communication

The toolkit could also function as a communication tool, useful for both internal team discussions and interactions with stakeholders such as clients. One participant discussed the importance of visualization in team communication:

- "When communicating within the design team, sometimes just talking doesn't convey the idea well... I need a tool to visualize my design." (S1).

Another noted the toolkit's potential in persuading clients:

- "After research, if I find that the client's initial request isn't reasonable, I need a toolkit to help convince them. Otherwise, they might design a website that doesn't work as intended, which isn't beneficial for the client." (S3).

4-3 Defining Design Goals

The toolkit should aid in defining design goals, a process described as challenging due to the need to balance multiple stakeholder requirements. One participant mentioned,

"Defining the design goal was one of the most challenging parts of our project. There were many directions, and it was difficult to choose the right one that met both client and healthcare staff needs while considering time and cost constraints." (S3).

Another highlighted the difficulty due to lack of experience:

- "The define stage is always painful because it requires summarizing insights, and I don't have enough practical experience to ensure that the design problem is framed correctly." (S2).

4-4 Creating an Achievable Project Plan

Developing a realistic project plan is another critical feature. One participant explained the difficulty:

- "Creating a project management plan is hard, not just making one, but ensuring it's achievable. It's often tough to estimate how much time and effort the next steps will take. A plan that's too detailed might not be good either, so creating a reasonable, achievable plan is challenging." (D2).

4-5 Selection of appropriate evaluation criteria

Evaluation within healthcare design poses specific challenges, particularly in choosing the right metrics to assess the design's success.

- "The key is deciding what to validate — is it the product itself, user feedback, or its actual effectiveness? Selecting the right evaluation criteria is difficult because evaluation aims to ensure consistency and standardization, not just to spark innovation." (D2).

Another pointed out the complexities in defining and testing design goals:

- "In healthcare design, some goals are hard to define and even harder to test. For instance, the quadruple aim — defining it can be tricky, and evaluating it even more so." (S4).

4.5 Limitations

There are several limitations to this study concerning sample size and theme generation. Firstly, the small size of the sample group, coupled with limited time for research and the geographical distribution of interviewees studied in the Netherlands and/ or China, may have led to an overrepresentation of the Dutch and Chinese design research education systems in the results. Consequently, the findings may lack the breadth and depth necessary for generalising across the digital health domain. To address this limitation, efforts were made to diversify the sample by selecting designers and design students from different nationalities, age groups, genders, and project experiences within various niche areas, aiming to enhance the data's diversity and focus the study on individual perceptions and project experiences.

Secondly, the researcher's understanding and prior research experience may have influenced the generated themes during qualitative thematic analysis.

4.6 Takeaways

Designers faced challenges

Stakeholder engagement

Healthcare design projects are complex and rely on the active engagement of diverse stakeholders for successful outcomes.

Managing Value and Interest Conflicts

Conflicts in values and interests among stakeholders are inevitable in healthcare design projects, often necessitating a key decision-maker to resolve disputes, which can be challenging with multiple stakeholders involved.

Aligning Expectations and Scope for realistic Goals

Designers often struggle to convey their work's value to clients with conflicting expectations.

The Sensitivity of Healthcare Topics

Patients, particularly those dealing with sensitive health conditions, are often reluctant to participate due to privacy concerns and the emotional burden of discussing their health.

The Professional Complexity of Healthcare Topics

The need for specialized knowledge in healthcare projects can be a barrier for designers.

Expected Toolkit Usage Purpose

Online Collaboration

The rise in online collaboration sessions is driving the trend towards digital toolkits in healthcare.
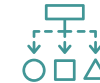
Organizing Thoughts and Insights

A cognitive tool to organize thoughts and insights.

Convincing and Communication

A communication tool effective for internal team discussions and stakeholder interactions, including clients.

Defining Design Goals

Defining the design goal is challenging due to multiple directions and the need to balance client and stakeholders needs within time and cost constraints.

Define Design Direction

Cross-analyzing the case studies and interviews highlights gaps in current toolkit cases. The interviews emphasize that creating a common understanding among multiple stakeholders in healthcare design is a significant challenge. Although some toolkits support co-creation, there is a clear lack of tools specifically designed to help designers align and facilitate shared design goals among diverse stakeholders within the healthcare domain.

05

Findings from case studies

Prepare to Define Phase

Card-based Tools Remain Mainstream

Digital version toolkit

Provide Editable Space

Define Design Goal

Focus on the Ideation Phase

Stakeholder engagement

Reduce Technical Language

Findings from interviews

Aligning Expectations and Scope

Organizing Thoughts and Insights

Managing Value and Interest Conflicts

Creating an Achievable Project Plan

Convincing and Communication

5.1 Insights from Case Studies and Interviews

Cross-analyzing the conclusions from case studies and interviews reveals key gaps in current toolkit offerings. Interviews highlight that creating a common understanding among multiple stakeholders in healthcare design is particularly challenging, especially for both designers and design students. This is most evident when interacting with target users, healthcare experts, and during co-design sessions. Although some existing toolkits support co-creation, they lack specific tools to help designers **align and facilitate shared design goals among diverse stakeholders**.

Interviews with digital health designers indicate that while co-creation workshops are effective for gathering insights from various stakeholders, it is difficult to include all relevant parties in a single session, especially in student projects due to limited resources. Designers often serve as coordinators among stakeholders. For example, in the early stages of a project, designers first align with clients to define the project brief and plan. They then conduct research and engage with target users such as patients or healthcare workers, synthesize the data using visual design tools, and report the findings back to clients.

5.2 Toolkit Usage Scenario

The toolkit is designed for design students (novice designers) working on healthcare-related projects that involve multiple stakeholders, such as hospitals, medical centers, or research institutions. It is intended for long-term projects, typically over three months, such as a six-month graduation design. The toolkit is most effective during the early, fuzzy front-end of a project, from the preparation phase to just before design ideation. It assists designers in regularly reporting to clients, organizing their thoughts, and facilitating communication with various stakeholders.

Expected Toolkit Application Scenario

Co-creation and Brainstorming

It supports co-creation and brainstorming sessions with other stakeholders.

Organizing Thoughts

The toolkit helps structure and prioritize collected data, gradually refining a clear and actionable design goal from a broad scope.

Reporting and Tracking

The toolkit can be displayed on a wall for regular self-checks to ensure the project remains on track. It can also be used as a communication tool to report progress to clients and mentors.

