Breaking down barriers to Inclusive Design

Creating a safe learning environment for
Industrial Design Engineering students

Master thesis by Dana de Jong

Master Thesis
Breaking down barriers to Inclusive Design
Creating a safe learning environment for Industrial Design Engineering students
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Preface

When I started my study in Industrial Design Engineering at the Delft University of Technology, I discovered my passion for human-centred design through various design projects. I find it interesting to learn from other perspectives and how these human needs can be at the centre of the design. I believe that every person's voice should be heard and that their needs should be considered.

Fortunately, during my Master's program, Design for Interaction, at the Delft University of Technology, I got the opportunity to delve deeper into human-centred design. Taking part in the Master's elective Inclusive Design, guided by Stella Boess, opened my eyes to new ways of approaching existing problems. It broadened my perspective. I learned to understand users' needs, experiences, perspectives, lives, and behaviour. This enabled a wide range of people to use products in a way they prefer and made me realise why Inclusive Design is so important, which is why I was inspired to explore this design approach further.

Besides being interested in human-centred design, the topic of inclusion holds personal significance for me. As someone who is neurodivergent (dyslexic), I have experienced moments of exclusion and the additional effort required to participate in certain activities. Therefore, I was delighted to have the opportunity to focus my graduation project on Inclusive Design.

I hope this project will inspire and support other (student) designers to explore this design approach.

Enjoy reading,
Dana

Acknowledgements

I am grateful to all those who supported me throughout my graduation project. I could not have done it alone.

First, I want to express my gratitude to my supervisors, Stella Boess and Stefan Persaud. Thank you for your support, expertise, guidance and constructive feedback throughout this process.

I want to thank my company mentor Timon van Hasselt. His expertise from the Koninklijke Visio (an expertise centre for the blind and visually impaired) led to many valuable and insightful discussions. I would also like to acknowledge Corien van Meulen and Jamunu van Raay from the Koninklijke Visio, who as well contributed to this project and were always willing to engage in meaningful discussions and brainstorming sessions.

I want to express my appreciation to everyone who contributed to this project. Thank you for participating and sharing all your experiences and opinions regarding this topic. You have given me many insights and provided me with a better understanding of the subject.

Finally, I would also like to thank my friends and family, who have supported me during this journey. Thank you for being there for me, encouraging me, listening to me, and giving me advice when I needed it.

Before reading

This graduation project explores the topic of Inclusive Design; therefore, this report will discuss inclusion and diversity. It is important to acknowledge that this is a sensitive and complex topic. While I have fully immersed myself in this study, I recognize that continuous learning is essential. As stated by Adobe Spectrum (n.d.): *"Inclusion is something that never has a perfect endpoint, but that does not mean we should not engage or improve upon the ways we have practised design upon to this point"*. Therefore, I will explain and justify certain choices made during this project in this disclaimer.

Person-first language
Although it is important in Inclusive Design not to classify or label people by certain properties, it is still being done in this thesis. It is difficult to describe how people are excluded without explaining this in terms people can understand. Labels and classifications are essential to this discussion because they entail exclusion.

Although there still is an ongoing debate on which form of language to use when discussing disabilities (Ferrigon, 2019), I choose to use person-first language (e.g. people with a disability) in this report because this emphasizes the person before the disability. I will not use identity-first language (a disabled person) because this puts their disability first *(Figure 1)*.

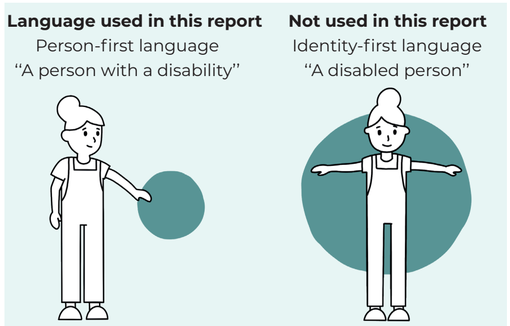

Figure 1: Person-first and identity first language

Focus of this project
Inclusion is a broad term. Recognizing the complexity of the topic, I have chosen to narrow the focus of this project. I decided to focus on people with a disability, mainly those with a visual impairment. The decision to focus mainly on people with a visual impairment was made because the elective course Inclusive Design was used as a starting point for this thesis (*Appendix A*). This elective focuses on people with disabilities, primarily visual impairments, and they also include other disabilities as physical impairment.

Design of this thesis
The topic of this thesis has inspired me to ensure its inclusivity, allowing readers to engage with the content in their preferred manner. For this purpose, several factors were considered while making this report. For example, the text is supported by visuals mostly, accompanied by alt-text to make the report accessible in audio format. More things taken into account in designing this report can be found in *Appendix B*.

Executive summary

Our society is becoming increasingly aware of the necessity of inclusion. However, some individuals are frequently not heard or understood and, therefore, not (yet) included in design projects and designs. Designing inclusively requires a good understanding of the abilities and experiences of a diverse group of people to strive for an inclusive design. This can be achieved when designers partner up with people while considering the full range of human diversity to design for their desired participation in society. Including these individuals in the design process will benefit a much broader audience.

For this project, I researched the context of Inclusive Design activities by Industrial Design Engineering students at Delft Technical University. I studied the perspectives of students regarding their experiences with Inclusive Design projects. Findings reveal that students do not experience Inclusive Design as a learning process. They are afraid to make mistakes and mainly work towards the final design. Additionally, students experience barriers to starting Inclusive Design activities, such as their insecurities, uncertainties, moral aspects, time pressure, and high expectations. To break down these barriers, students express the need for support and information that they can directly apply to feel better prepared for the activities because they would like to work from existing knowledge rather than explore and discover it themselves. While there are tools to support Inclusive Design projects, they do not consist of fixed, predetermined steps that can be followed, which means they cannot be applied literally, and require students to experiment.

To allow students to explore Inclusive Design activities, a safe learning environment has to be created to reduce the barriers. This should ensure that each team member feels safe, supported and comfortable exploring during an Inclusive Design project.

The project's research and design activities resulted in the co-design of a refocusing of the Master elective Inclusive Design. During my graduation project, an edition of the Inclusive Design elective ran in which several interventions were implemented based on my project findings. These interventions aim to break down barriers to exploring Inclusive Design (activities) by establishing a safe learning environment for students. Additionally, I designed a workbook for students *(Figure 2)* that bundles and serves as a tool to lower the barrier. The workbook provides reflective exercises for students to process information throughout an Inclusive Design project iteratively.