Ongoing Project Review

The toolkit serves as a comprehensive visual map of the project, offering a clear overview of the design goal, key data, and core insights.

Novice designers often struggle to maintain an overview of the project and may get lost in the information-gathering process. The toolkit provides structure to existing data, helps prioritize key content, and ensures that the design direction stays on the right track. It also encourages clear decision-making early in the project, helping to align stakeholder expectations and navigate complex design challenges effectively.

Toolkit Development

The development process for the toolkit is outlined, leading to the initial design. First, insights from previous research are translated into 8 dimensions of defining a shared design goal. Then, the initial toolkit prototype are created and are ready for evaluation.

06

6.1 Design Approach

- I held a one-hour meeting with two experienced design researchers and educators to explore what constitutes an effective and practical design goal, focusing on its essential components.

- I thoroughly reviewed academic literature and key references on defining good design goals, to ensure the toolkit aligns with best practices in design methodology.

- I consulted rubrics from core master's courses and graduation projects at Delft University of Technology (TU Delft), specifically examining how design goals are evaluated and structured in an educational context.

- Additionally, I selected and analyzed 10 master's theses from the 2022-2023 Medisign program, identifying and synthesizing the core elements of the design goals presented in these projects. This analysis helped to inform the toolkit's framework, ensuring it addresses the needs and challenges commonly encountered in healthcare design projects (Figure 6.1).

Figure 6.2 Toolkit ideation

After a few rounds of brainstorming, I chose to scope down the toolkit to create an integrated canvas of information, incorporating the important elements of defining a clear and achievable design goal, which I would use to explore the needs and ideas of all parties during the co-creation process with the stakeholders.

Figure 6.1 Design goals from 10 master design students thesis

6.2 Dimensions of Defining Design Goals

Based on the comprehensive analysis of design projects in the digital health domain, the following dimensions have been identified as essential for defining a clear and feasible design goal in a student project:

Key Performance Indicators (KPI's)

The measurable metrics to evaluate the success of the design outcome.

Values

What people consider important in life. Ensuring alignment with both user needs, stakeholders needs and broader ethical considerations.

Impact

Specify the intended outcomes or effects of the design, both short-term and long-term, on the users and the broader healthcare context.

Target Users

Clearly identify and describe the primary users of the design, including their specific needs and characteristics.

Context

The environmental, cultural, and technological factors that influence how the design solution will be used

Interaction Qualities

Describe the desired qualities of interaction between the user and the design, such as ease of use, accessibility, and emotional engagement.

Deliverables

Detail the tangible outputs of the project, including prototypes, documentation, and other materials that will be produced.

Project Plan

Develop a comprehensive plan that outlines the stages of the project, timelines, resource allocation, and critical milestones.

6.3 Toolkit Prototype

After several rounds of ideation and brainstorming, the essential components of the toolkit were finalized as follows:

1. **A0-Sized Initial Canvas:** This large canvas serves as the foundation for organizing and visualizing the design goal components.

2. **Information Cards:** These cards represent the eight key dimensions of a design goal, with each dimension symbolized by a hexagonal card in a distinct color. Each card includes trigger questions to guide designers in exploring the relevant aspects of that dimension. For example, the Impact card might include prompts like Patient Outcomes, Healthcare Provider Efficiency, System-Level Impact, Social and Economic Impact, Long-Term Sustainability.

3. **Blank Hexagonal Sticky Notes:** These notes, corresponding in color to the information cards, come in varying shades to indicate priority. Designers can write specific details on these notes and place them on the canvas. Darker shades represent higher priority information, which should be placed closer to the center of the canvas. Lighter shades denote lower priority or raw data, positioned toward the outer edges. Each sticky note includes a designated area at the bottom to note the responsible person or most relevant stakeholders.

4. **User Manual:** A guide that explains how to effectively use the toolkit, ensuring that users can navigate its components and maximize its potential.

Evaluation

How to evaluate this design toolkit?

Usability testing involving six design students confirmed that the toolkit effectively supports the design process. Participants valued its structured approach for co-creation and brainstorming, though they recommended enhancements, including a digital version for greater flexibility and clearer instructions.

07

7.1 Evaluation Objectives

1. **Assess Toolkit Usability:** Evaluate how user-friendly and accessible the toolkit is for participants, ensuring it can be effectively utilized without significant difficulty. Specifically, assess whether it is easy to understand and if participants can follow the steps to use the toolkit correctly.

2. **Determine Goal Alignment:** Test whether the toolkit successfully meets its intended design goals, verifying its effectiveness in supporting the design process. This includes assessing its usability in expected scenarios.

3. **Identify Areas for Improvement:** Pinpoint specific aspects of the toolkit that require enhancement or modification to better serve its purpose and improve overall functionality.

7.2 Evaluation Sessions

Duration: 40 mins

Participants: 6 Medisign students who did at least one (digital) healthcare design project before; part of them are the same group from the interview in Chapter 3

Introduction and Consent (5 min): Begin by introducing the participants to the context of the session and ensuring they sign the consent form.

Toolkit Exploration and Hands-On Trial (15 min): Present the toolkit to the participants and invite them to freely explore its features. Encourage them to apply the toolkit to a recent or ongoing digital health design project. Engage in discussions and address any questions they may have throughout the process.

Feedback and Suggestions (20 min): Invite participants to share comments and ideas for improving the toolkit. Ask open-ended questions to gather their suggestions for enhancing the toolkit's functionality and effectiveness.

Figure 7.1 Evaluation session settings

Figure 7.2 During the evaluation session

7.3 Evaluation Questions

- What aspects of the toolkit did you find most valuable, and which did you find least valuable?
- If you could change one thing about the toolkit, what would it be? Are there any additional features you would like to see included?
- Do you feel more confident in defining and aligning design goals after using the toolkit?
- Would you use this toolkit in your future projects? Why or why not?
- Do you think this toolkit will change the way you approach defining design goals in your projects?
- Are the dimensions of the sticky notes, cards, and canvases appropriate?
- Is the visual information clear and easy to understand?
- Would it be helpful to provide example cards?

Can you imagine scenarios where you would use this toolkit? What can you as a designer accomplish with the current toolkits?

In what scenarios do you think the toolkit is suitable for application? (Provide options)

- **Reporting and Tracking:** The toolkit can be displayed on a wall for regular self-checks to ensure the project remains on track. It can also be used to report progress to clients and mentors.
- **Co-creation and Brainstorming:** It supports co-creation and brainstorming sessions with other stakeholders.
- **Organizing Thoughts:** The toolkit helps structure and prioritize collected data, gradually refining a clear and actionable design goal from a broad scope.
- **Ongoing Project Review:** The toolkit serves as a visual map of the project, providing a clear overview of the design goal, underlying data, and core insights, which is crucial during stakeholder feedback, testing, and project evaluation stages.
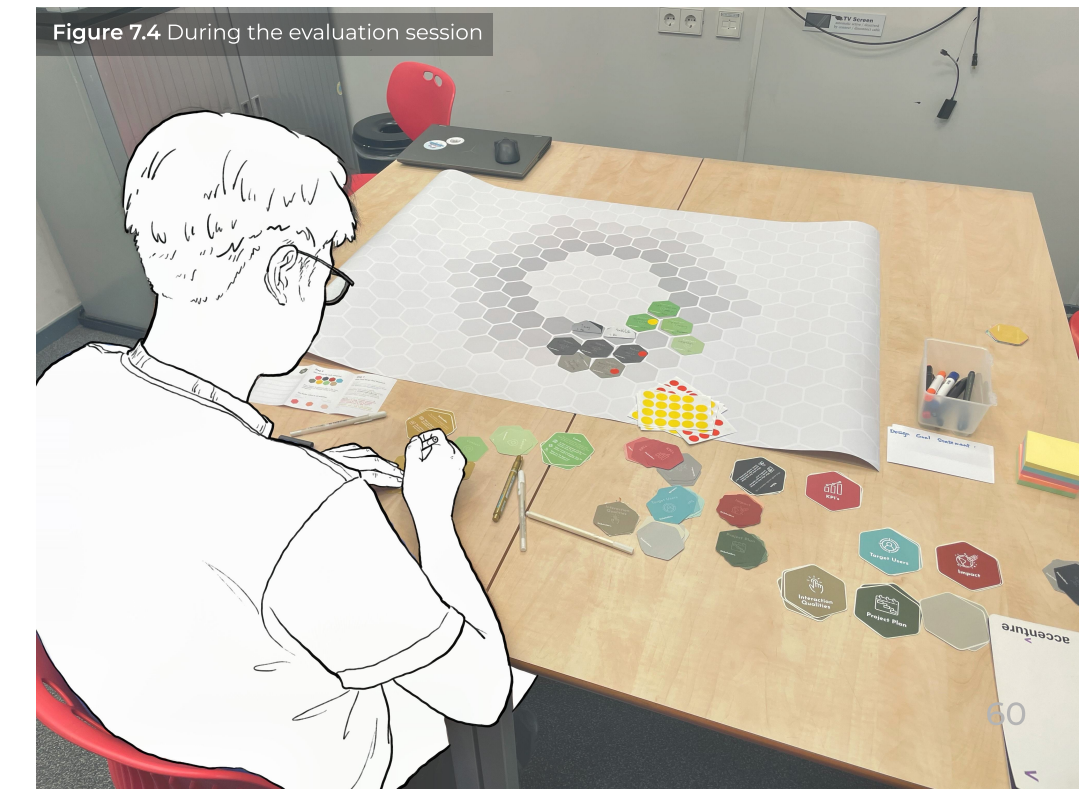

Figure 7.3 During the evaluation session

Figure 7.4 During the evaluation session

7.4 Evaluation Results

Theme 1: Key Strengths and Benefits of the Toolkit

The evaluation sessions with six design students (S1-S6) revealed four key strengths of the toolkit: usability, structured process, comprehensive visualization, and data organization. Each of these aspects contributed to the perceived value and utility of the toolkit.

1-1 Usability

The toolkit was praised for its user-friendly design, intuitive layout, and clarity in presenting information. Several participants highlighted the ease with which they could navigate and understand the toolkit's content. S3 remarked,

- "I think the entire content of the toolkit is quite useful. Each card has an explanation, the titles are clear, and the combination of images and text is very intuitive. The amount of information is just right, and the process is straightforward, step-by-step, making it easy to understand."

This sentiment was echoed by S6, who appreciated the clarity and depth of the explanations provided for each dimension, stating,

- "I also like that each dimension has detailed explanations, and I find these explanations very clear."

1-2 Structured Process

One of the toolkit's strengths was its ability to provide a structured approach to design thinking, which helped students focus on the essential aspects of their projects. S1 succinctly described this as,

- "It provides you with a structured way."

S4 emphasized that this structure contributed to the toolkit's credibility:

- "What makes this toolkit feel trustworthy is its structure, and each part of the structure clearly tells you what is required."

The toolkit also aided in organizing and refining design thoughts. S3 appreciated its role in helping to "map out key points," remarking that without it, independent thinking might focus too narrowly on areas such as "context, target user, and value." The toolkit enabled them to broaden their considerations by offering a visual overview. S6 was particularly fond of the gradient feature, which helped track progress:

- "The feature I liked the most is the gradient function... it allows me to move forward step by step."

1-3 Comprehensive Visualisation

Participants appreciated the toolkit's ability to break down complex design projects into comprehensive and visual elements. S4 mentioned,

- "Its greatest value lies in listing eight important aspects of a project. Sometimes, designers go deep into one point but may overlook others. This toolkit helps you consider all key aspects comprehensively and visually."

The ability to visualize various dimensions of a project made it easier for designers to think more broadly and deeply, which was especially beneficial in collaborative settings involving multiple stakeholders. S3 emphasized,

- "This toolkit combines everything, providing a holistic perspective."

This integrative approach was seen as essential for effective team communication and coordination.

1-4 Organising Large Amounts of Data

The toolkit proved valuable in managing and organizing large quantities of data, particularly in the early stages of projects involving multiple stakeholders. S5 commented,

- "I think the toolkit would be very useful in a real project where there is a lot of data."

The ability to map out priorities and important information allowed designers to focus on critical aspects without being overwhelmed by excessive data. S5 also remarked that the toolkit helped maintain direction during goal-setting:

- "It helps map out what is important and what is less important, ensuring the design direction doesn't get off track."

When asked if the toolkit would change how they define design goals, both S5 and S6 expressed that it would significantly impact their approach. S5 noted that their usual method might become narrow, focusing only on user needs or problem-solving. However, the toolkit allowed them to "map all the information onto one diagram," making it clearer which elements should be prioritized and which could be addressed later. Similarly, S6 highlighted how the toolkit shifted their thinking when considering diverse perspectives:

- "If I were designing alone, there would definitely be a change, because now I need to collect different opinions and balance them. So it really would change my approach, as I would consider other people's interests more, rather than relying solely on my imagination."