Figure 2: Workbook

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1

Introduction

In this chapter, I will provide a general overview of the project. First, I will introduce the topic of Inclusive Design activities for educational purposes. This is focused on the context of Industrial Design Engineering at the TU Delft. Furthermore, I will discuss the project's stakeholders, scope, goal, and approach.

1.1 Introduction to the topic

This thesis is a graduation project for the Master Design for Interaction at the Faculty of Industrial Design Engineering at the Delft University of Technology. This project focuses on the practice of Inclusive Design during design projects by Industrial Design Engineering students.

Our society is becoming increasingly aware of the necessity of inclusion. It is now recognised that there is no such thing as ‘‘normal’’ and that there’s no design for it either (Foggia, 2021). Considering the full range of human diversity, it is recognised that not everyone can fully use their senses and abilities at each moment. Therefore, design practices emphasise ensuring no mismatches between individuals and their environment. A consequence of mismatches is that individuals are excluded from using products, services, and systems to participate in society (Holmes, 2020; Microsoft, 2015).

However, some individuals are frequently not heard or understood and, therefore, not (yet) included in design projects and designs. Designing inclusively requires a good understanding of the abilities and experiences of a diverse group of people to strive for an inclusive design. This can be achieved when excluded people are involved at the beginning of the design process to ensure that everyone can participate in their own preferred way.

However, Industrial Design Engineering students have no or few opportunities to experience Inclusive Design during their study career. As a result, they cannot take this knowledge and experience in Inclusive Design with them during their following careers. There is only one optional course for students during their Master’s program, which entirely focuses on the practice of Inclusive Design. During this elective, there is a collaboration with Visio, a centre of expertise for blind and visually impaired people. They allow students to work with people with a visual impairment and gain experience in Inclusive Design. This partnership is due to the involvement of Visio in the Inclusive Design Lab. The latter aims to promote interactions through design and research so that a wide range of people can use them. This Inclusive Design course has also been the starting point of my project. Stakeholders of this elective, Visio and the Inclusive Design Lab, are also involved in my design project. More information about the stakeholders is presented on the next page.

Delft Design Labs

The Inclusive Design Lab was established in 2021 as part of the Delft Design Labs at Industrial Design Engineering. The lab researches how to design more inclusively, connects stakeholders to promote inclusion, and supports Inclusive Design projects and courses in Industrial Design Engineering.
Due to the Inclusive Design Lab, students in the Inclusive Design elective get the opportunity to co-design with people with a visual impairment of Visio.

The Inclusive Design Lab is now seeking to develop a format to carry forward learnings from the course and graduation projects to build on the knowledge previously gained from the lab.

Visio

Visio is a centre for expertise for people who are visually impaired. They offer information, advice, guidance, rehabilitation, education and living. They also conduct research and share their knowledge to inspire others.

Visio is a partner of the Inclusive Design Lab. They are bringing research questions and assignments to the Inclusive Design Lab, allowing students to work on Inclusive Design projects. In doing so, they let students work together with people with a visual impairment to aim for inclusive solutions.

1.2 Project scope and aim

The starting point of this project (*Appendix A*) was the Inclusive Design elective given in the Master of Industrial Design Engineering at the TU Delft. I studied the context of Inclusive Design activities by Industrial Design Engineering students in an explorative way to formulate a design goal. During the project, the scope, target group, and design focus changed, and therefore, I reformulated it several times based on the research outcomes. An overview of the final project scope and aim of the project is shown on the right.

Target group

Industrial Design Engineering students from Delft University of Technology who participate in Inclusive Design projects, teachers and experts.

Context

Inclusive Design activities by Industrial Design Engineering students from the Delft University of Technology for educational purposes.

Research goal

To understand the perspectives of students involved in an Inclusive Design process.

Research questions

- What is Inclusive Design?
- How to do Inclusive Design?
- What are the opportunities for students to learn about Inclusive Design?
- How do students, experts and teachers experience an Inclusive Design process?
- What are the needs and wishes of students regarding Inclusive Design?
- How can students be supported during an Inclusive Design process?

Design goal

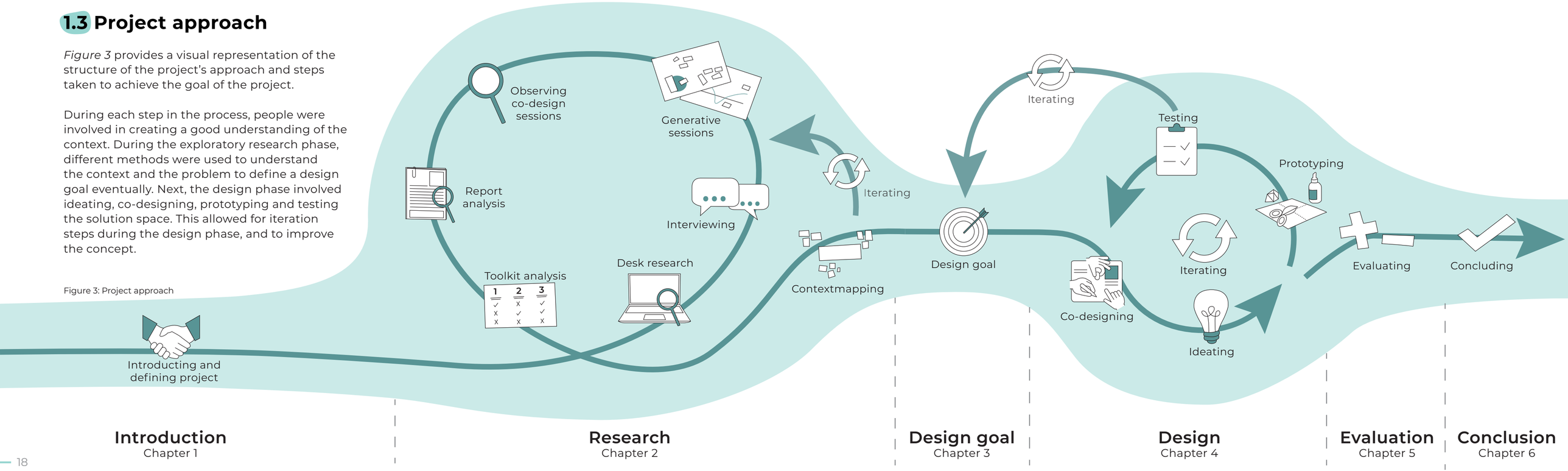
To enable Industrial Design Engineering students, starting with Inclusive Design at the Delft University of Technology, to do and experience Inclusive Design by creating a safe learning environment.