Figure 7.5 Results from the evaluation sessions

Theme 2: Expected Usage Scenarios

During the evaluation, participants were asked to identify which of the four potential scenarios (discussed in Chapter 5) they believed the toolkit would be effective for.

1. Co-creation and Brainstorming,
2. Ongoing Project Review,
3. Organizing Thoughts, and
4. Reporting, Tracking, and Long-Term Use

The responses revealed that the toolkit was perceived to be particularly valuable in co-creation and brainstorming sessions, with some utility for organizing thoughts and ongoing project reviews, but less so for reporting and tracking.

2-1 Co-creation and Brainstorming

Participants consistently identified co-creation and brainstorming as a scenario where the toolkit excelled. S2 remarked that the toolkit was ideal for group collaboration, stating,

- "I hope there are others with me when using this. When I see this canvas, I feel it shouldn't be just me working on these things alone."

This sentiment was echoed by S6, who noted that the toolkit would be more effective when used with a team:

- "it's better suited for collaboration with a team or different stakeholders."

Similarly, S5 emphasized,

- "This toolkit will definitely be used in co-creation and brainstorming sessions."

The toolkit's structured approach was particularly suited to guiding group discussions and organizing input from multiple stakeholders. S2 suggested that the toolkit could be enhanced by incorporating additional facilitation elements:

- "If I were the facilitator, a group of stakeholders would sit down, and we would brainstorm values together, then discuss and cluster them on the canvas."

S6 offered a practical example, describing how they would invite participants to write down their ideas on different colored cards and prioritize them together, explaining,

- "We sort them by importance—those further away will be discussed later, while we handle the core issues first."

The toolkit's ability to visually organize and structure thoughts was seen as particularly helpful in a collaborative setting. S3 mentioned,

- "This toolkit is very useful in team discussions, especially when it helps the group consider issues they wouldn't normally think of."

S4 reinforced this idea, stating that the toolkit's core strength lies in "co-creation and communication."

2-2 Ongoing Project Review

While the toolkit was primarily designed for use in the early stages of a project, participants saw its potential for use in ongoing project reviews. S5 suggested that the toolkit could be used to evaluate progress against design goals:

- "Once you have a design goal statement, and you're starting the project, you could use it to assess whether the design meets the goals. For example, does it satisfy the target user's needs? You could refer back to this diagram."

S4 acknowledged that the toolkit could still be helpful during ongoing project reviews, where it might serve as a reference point to check whether design goals are being met.

2-3 Organizing Thoughts

Participants also found the toolkit useful for organizing thoughts, especially when it came to structuring and prioritizing data during the design process. S5 said,

- "The third scenario, Organizing Thoughts, is also very appropriate."

The toolkit allowed designers to break down broad ideas into manageable components, helping them to refine and prioritize their design goals. As S3 pointed out,

- "Overall, this toolkit really helps to organize ideas, categorize, and rank them—this is the essence of the toolkit."

However, some participants were less certain about the toolkit's impact on their thought processes. S4 expressed doubt about its utility for personal organization, explaining,

- "I feel like I already have my own thinking system, so it might not influence me much."

Despite this, S4 acknowledged that the toolkit could still be helpful during ongoing project reviews, where it might serve as a reference point to check whether design goals are being met.

2-4 Reporting, Tracking, and Long-Term Use

Participants expressed mixed feelings regarding the toolkit's role in reporting and tracking progress, especially when it involved communicating with external stakeholders. S5 pointed out that the toolkit was more aligned with designers' needs, which could make it less relevant for clients or non-design stakeholders. According to S5,

- "For external clients, they may not care about the design goals. What's more important is explaining to them what's relevant, what they need to contribute or get from the project. A clear statement might be enough."

This suggests that while the toolkit helps designers structure and refine their ideas, it may not be as effective in communicating design progress to stakeholders who are more focused on outcomes than on process.

S3 added that the toolkit could still serve a purpose in project reporting by visually presenting research findings:

- "It could be used for project reporting to help visualize the research findings."

However, they didn't consider it essential for tracking progress or engaging clients, indicating that its strengths lie in organizing internal thought processes rather than outward-facing reporting.

Despite these reservations about reporting and tracking, participants saw the toolkit's potential in long-term, iterative use within design teams. S2 suggested that the toolkit could evolve with a project over time:

- "You could use it for long-term projects within a design team or company, starting at the project's kickoff and then continuously modifying it as the project progresses."

This adaptability was highlighted as a strength, particularly in projects where design goals or priorities shift during development. S5 similarly saw value in using the toolkit to reassess whether the evolving design continues to meet the established goals, stating,

- "Once you have a design goal, and the project is underway, you could use the toolkit to evaluate whether the design is meeting those goals."

In summary, while the toolkit may be less suited for formal reporting and tracking, it was recognized for its usefulness in long-term project development and continuous evaluation of design goals. Participants viewed it as a flexible tool that could guide designers through the iterative nature of complex projects, especially when internal team alignment and ongoing goal refinement are necessary.

Theme 3: Toolkit Limitations and Areas for Improvement

3-1 Preference for a Digital Version

The majority of design students (4 out of 6) preferred a digital version of the toolkit, citing greater flexibility, collaboration opportunities, and adaptability for long-term projects. S5 emphasized the practical benefit of a digital version in real-world scenarios:

- "If it's a real project, the cycle is often long, and it could take one or two months to get all the data. So, a digital version would be better."

Additionally, S5 noted that digital platforms offer flexibility, such as organizing ideas through virtual post-its:

- "A digital version would be more flexible. You could post many notes, vote on which ones are more important, and place key ideas in the center."

S2 preferred digital platforms like Miro over physical tools for external collaboration, explaining,

- "Miro is more practical. You won't expect clients to come to your office to see these things. You'd rather generate content together with multiple stakeholders."

The limitations of the physical toolkit in terms of customization were highlighted by S2, who said,

- "If it's on Miro, you can freely adjust colors, which eliminates the issue of color and quantity limits in a physical version."

Moreover, digital versions could facilitate collaboration through added features like comments and voting. S3 noted,

- "In a digital toolkit, you could add comments directly on the post-its. This paper version doesn't allow for that."

S3 also suggested that digital versions would enable team members to mark their responsibilities and voice their perspectives, which would be particularly useful in collaborative environments:

- "Each stakeholder's point of view could be expressed. Developers may focus on KPIs, while designers care more about interaction quality. This way, each team member's needs are visible."