1.3 Project approach

Figure 3 provides a visual representation of the structure of the project's approach and steps taken to achieve the goal of the project.

During each step in the process, people were involved in creating a good understanding of the context. During the exploratory research phase, different methods were used to understand the context and the problem to define a design goal eventually. Next, the design phase involved ideating, co-designing, prototyping and testing the solution space. This allowed for iteration steps during the design phase, and to improve the concept.

Figure 3: Project approach



2

Research

During the research phase, I studied the context Inclusive Design activities for educational purposes to identify where the problems and opportunities lie.

2.1 Research approach

In this first phase of the project, the scope is researched in an explorative way. This research phase focuses on becoming familiar with the context of Inclusive Design activities for educational purposes, and understanding the stakeholders' perspectives to comprehend the problems they face in more detail.

Various research activities were done to identify problems and themes related to the context. The different activities are shown in the overview on the right. It was ensured that methods from all layers of the Sanders and Stappers (2012) framework were used. As a result, tacit and latent knowledge can be discovered through generative sessions (what people know, feel, and dream), besides explicit and observable knowledge through interviews and observations (what people say, think, and do).

In this chapter, I will present the results from these research activities structured by theme, and later I will discuss them. These insights will later be used to address design opportunities.

Literature research
Literature research was conducted to get an understanding of Inclusive Design and the context.

Toolkit analysis
The toolkit analysis is a comparison in which various Inclusive Design tools and toolkits are analysed and compared to find similarities and differences.

Course evaluation Inclusive Design
After finishing the Inclusive Design course in 2021, participating students completed an evaluation form.

Observing three co-design sessions
Joining co-design sessions that are related to the topic Inclusive Design. I observed co-design sessions where people with a visual impairment participated (*Appendix C*).

Interviewing two experts
Interviews were held with people with a visual impairment who participated in co-design sessions as an expert with students during the Inclusive Design courses *(Appendix D)*.

Report analysis
The reports between 2019 and 2022 of Inclusive Design courses were analysed to understand how students approach Inclusive Design *(Appendix E)*.

Evaluation Visio
Visio evaluated their involvement with the Inclusive Design Lab *(Appendix F)*.

Meetings with the Inclusive Design Lab
The Inclusive Design Lab director Stella Boess has been very involved during this project; this way, I was able to include this stakeholder's perspective well.

Six generative sessions with students
Generative sessions were held with diverse Bachelor and Master students to explore their perspectives *(Appendix G)*.

Five generative sessions with students who participated in Inclusive Design courses
Generative sessions were done with four Master's and one Bachelor's students who participated in Inclusive Design projects to understand how they experienced Inclusive Design *(Appendix H)*.

Interview with two teachers
Interviews were conducted with teachers; one teacher is involved in the Inclusive Design course. The other teacher was not involved, but involved in general Bachelor courses (Appendix I).

2.2 Inclusion vs. exclusion

What is exclusion?
Before I can delve deeper into Inclusive Design, I will first need to discuss inclusion in more detail since this is the foundation of Inclusive Design. First, the opposite of inclusion, exclusion, will be described to understand inclusion. Exclusion universally has the same meaning for everyone, in contrast to inclusion, which can mean something different to everyone. Exclusion occurs when you are not a participatory member (Holmes, 2020), but when and why does exclusion happen to people?

As designers, we tend to create designs based on existing knowledge. For this, we often use our own abilities and biases as a starting point (*Figure 4)*. As a result, we end up designing for people with specific abilities and assume that all abilities and senses are fully available all the time (Microsoft, 2015; Holmes, 2020). Consequently, we ignore the wide range of human diversity. Therefore, people will be unintentionally excluded. This exclusion can occur at cognitive, social, and physical levels (Microsoft, 2015).

It is not always noticed when exclusion occurs because people have the ability to adapt themselves to situations, which is why only some notice when they are excluded at certain moments. Therefore, products should be adapted to how people think, do, and behave instead of asking people to adapt to products. And if exclusion occurs, it should be intentional rather than accidental harm.

Almost everyone has experienced being left out, but not all are aware of it. The people who have felt excluded are the pioneers in addressing this and seeking inclusion. This is also mentioned in the book Mismatch by Kat Holmes (2020):

> *"We have the most to learn from leaders who've experienced great degrees of exclusion in their own lives."*

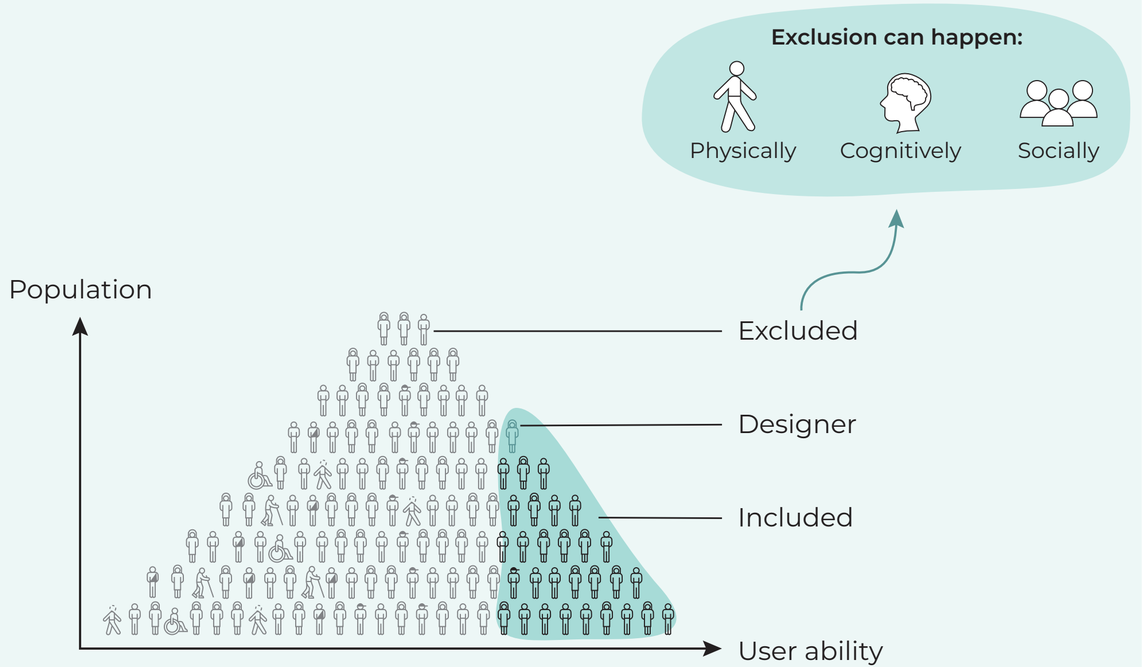


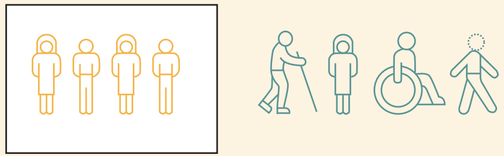
Figure 4: Designing for our own abilities

Exclusion vs inclusion
To prevent exclusion, we must strive for inclusion. Inclusion means that everyone can participate in their own desired way. However, inclusion is still ongoing, never perfect, and there is always a place for improvement (Holmes, 2020). As Adobe Spectrum (n.d.) stated:

> *"Inclusion is something that never has a perfect endpoint. But this doesn't mean we shouldn't engage or improve upon the ways we have practiced design up to this point."*

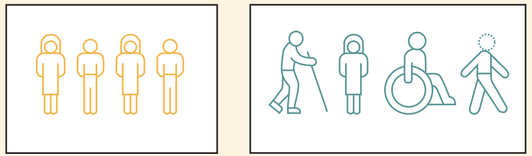
There are also two stages between inclusion and exclusion that are sometimes still confused with inclusion: integration and segregation. In these cases, individuals can participate, but not in the desired way or in a modified form (Villegas, 2017). The overview on the right shows how the project views these four stages (*Figure 5*).

Exclusion



Exclusion happens when diverse groups or individuals are denied participation in society, directly or indirectly.

Segregation

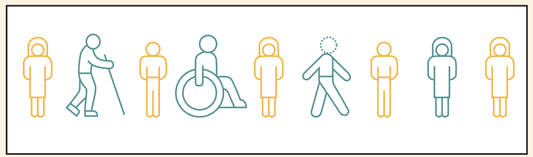


Segregation happens when diverse groups or individuals are placed in separate environments designed or used to respond to their differences.

Integration

Integration happens when diverse groups' or individuals' needs are met by employing policies. However, these people are often in the mainstream experience but treated as the "diverse" group.

Inclusion



Inclusion means groups or individuals are accepted, welcomed, and equally treated. This way, everyone can participate in their desired way.

Figure 5: Exclusion, segregation, integration and inclusion

Permanent, temporary, and situational disabled
A disability can be permanent; about 15% of the population have a disability (World Health Organisation, n.d.).

Besides permanent disabilities, they can also be temporary. A temporary injury or the context can impact people's interactions with the environment—for example, an ear infection.

Exclusion can also depend on the situation. Different environments have an impact on a person's abilities. For example, people having trouble hearing because they are in an environment with loud sounds (Microsoft, 2015).

Figure 6 presents an overview of examples of when permanent, temporary and situational disabilities occurs for different senses.

This recognises that Inclusive Design is not only beneficial for people who have a disability but that it can also be beneficial for a larger group of people who are, for example, temporarily or situationally excluded. This leads to the conclusion that a person can be disabled by their environment.

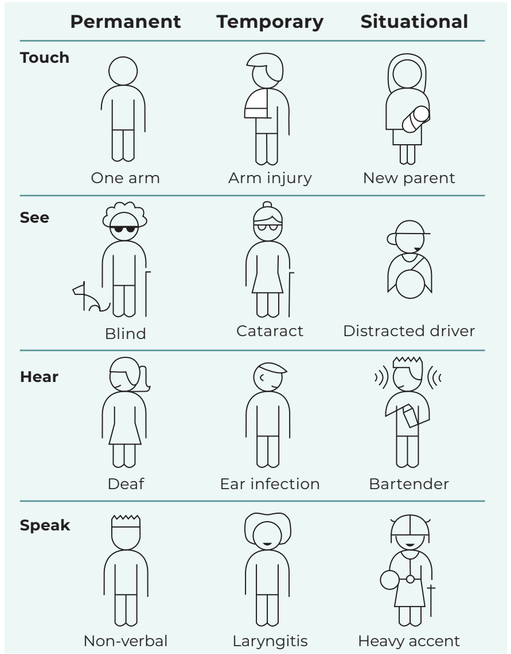


Figure 6: The Persona Spectrum (Microsft, 2015)

A designer can create exclusion
This allows a designer to create exclusion with each choice they make in the design process. In other words, a designer can create a disability with their design because a disability happens when individual characteristics do not match the context (Adobe Spectrum, n.d.). There is a mismatched interaction. A person is thus disabled by his or her environment and therefore excluded from equal participation in society. In contrast, a few decades back, a disability was viewed differently. At that time, it was still seen as a personal health condition. There was a shift from the medical model towards the social model. This shift *(Figure 7)* increased understanding of the importance of more inclusive design (van Houting, 2019; Microsoft, 2020; Adobe Spectrum, n.d.).

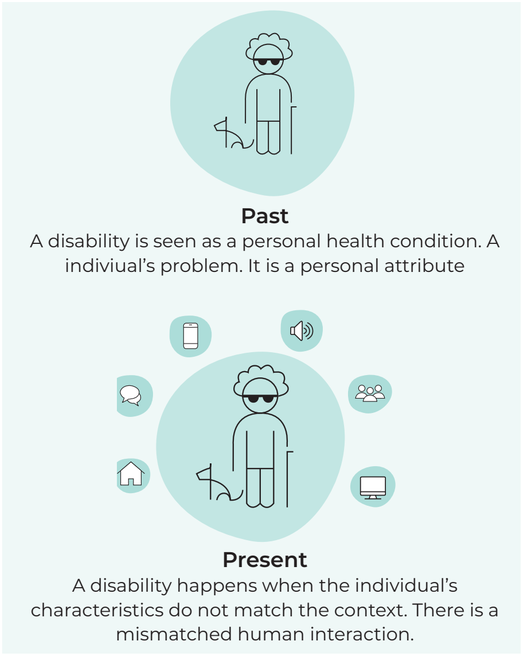


Figure 7: Disability

2.3 What is Inclusive Design?

By designing inclusively, products, services, environments, and experiences will become accessible to people with a wide range of abilities.