While most participants favored a digital toolkit, one participant, S6, saw the advantages of a physical version for fostering direct interaction:

- "The benefit of the physical toolkit is that face-to-face discussions are more efficient. Everyone can write their thoughts and adjust them as we discuss, which is harder to do when everyone is on a computer."

3-2 Steps and Instructions

Several participants found the instructions and steps somewhat unclear and repetitive. S6 suggested adding more detailed guidance for balancing the content when certain areas of the canvas are overcrowded, while others are underrepresented:

- "If one area has ten sets of data and another has only superficial information, should we balance the areas? ...Providing users with situational examples and advice on how to prioritize could help."

Similarly, S5 noted that the instructions lacked clarity:

- "Without you explaining, I wouldn't understand how it works just from reading the instructions. The self-explanatory nature is not strong enough."

3-3 Dimensions: Value, Impact, and KPI

Participants pointed out that some dimensions in the toolkit, such as "value," "impact," and "KPI," seemed overlapping or confusing. S4 noted that "value" and "impact" are closely related:

- "Some values lead to specific impacts."

This overlapping was seen as both a limitation and a potential strength, with S1 noting that repetition could highlight the importance of key concepts in the design process.

There was also a discussion regarding the prioritization of different dimensions at various project stages. S2 emphasized that some dimensions, like value, are critical in the early design stages, while others, like KPI, become relevant later on:

- "Initially, you should focus on goals and values. Later, as the project progresses, you can introduce specific KPIs."

3-4 Information Cards

Several participants felt that the information cards lacked sufficient detail, particularly when dealing with abstract concepts like value. S4 suggested adding more background information:

- "It would be better to provide more detailed explanations, especially after seeing the questions. It helps to know what to discuss next."

S5 recommended offering examples to clarify terms for users unfamiliar with value-sensitive design:

- "Some designers may not know what 'value' means. Examples could be helpful."

However, not all participants agreed on the need for detailed explanations. S2 argued that most terms were common knowledge for designers and did not require additional explanation:

- "I think we naturally know what these terms mean. Context is a familiar term for designers, but maybe not for other stakeholders."

Similarly, S6 expressed concerns about overwhelming users with too much information:

- "Too much detail could make it harder for users to adapt. The toolkit is already clear enough for most designers."

3-5 Final Statement

The final design goal statement was another area identified for improvement. Several participants felt that the final step was too cumbersome and suggested simplifying the process. S2 stated,

- "The final step should be simplified. Not all dimensions need to be included in the final statement."

S3 added that not every dimension is relevant to every project:

- "I wouldn't include all eight dimensions in the final design statement because it would be too long, and not all dimensions are necessary for designers."

Some participants proposed a more streamlined approach, with S5 suggesting a fill-in-the-blank template for crafting the final design statement:

- "A template like 'My design goal is to achieve [impact] for [target users] in the context of [what]' would make it easier."

3-6 Color and Layout

There were mixed opinions about the toolkit's color scheme and layout. Some students found the color contrasts challenging, particularly when writing on darker-colored cards. S5 noted,

- "The impact and value cards are too dark, so you need pens that can write over them, like acrylic pens."

S3 also suggested that making some areas lighter or outlining sections could improve readability.

The layout also posed challenges for some participants, as S2 mentioned difficulties in arranging the different dimensions effectively:

- "You still have to organize it yourself, and I'm not sure I can place everything in the right spots."

However, S6 felt that the current sizes of the stickers and canvas were appropriate, stating,

- "The dimensions and sizes seem well-suited for the task."

7.5 Limitations

1. **Limited Sample Size:** The evaluation involved only six design students, which may not provide a comprehensive representation of the broader population of designers in the field.

2. **Similar Educational Backgrounds:** The participants all had similar design education backgrounds, which could lead to biased feedback and limit the diversity of perspectives. This homogeneity might not reflect the varying experiences and expectations of designers from different educational paths.

3. **Diverse Opinions:** While most designers provided positive evaluations of the toolkit's functionality, there were significant differences in their opinions. For example, some designers expressed a desire for more conceptual explanations and examples on the information cards, whereas others felt that excessive information could create cognitive overload. This divergence in feedback indicates that there is no one-size-fits-all solution.

4. **Varied Preferences for Toolkit Types:** The results showed considerable variation in preferences among designers, with some leaning towards card-based toolkits while others favored digital toolkits. Some participants expressed a desire for additional functionalities in the toolkit to make it applicable to a more general design domain, while others indicated a preference for a focus on digital health, seeking to enhance the toolkit's specificity. This disparity suggests that future toolkit designers may need to consider personalized designs tailored to different stakeholders or target groups, rather than adopting a single, universal approach.

5. **Potential Bias in Feedback:** The students may have felt inclined to provide positive feedback due to their educational ties or peer dynamics, potentially skewing the evaluation results.

7.6 Summary of the evaluation results

This study explores the perceptions of design students toward the toolkit during the evaluation sessions, with insights grouped into three key themes: 1. Valuable Aspects of the Toolkit, 2. Expected Usage Scenarios, and 3. Toolkit Limitations and Areas for Improvement. These themes highlight the strengths, potential use cases, and limitations of the toolkit, providing guidance for future improvements and design iteration.

Theme 1: Valuable Aspects of the Toolkit

The evaluation sessions demonstrated that the toolkit effectively supported the design process by providing a structured, visually comprehensive, and user-friendly approach to managing data and refining design goals. Participants highly valued the toolkit's ability to integrate typically disparate elements, such as values and design goals, while fostering collaboration in multi-stakeholder environments. More than half of the designers reported feeling more confident using the toolkit to define shared design goals and communicate with different stakeholders to gather their expectations. These insights suggest that the toolkit has potential for broader application, especially in complex design projects where organization and communication are critical.

Theme 2: Expected Usage Scenarios

Participants found the toolkit most valuable for co-creation and brainstorming, where its visual structure helped facilitate group discussions and prioritize ideas. The toolkit also proved helpful for organizing thoughts and had some utility in ongoing project reviews, though it was seen as less effective for reporting and tracking. Additionally, participants identified potential uses for the toolkit in long-term projects and as a tool for ongoing design evaluation, indicating its flexibility and adaptability across different stages of the design process.

Theme 3: Toolkit Limitations and Areas for Improvement

Toolkit Limitations and Areas for Improvement:
While overall feedback was positive, participants identified several areas for improvement:

- Digital Version: Four out of six participants preferred a digital format for greater flexibility, especially for long-term projects and real-time collaboration. S5 emphasized its importance for remote teams, while S2 and S3 suggested using platforms like Miro for better stakeholder interaction.