Inclusive Design is still often confused with designing for people with disabilities. However, the basis of Inclusive Design is not accessibility, but the starting point is the exclusion that people experience when mismatches between them and their environment happen. Including these people in the design process will benefit a much broader group of people, such as those who are temporarily or situationally disabled.

The overview on the right describes the term Inclusive Design (*Figure 8*) from the project's point of view. In addition, the concepts of Universal Design (*Figure 9*) and Accessible Design (*Figure 10*) are also discussed in this overview; these terms are often confused with Inclusive Design because these approaches also focus on lowering barriers so that the broadest possible audience can use products (Joyce, 2022; Persson et al., 2015).

Inclusive Design

Inclusive Design is an approach in which the designers partner up with people while considering the full range of human diversity to design for their desired participation in society (Inclusive Design Lab, 2020; Heylighen & Bianchin, 2018; British Standard Institute, 2004). Inclusive Design does not mean designing one thing for all people but designing a diversity of ways for people to participate so everyone has a sense of belonging (Khazanchi, 2018).

For example, options to control the text size, contrast between text and background and text available in audio format.

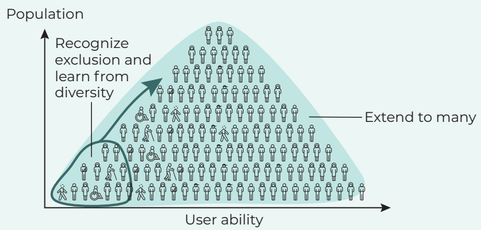


Figure 8: Inclusive Design

Design for All / Universal Design

The definitions Design for All and Universal Design can be used interchangeably. These methods aim to design products accessible for all people, to the greatest extent possible, without the need for adaptation or specialised design (National Disability Authority, n.d., a.). This is equal to Inclusive Design, but in contrast, Universal Design is based on seven universal design principles and on creating one solution that can be used by as many people as possible (National Disability Authority, n.d., b.; Persson et al., 2015). Lastly, Universal Design focuses on identifying the most suitable target market and making selections to maximise the "Product performance indicators" for that target market (University of Cambridge, n.d.).

For example, a sufficient text size makes reading easier for almost everyone.

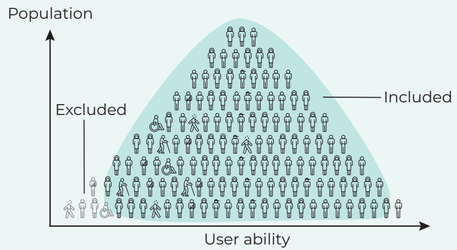


Figure 9: Universal Design

Accessible Design

Accessibility is focused on the outcome of a design project in which the needs of people with disabilities are specifically considered, so products, services, and facilities can be independently used by people with various disabilities (Chapman, 2020; DO-IT, n.d.).

These products can be made available via a medical model (reimbursement). This emphasises the disability more, but it creates equality. Another option is that people with disabilities have to buy these products themselves. So people with a disability must finance it themselves, creating inequality because not everyone can afford it (Chung, 2020).

For example, a text available in braille for people with a visual impairment who can read braille.

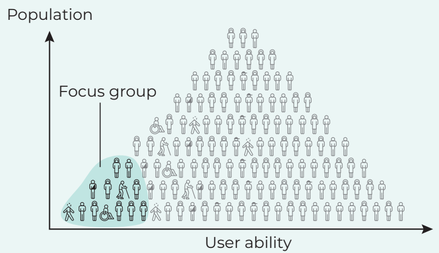


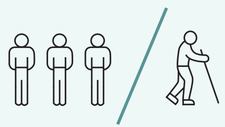
Figure 10: Accessible Design

2.4 How to do Inclusive Design?

Principles of Inclusive Design
My research shows that Inclusive Design is an approach, and no set predefined methods or steps can be followed precisely for this. However, there are three principles that Microsoft has established for an Inclusive Design process. These principles can help designers in order to master the basics of Inclusive Design. These principles are explained below (*Figure 11*).

Recognise exclusion

It is essential to recognise exclusion; who is being excluded? Moreover, is this intentional, unintentional, or structural? (Adobe Spectrum, n.d.; Microsoft, 2020).



Learn from diversity

Including people in the design process and putting them in the centre provides many insights into their experiences and how they adapt to their environment (Bhat, 2021; Microsoft, 2020).

Solve for one, extend to many

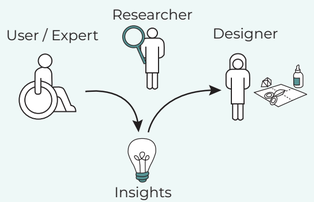
Designing products that solve problems for an individual with a permanent disability could also benefit others (Bhat, 2021; Microsoft, 2020).

Figure 11: Principles of Inclusive Design according to Microsoft

Co-designing
To understand and include needs, values, and experiences of people with various abilities in the design, these stakeholders want to be involved in the process. They want to be considered co-designers and given credit for their input and perspectives (Betts, 2019; Adobe Spectrum, n.d; Sanders & Stappers, 2012). Thus truly designing together rather than simply listening to them. *Figure 12* gives more information about co-designing. Users are experts in their own experiences. Therefore, they will also be referenced as experts in this report.

Classical designing

In the classical user-centred design process, the researcher researches the user and passes this knowledge to the designer. The designer creates ideas, concepts, etc (Sanders & Stappers, 2008).



Co-designing (Inclusive Design)

In co-designing, also called participatory design, the user is considered an 'expert of his/her experience'. Therefore, the designer and researcher collaborate on the tools for ideation, and these tools support the expert for ideation and expression (Sanders & Stappers, 2008).

Figure 12: Co-designing

What types of Inclusive Design tools are there?
So there are some principles to consider when doing Inclusive Design, but there is no fixed step-by-step plan on how to do Inclusive Design. However, there are tools available to help designers with Inclusive Design. For this project, I divided the available tools into three different categories:

1. Tools to collaborate with experts *(Figure 13)*.
2. Tools to become aware of inclusion *(Figure 14)*.
3. Tools to check accessibility *(Figure 15)*.

The category 'Tools to collaborate with experts' strives for an essential principle of Inclusive Design: involving people in the design process. The other two categories only ensure that designers themselves will think about inclusion during a design project, but it does not help designers to include people in the process. The overview on the right gives more information about the type of existing tools.