- Clarity of Instructions: Some participants, like S5, struggled with understanding the toolkit without additional guidance, and S6 suggested using examples or scenarios to clarify complex information.

- Conceptual Overlaps: There were concerns about overlaps between categories like "value," "impact," and "KPI," with S3 noting that these often felt redundant. Clearer distinctions could improve usability.

- Simplifying the Final Design Statement: S5 and S6 recommended simplifying the process for creating the final design statement, potentially through a template, to make it easier to conclude design exercises.

Design Iteration

Based on the evaluation session results and feedback, the toolkit design was iterated upon, leading to the creation of a new prototype version.

08

8.1 Design Iterations

Based on the results and feedback from the evaluation session, I iterated on the toolkit design. The main modifications include:

1. Converting the printed version into an interactive digital prototype for use in Figma.

2. Reducing the number of dimensions from eight to seven. Merging KPIs with impact to eliminate unnecessary repetition and explaining how they work together in the information card.

3. Adding step-by-step instructions alongside the frames to clarify how to use the toolkit.

Before:

A separate instruction booklet was designed

Step 1
List all the stakeholders and their role in your project

Stakeholders	Descriptions
Target user	
Client	
Designer	

Step 2
Add contents for each categories.

Don't forget to mention who is the main stakeholder or decision maker in each categories

Use darker colors to set priorities.
More ←————————————→ Less
important   important

Step 3
Write Final Design Goal Statement

Example:
Design a user-friendly chronic disease management app for adults aged 40-65 with diabetes and hypertension.

The app will provide a simple, supportive, and empowering interaction, focusing on privacy and inclusivity. It will operate effectively in low-connectivity environments and integrate seamlessly into users' daily routines.

The project will be completed over 8 months, aiming to increase medication adherence by 20%, reduce hospital readmissions by 15%, and improve patient satisfaction by 30%. Key deliverables will include user personas, prototypes, and a fully functional app, with ongoing evaluation through defined KPIs.

After:

A separate page describing the contents and purpose of the toolkit

Step-by-step explanations are placed on the side of the canvas

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Intro
About this Toolkit

Participants: 2-10+ (one facilitator needed)

Time: 60-90 minutes, depending on the level of detail you want to collect.

This toolkit is designed for (digital) health designers to address the complexity of coordinating multiple stakeholders in healthcare projects. It helps designers gather, organize, and prioritize insights from target users (patients, healthcare providers), clients (healthcare institutions, companies) and other stakeholders.

The toolkit guides you through visualizing and prioritizing stakeholder information using a Honeycomb diagram. It incorporates 7 key dimensions to help you define a clear and achievable design goal:

- Who are your **target users**?
- In what **contexts** will they use this solution?
- What **value** does your design provide to these users (patients, providers, etc.) and other stakeholders (clients, medical institutions)?
- What **impact** (measurable outcomes) do you aim to achieve with your design, and how will you measure it (KPIs)?
- What are the milestone **deliverables** needed?
- What specific **interaction qualities** should exist between the users and the design solution?
- What is the **project plan** to achieve this outcome?

Of course, the information and dimensions you include will depend on your project's context, as every project is unique. As the designer, you also have the flexibility to add or replace dimensions based on what's most important for your project.

Ultimately, the toolkit helps you prioritize these inputs, enabling you to define **a shared design goal** that aligns the interests of all stakeholders. This results in a final **design goal statement** that clarifies and unifies the project's objectives across the board.

After:

Add visual elements and use Lego Minifigures to increase participant engagement and enhance their interest in using the toolkit.

Before:

Use a blank template to list the stakeholders

Step 1
List all the stakeholders and their role in your project

Stakeholders	Descriptions
Target user	
Client	
Designer	

---

1 Step 1
Stakeholders

Duration: 5 mins

1. List the stakeholders involved in this project, along with their roles or responsibilities.

   Jane
   Chronic disease patients, Target user

2. Participants can pick a Lego mini-figure to represent each role.

   Jane
   Diabetic patients, Target user

3. Add a tag in the top right corner of the card for each, to identify it in the next step using a sticker.

   Jane
   Chronic disease patients, Target user

Google "Lego Minifigures" for more different styles...

Name...	D	Name...	HP
Designer/ Design Lead		Healthcare Provider	
Name... C	Name... P
Client, Company A	Patient, target user
Name... E	Name... ?
Healthcare Expert	Roles or responsibilities...
Name... ?	Name... ?
Roles or responsibilities...	Roles or responsibilities...
Name... C	Name... ?
Roles or responsibilities...	Roles or responsibilities...

Information Cards

Duration: 10 mins

Start by understanding the 6 dimensions through the provided information cards.

- Dark-colored cards: These contain definitions and key trigger questions for each dimension.
- Light-colored cards: These are for brainstorming and inspiration later on.

Tips:

Since each digital health project varies in background and details, the cards are meant to guide your understanding of what each dimension may include, but they aren't a strict formula to follow. Whether you use all the cards depends on the facilitator and the participants' familiarity with the dimensions. For example, a designer experienced in healthcare design may already know these concepts, but other stakeholders might not be familiar with terms like "interaction qualities" or "values."

You can add dimensions as needed.

Before:

Each dimension contains only definitions and one trigger question.
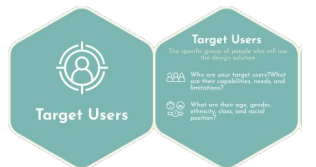
After:

Dark-colored cards explain key concepts.
Light-colored cards provide some trigger questions and examples.

Brainstorming

Duration: 30-40 mins

1. Brainstorming for each dimension. There is no fixed order between the dimensions. You can start with the one you find easiest.

2. Don't forget to mention:
   - Which stakeholder can help with this dimension?
   - Who is this dimension for?
   - Add their tag from step 1.
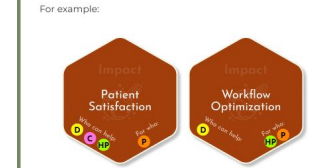
For example:

3. After completing all dimensions, participants can discuss and use darker colors to indicate priorities.

More important ←——————→ Less important
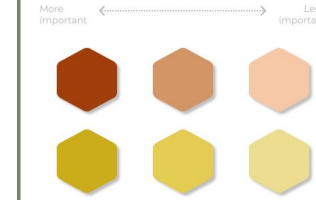
4. Prioritize by voting if necessary.