Tools to collaborate with experts

Tools to involve people in the design process and to understand their needs and experiences to include these insights in the design. By using these tools, Inclusive Design can be achieved.

For example, the Microsoft Inclusive Design Toolkit provides activity and support cards that can be integrated into an existing design process (Microsoft, n.d.).

Figure 13: Tools to collaborate with experts

Tools to become aware of inclusion

Tools to think about Inclusive Design and why it is essential. It does not indicate how to work together with experts, but it lets the designer think about the topic themselves.

For example, the practical online tool for Inclusive Design, Cards for Humanity. The tool provides two random cards, which challenge the designer to include their needs in the design (Idean x Cards for Humanity, n.d.).

Figure 14: Tools to become aware of inclusion

Tools to check accessibility

Tools to check if a design is suited for people with a disability.

For example, the site whocanuse.com can be used to check whether colour combinations contrast enough for people with colour blindness (whocanuse, n.d.).

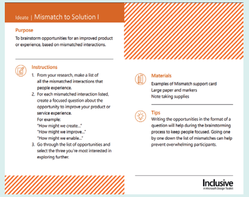
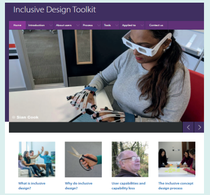
Figure 15: Tools to check accessibility

Tools for Inclusive Design
So several tools can support designers during an Inclusive Design project. *Table 1* lists a number of tools that I frequently have found in my research. The table continues on the next spread page.

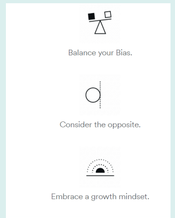
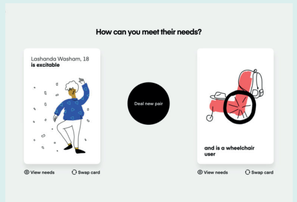
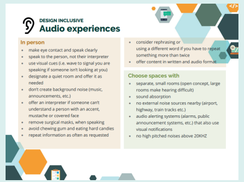
There is one dominant tool: The Microsoft Inclusive Design Toolkit. It is often used as a starting point in projects on Inclusive Design, including during projects at TU Delfts Industrial Design Engineering. This toolkit was released in 2015, and in 2023 they expanded their collection of tools and released a guidebook, worksheets, and case studies primarily focused on cognitive exclusion.

However, these tools do not intentionally include emotional aspects when designing for inclusion (Boyuklieva, 2021). While this emotion and feeling are essential when doing Inclusive Design.

Table 1: Inclusive Design tools

	Microsoft *Inclusive Design Toolkit*	Microsoft *Inclusive Design Cognitive Exclusion*	Cambridge *Inclusive Design Toolkit*	Mismatch by Kat Holmes *Book*	Adobe *Inclusive Design Workshop*
Toolkit					
Explanation	Information about Inclusive Design and activity cards	Guidebook, worksheet, screeners and case studies	Design method with tools to simulate disabilities	Information about Inclusive Design	Information about Inclusive Design and exercises
Focus	Physical inclusivity Social inclusivity	Cognitive inclusivity	Physical inclusivity	Physical inclusivity Social inclusivity	Physical inclusivity Social inclusivity Cognitive inclusivity

The table continues on the following pages ▸

	Airbnb Design *Research Tool*	Cards for Humanity *Tool for Inclusive Design*	InHolland *Inclusive Design Toolkit*	Bridgeable *Inclusive Co-Design Toolkit*	Government of Ontario *Guidelines cards*	Government of Western Australia *Training Toolkit*
Toolkit						
Explanation	A set of questions to help you balance your biases	A tool to design for different needs	Design method that can be applied to an existing design process	Toolkit to guide designers with co-design activities with people with language barriers	Guidelines for different levels of exclusion (audio, visual, thought, etc)	Training toolkit on how to co-design with people with a disability
Focus	Social inclusivity	Physical inclusivity Social inclusivity Cognitive inclusivity	Physical inclusivity Social inclusivity Cognitive inclusivity	Social inclusivity	Physical inclusivity Cognitive inclusivity	Physical inclusivity Cognitive inclusivity

2.5 Inclusion at Industrial Design Engineering

The scope focuses on Inclusive Design at TU Delft's Industrial Design Engineering faculty. For this, the current state of inclusion at the Industrial Design Engineering Faculty will first be examined.

In 2016, a United Nations Convention about people with disabilities was established (Rijksoverheid, n.d.). TU Delft signed this convention, and following this, TU Delft made a policy plan on studying with a disability in 2018 (ECIO, 2022). This was done in cooperation with a student group. In 2020, these students established a platform called Student Onbeperkt to proactively provide input to TU Delft about this topic (TU Delft, n.d., b). In addition, Horizon, an online service centre for studying with a disability or additional support needs, was launched in 2021 (TU Delft, n.d., a.).

As a result of the United Nations Convention, TU Delft established a Diversity Office in 2017. In addition, each faculty has also appointed a Diversity Officer to promote diversity and inclusion within their faculty. Even though actions have thus been taken in this area, research by Gunneweg et al. (2022) shows that TU Delft is not (yet) making its curriculum and teaching materials more inclusive. In comparison, the majority of universities and colleges surveyed for this purpose are working on making the curriculum and teaching materials more inclusive. Consider, for example, the diversity of literature and its authors, the images used, and the guest lecturers invited (Braat, 2021). So the first steps have been taken, but not yet many concrete actions. This is mainly because TU Delft is now researching and monitoring diversity and inclusion, and only after this can clear actions be taken (TU Delft, n.d., a).

Finally, the Diversity & Inclusion Week, hosted by the TU Delft (TU Delft, n.d., b.), and Onbeperkt Studeren Week, hosted by Student Onbeperkt, have also been launched, bringing attention to a safe and inclusive campus. The latter has been renamed AccessAbility Week (AccessAbility Week, 2023).

Figure 16 presents an overview of what actions Delft University of Technology is taking to improve inclusion, but concrete actions still need to be taken by the Faculty of Industrial Design Engineering.

Initiatives regarding to inclusion at TU Delft

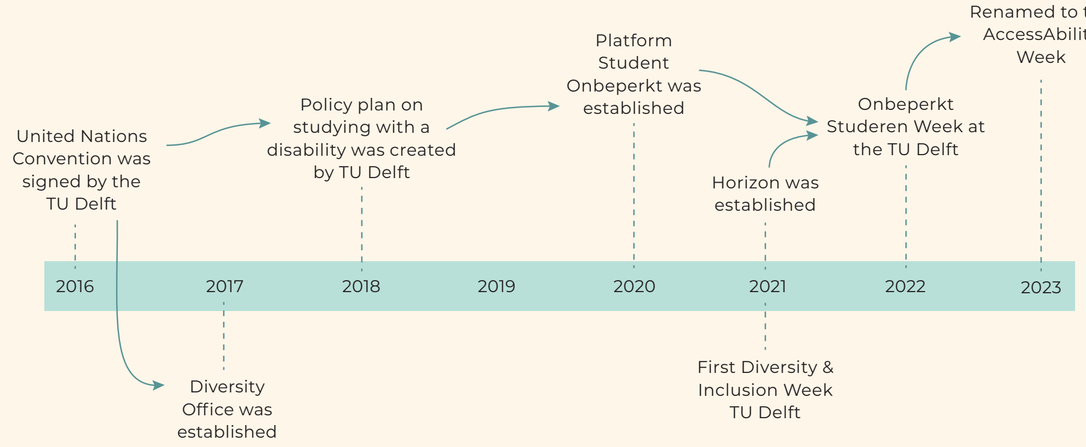


Figure 16: Initiatives regarding to inclusion at TU Delft

2.6 Educational opportunities for students to learn about Inclusive Design

However, applying and teaching Inclusive Design is even a layer deeper than making education at the Faculty of Industrial Design Engineering more inclusive.

Courses about Inclusive Design

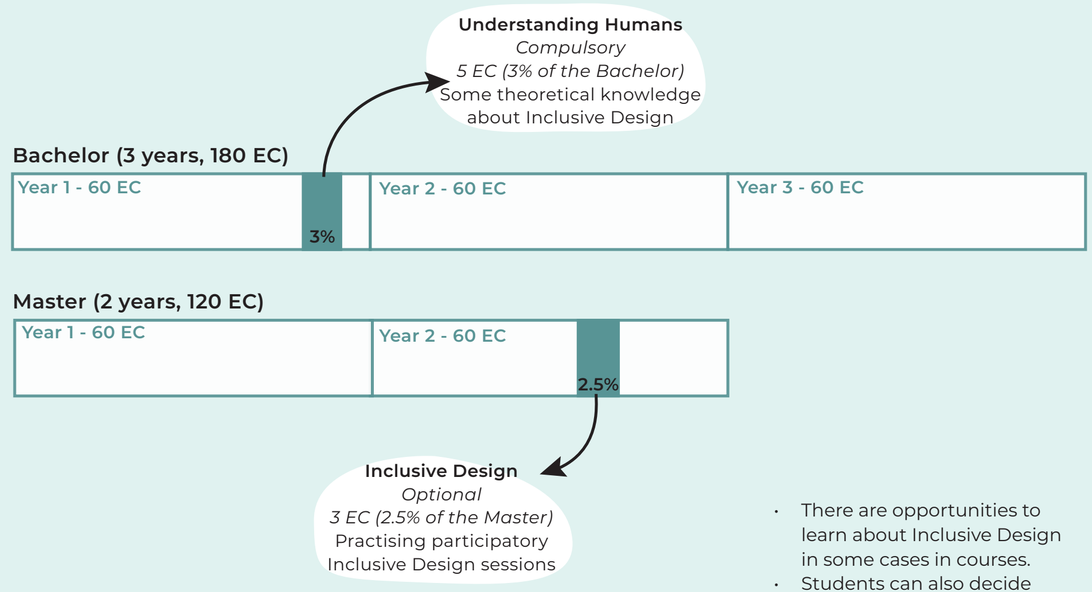
The Industrial Design Engineering faculty has limited opportunities for students to learn about Inclusive Design (*Figure 17*). In the first academic year of the Bachelor's degree, students receive some theory on Inclusive Design and ergonomics during the course Understanding Humans. This course makes up 5 ec of the 180 ec to be attained in the Bachelor's programme. The theoretical knowledge they gain through papers and books is minimal. Students learn the definition of Inclusive Design and why it is essential. However, they hardly apply this knowledge in practice (*Appendix H*). For the course Understanding Humans, a 2021 graduate student, Cindy Jantji, designed a self-awareness activity on skin tone inclusivity in product design, but it has not (yet) been introduced into the course (Jantji, 2021). In the Master, there is an elective, Inclusive Design, given by Stella Boess. By following this course, 3 EC can be earned from the total 120 EC to be achieved in the Master's program. Because this course is optional, only a few students gain this knowledge and experience. Through the collaboration with Visio, an expertise centre for the blind and visually impaired, this is their primary focus group during this elective. They strive for inclusivity through participatory sessions involving their target group through co-creation sessions (Inclusive Design Lab, 2020).

Moreover, other courses sometimes provide cases on Inclusive Design. Alternatively, students themselves may choose to focus on Inclusive Design during a project, for example, a graduation project.

This shows that there are only a few opportunities for students to learn more about Inclusive Design, and students often have to take the initiative themselves to learn more about it. As Miriam Jimenez Lluva (2022) states in her graduation thesis:

"In order to carry out Inclusive Design, it seems to be a personal proactiveness and responsibility."

Educational opportunities to learn about Inclusive Design



- There are opportunities to learn about Inclusive Design in some cases in courses.
- Students can also decide themselves to choose a topic related to inclusion.

Figure 17: Educational opportunities to learn about Inclusive Design

Inclusion is not integrated into the design process
As concluded in the previous section, not many students practice Inclusive Design. Therefore, inclusion is not fully integrated into students' design process. As a Bachelor student pointed out (*Appendix H*):

> *"Sustainability and inclusivity are important, but it seems like an extra part of the process; it is not integrated. It is not the primary goal of a project."*

That inclusion is often not (yet) included in design processes is also shown by the fact that six out of six students from the generative session indicated that they aim to design for average users. Although, some students do intend to check the accessibility of the product with people with disabilities later in the process. As one Bachelor student indicated (*Appendix H*):

> *"I would first involve the most typical users, and in the end, check if it is useable for visually impaired people, wheelchair users, etc. because it will make the design process more difficult. This is only a small group."*

I made a generic design process with the insights from the generative sessions with six Industrial Design Engineering students *(Appendix H) (Figure 18).* Most students follow this process throughout their projects in their design education at Industrial Design Engineering. Below this generic design process, I also visualised the Inclusive Design approach so it can easily be compared.