After:

Add stakeholders' tag on the stickers

Partly filled canvas

Step 5
Map on the Honeycomb

Duration: 30-40 mins

Move the sticky notes you identified as important in the previous step onto this honeycomb diagram.

Information placed closer to the center represents what's most critical to achieving the design goal or holds greater importance for multiple stakeholders. Notes placed toward the edges are relatively less important.

The key here is to continuously discuss and weigh these elements with the group, fostering mutual understanding and alignment on a shared goal.

Blank template

Map on the Honeycomb

After:

Short empty template with examples

Before:

Long statement with examples

Step 3

Write Final Design Goal Statement

Example:
Design a user-friendly chronic disease management app for **adults aged 40-65 with diabetes and hypertension.**

The app will provide a **simple, supportive, and empowering interaction,** focusing on **privacy and inclusivity.** It will operate effectively in low-connectivity environments and integrate seamlessly into users' daily routines.

The project will be completed over **8 months,** aiming to **increase medication adherence by 20%, reduce hospital readmissions by 15%, and improve patient satisfaction by 30%.** Key deliverables will include **user personas, prototypes, and a fully functional app,** with ongoing evaluation through defined KPIs.

Step 6
Final Design Goal Statement

Duration: 10 mins

Discuss with all participants and craft the final design goal statement based on the outcomes from Step 5. Use the provided template and example for inspiration.

Tips:

Continuously consider which elements in each dimension should take priority and why.

Example:

Design a user-friendly chronic disease management app for adults aged 55-75 with diabetes and hypertension.

This app will offer a simple, supportive, and empowering experience, prioritizing privacy and inclusivity. It will be optimized for low-connectivity environments and seamlessly integrate into users' daily routines.

The project will span 8 months, aiming to increase medication adherence by 20%, reduce hospital readmissions by 15%, and improve patient satisfaction by 30%. Major milestones will include user personas, prototypes, and a fully functional app.

Template:

Design a (final deliverable) tailored for (target user).

This (deliverable) will offer a (interaction qualities) experience, emphasizing (key values). It will be optimized for use in (specific contexts).

The project will span (project duration and plan), aiming to create (desired impact). Major milestones will include (key deliverables).

8.2 Usage Steps

Step 3
Information Cards

Step 4
Brainstorming

Step 6
Final Design Goal Statement

Step 5
Map on the Honeycomb

Step 1
Stakeholders

Step 2
Project Plan

Intro
About this Toolkit

8.3 Recommendations

1 **Recruiting Designers from Diverse Educational Backgrounds for Toolkit Evaluation**

Due to limitations in time and available resources, this project only included master's level design students or recent graduates from the Netherlands or China, all of whom had similar educational backgrounds. To enhance the accuracy and validity of the evaluation, future research should involve designers and students from a broader range of educational systems. This will ensure a more comprehensive understanding of how the toolkit performs across different design paradigms and contexts.

2 **Incorporating More Stakeholders in the Development Process**

The current evaluation primarily involved discussions with designers. However, given the importance of co-creation in healthcare design, it is crucial to incorporate feedback from other stakeholders, such as healthcare professionals, patients, and institutions, in the future development of the toolkit. To simulate real-world usage, co-creation sessions should be conducted with a more diverse group of stakeholders, using a specific project theme. This approach will provide more realistic, multi-perspective feedback and improve the toolkit's usability in actual healthcare design scenarios.

3 **Engaging Patients in a Meaningful Way**

While the current toolkit provides a general framework for involving multiple stakeholders, the patient group presents unique challenges. Patients, particularly those dealing with sensitive health conditions, are often reluctant to participate due to privacy concerns and the emotional burden of discussing their health. The interviews conducted during this research highlight the importance of showing empathy and finding ways to engage patients in the design process without adding to their stress. Future iterations of the toolkit should explore strategies for involving patients more effectively, ensuring that their voices are heard while minimizing any additional burden on them.

4 **Expanding the Application of the Toolkit Beyond Digital Health**

Currently, the examples included in the toolkit are primarily drawn from digital health design projects (T. Wang et al., 2022a, 2022b; T. Wang, Giunti, et al., 2024; T. Wang, Qian, et al., 2024). However, defining design goals is a method widely used across various design disciplines, especially in student projects. During the evaluation, several design students pointed out that the toolkit's seven dimensions for forming a design goal could also be applied to general design contexts. Therefore, future iterations of the toolkit could be adapted to incorporate examples and information tailored to different design fields, allowing for broader application.

5 **Integrating the Toolkit into Professional Design Practice**

While the toolkit was initially developed for design students new to healthcare, partly due to limited access to industry designers and the toolkit's educational focus, professional designers have also shown significant interest in using it to foster common understanding and align multi-stakeholder projects. Designers often face challenges in reconciling client expectations with project scope, especially when clients have unrealistic or conflicting demands. The toolkit could be customized for use within design firms to facilitate negotiations between design teams and clients, addressing resource allocation, long-term project impact, and economic benefits. Expanding the toolkit's application to the industry would provide greater value, especially in managing the more complex stakeholder dynamics encountered in professional practice.

6 **Recognizing the Evolving Nature of Design Goals**

Design goals are not always fully defined at the early stages of a project, particularly in student-led initiatives that follow a generative design process. In these cases, the design scope evolves as new information is gathered, gradually leading to a refined design focus (Sanders & Stappers, 2012). The toolkit should therefore account for its use during the entire fuzzy front-end of the design process and integrate with other research and design activities that occur during this phase. This would make the toolkit more adaptable to the iterative nature of design projects.

7 **Physical vs. Digital Versions of the Toolkit**

There is some debate among respondents regarding whether the toolkit should be digital or physical. Most designers and students preferred a digital version due to the increasing prevalence of online meetings and co-creation sessions, which allow for easier collaboration. However, a significant number of designers emphasized the value of physical cards and playful tools in face-to-face interactions, suggesting that tangible tools facilitate better expression in in-person settings. Going forward, the toolkit could be developed in both digital and physical formats, or alternatively, offer downloadable and printable PDFs, ensuring its usability across both online and offline contexts depending on the specific needs of the project.

Conclusion and Reflection

09

9.1 Conclusion

RQ1 — What design tools and toolkits are currently available to designers?

Through case studies of 14 widely recognized toolkits from the past decade, this research has identified and classified the contents, elements, formats, methods of use, and contributions of existing design toolkits. A new classification method is proposed, summarizing the distribution of toolkits across design fields and uncovering opportunities for further development.

The findings reveal that many toolkits are designed for broad application across disciplines like Human-Centered Design and service design, incorporating standard methods and processes from these fields. Most existing toolkits are concentrated in the design ideation phase, with fewer tools focused on the earlier stages of project preparation and goal definition. The dominant format remains card-based design tools, though there has been a notable shift towards online versions, spurred by the rise of online education, particularly during the pandemic.

Furthermore, while many toolkits are still tailored for designers, there is an increasing trend toward tools aimed at co-creation processes involving stakeholders from diverse backgrounds, such as target users, to foster idea generation and establish shared understandings. This shift reflects the growing emphasis on participatory design and the need for tools that facilitate collaboration between designers and non-designers.

RQ2 — What tools do digital health designers need, and what key components should a toolkit include?

To address this research question, structured interviews averaging one hour each were conducted with 6 design students who had recently entered the healthcare design field and participated in at least one digital health project, and 4 experienced designers with over a year of working experience and involvement in 4-8 healthcare design projects. The purpose was to identify the challenges they faced in the digital health design process that could benefit from toolkits, as well as their preferences regarding toolkit format, content, and usage.

The findings revealed that Stakeholder Engagement emerged as one of the most significant challenges in digital health design projects. Participants expressed the need for toolkits to facilitate Creating Common Understanding Among Stakeholders, Managing Value and Interest Conflicts, and Aligning Expectations and Scope for Realistic Goals. These challenges were particularly pronounced among less experienced design students. Moreover, the sensitive nature of medical topics and concerns about privacy further complicate communication and co-creation with patients, healthcare providers, and other stakeholders in digital health contexts.

The primary purposes for which designers hoped to use a toolkit included Convincing and Communication, Organizing Thoughts and Insights, and Defining Design Goals. In terms of desired features, participants emphasized the importance of the toolkit being Easy to Use, Reusable and Adaptive, Comprehensive, and Adjustable. Additionally, several designers indicated a preference for a digital version of the toolkit, which aligns with findings from the case studies on design toolkits, particularly for use in online sessions.

RQ3 — How to develop a toolkit based on the needs of digital health designers?

Cross-analysis of case studies and interviews revealed significant gaps in existing toolkits, leading to the development of a toolkit tailored to the needs of digital health designers. The final design goal was narrowed to helping novice designers align and facilitate shared goals among diverse stakeholders in the digital healthcare domain.

This toolkit is designed to address the complexities of coordinating multiple stakeholders, such as patients, healthcare providers, institutions, and companies, by helping designers gather, organize, and prioritize insights from these key participants. It uses a Honeycomb diagram that incorporates seven essential dimensions to guide designers in defining a clear and achievable design goal. The toolkit ensures alignment of stakeholder interests, resulting in a unified goal that brings clarity and cohesion to the project.

Key usage scenarios for the toolkit include:

- Co-creation and Brainstorming: Facilitating collaboration with stakeholders to refine ideas.
- Organizing Thoughts: Structuring and prioritizing data to define a focused design goal.
- Reporting and Tracking: Serving as a communication tool for providing progress updates to stakeholders.
- Project Review: Providing a clear visual summary of the design goal, key data, and core insights.

After defining the project's design goal, the first version of the paper-based toolkit prototype was created.

RQ4 — How to evaluate this design toolkit?

To evaluate the toolkit, three aspects were examined: usability, usefulness, and areas for improvement. Six design students with digital health experience participated in 40-minute tests, followed by feedback collection through open questions.The evaluation revealed the following:

1. **Valuable Aspects of the Toolkit:**
   Participants found the toolkit helpful in structuring the design process, organizing data, and refining design goals. It was especially useful for facilitating collaboration with multiple stakeholders. Many expressed greater confidence in defining shared design goals and managing stakeholder expectations, indicating potential for broader application in complex design projects.

2. **Usage Scenarios:**
   The toolkit was most valuable for co-creation and brainstorming, aiding in group discussions and idea prioritization. It was also helpful for organizing thoughts and somewhat useful for project reviews, though less effective for reporting and tracking.

3. **Areas for Improvement:**
   Key suggestions included developing a digital version for more flexibility and better collaboration, especially with remote teams. Participants also noted that instructions could be clearer, possibly through examples or scenarios, and recommended simplifying the final design statement process. Lastly, overlaps between concepts like "value," "impact," and "KPI" needed clarification to avoid redundancy.

Based on these evaluation results, a final digital version of the toolkit was developed.

9.2 Reflection

This project made me realize that healthcare design requires a distinctive approach, as designers often lack direct access to the end-user's journey. Consequently, patient involvement is crucial for developing effective solutions. Additionally, many patients increasingly seek to actively engage in the design process, advocating for their own needs and preferences. This understanding has further solidified my commitment to participatory design methods.

Over the course of this six-month research project, I not only deepened my understanding of the complexities inherent in healthcare design but also enhanced my ability to work independently and systematically address research problems. This undertaking has significantly influenced my academic and personal growth, challenging me to engage with the subject matter on a deeper level. From the beginning, I faced the challenge of managing my learning objectives and time effectively. The demanding timeline pushed me to improve my multitasking abilities and adopt a more disciplined approach to project management. Although I faced moments of uncertainty, these experiences taught me to trust in the process and believe that solutions would arise, which has bolstered my confidence in handling independent research in the future.

From a research methodology perspective, I gained valuable insights into conducting case studies and performing qualitative research. I learned about the entire research process and how to carry out interviews and thematic analysis. These skills will undoubtedly be beneficial in my future endeavors. During my initial exploration of the digital health domain, I engaged with a substantial body of literature, which enhanced my understanding of health care design and sparked my interest in the field. As a result, this project has solidified my confidence and determination to continue studying and researching in this area.

Moreover, I experienced significant improvement in my communication skills throughout this project. Engaging with participants, recruiting them, and conducting interviews required me to evolve from initial uncertainty to clarity in formulating questions that effectively elicited their perspectives. This process greatly enhanced my overall communication abilities, although I recognize that my academic communication skills still need further refinement.

In conclusion, this project has been a catalyst for my personal and academic development, revealing both strengths and areas for improvement. It has fostered a critical mindset that encourages ongoing questioning and exploration, laying a solid foundation for my future endeavors in research.

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Appendix

A. Approved project brief

B. Interview results

C. Informed Consent

D. Final Toolkit Layout