Besides experts often being involved late in the project, many people are also forgotten, mainly those with disabilities that are not visible to others, as one Master's student stated (*Appendix H*):

> *"I did not think about low literacy and other cognitive disabilities because you can not see that."*

Lastly, the fact that inclusion is not integrated into the design process at Industrial Design Engineering is also shown by the fact that students are not (yet) assessed on this during courses. It is not included in the assessment form used to evaluate their projects. As a teacher stated in an interview (*Appendix I*):

> *"It should be a nice step to implement inclusivity in the assessment."*

	Research	Design	Evaluation
Design process of students	People involved: The researcher/designer researches the (most typical) user.	People involved: The designer creates ideas, concepts, etc. themselves based on the insights of the research.	People involved: The designer evaluates the concept with the most typical user and sometimes with people with disabilities.
Inclusive Design approach	People involved: The researcher/designer researches together with the co-designer/expert.	People involved: The designer creates ideas together with the co-designers/experts.	People involved: The designer evaluates the concept with a diversity of people.

Figure 18: Inclusive Design is not integrated in the design process

2.7 Stakeholders

All the direct and indirect stakeholders
Several stakeholders are involved in the Inclusive Design projects of Industrial Design Engineering students. Therefore, during my research, I first focused on all stakeholders: Students, teachers, experts, clients, users, and the faculty. Each stakeholder has a different perspective on Inclusive Design, as Visio stated (*Appendix F*):

> *"The term 'Inclusive Design' is complex; stakeholders interpret it differently. This is sometimes confusing when dealing with external stakeholders (companies, organisations). 'Inclusive' is often understood as diversity (gender, ethnicity, etc.) or as a specifically accessible design for one group."*

Focus of the project: Students involved in Inclusive Design projects
Throughout the research, I started to focus more and more on students because I concluded there were several opportunities here for me as a designer. There are several design opportunities related to students with little or no affinity for Inclusive Design. For example, there are only a few projects to gain experience in Inclusive Design at Industrial Design Engineering (*Chapter 2.6*), not all students were aware of inclusion (*Appendix H*), and lastly, inclusion is not integrated into the design process (*Chapter 2.6*).

I decided to focus on students who participate in Inclusive Design projects or are interested in this topic because I discovered students experienced problems while doing Inclusive Design activities. I do not think the priority of this project is getting students interested in Inclusive Design because there are already initiatives for that (*Chapter 2.5* and *Chapter 2.6*). Therefore, my thesis focuses on issues arising during Inclusive Design projects. Thus students who have an affinity for Inclusive Design and choose these projects are involved in this chosen context. This way, the problem will be addressed at the core.
However, besides students, experts are also direct stakeholders in this context. They are involved in participatory sessions where the students thus experience difficulties. They want to be involved from the start of the project. The following two chapters present the insights of these stakeholders. *Chapter 2.8* presents the insights from the perspective of the student doing Inclusive Design projects, and *Chapter 2.9* presents the expert's perspective. A visual overview of the focus of my project can be seen in *Figure 19*.

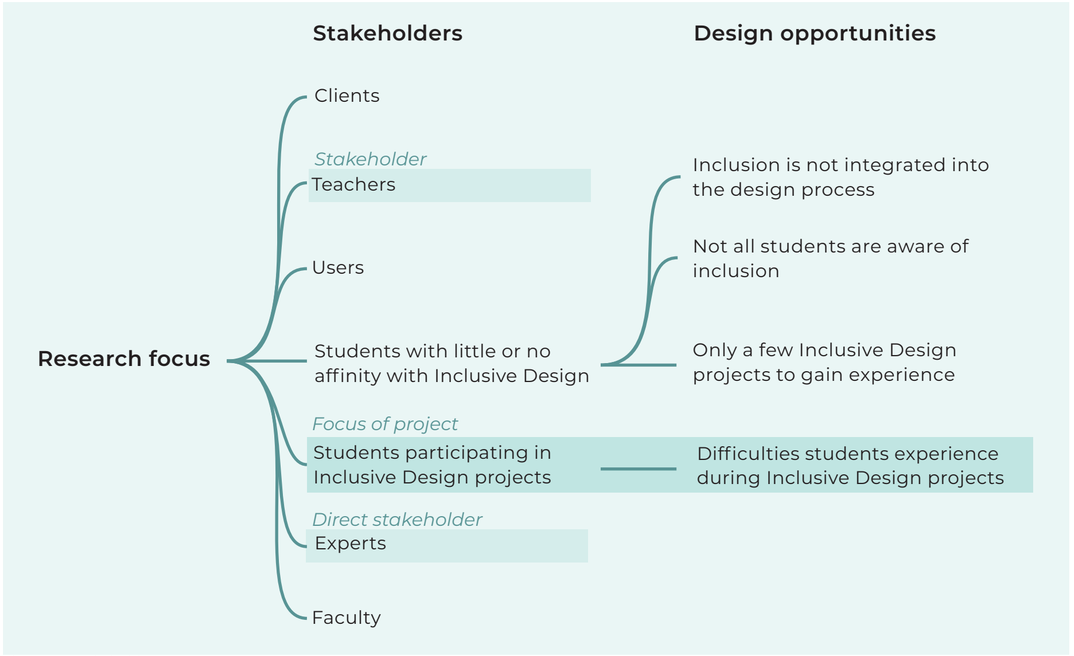


Figure 19: Stakeholders

2.8 Students' perspective

From the research a number of insights follow from students' perspectives on how they (want to) experience Inclusive Design projects. These insights are based on students who have participated in Inclusive Design projects. These Industrial Design Engineering students understand why Inclusive Design is important and believe this approach would be valuable for other students. However, they experience unforeseen difficulties during Inclusive Design activities and do not know how to overcome them.
Inclusion is a complex and sensitive topic that is sometimes difficult to discuss, which is why many of these difficulties were not discussed before. Students occasionally indicate where they experience problems, for example, wanting more methods to support them with Inclusive Design, but their needs often lie elsewhere than they could previously identify. So this research will show that they may not fully articulate their actual needs (*Appendix G*).

During my research, nine insights from the students' perspective emerged, presented in *Figure 20 to Figure 28*.

Students' perspective

1. Students are insecure about their skills and competencies, they are still learning to design.

"*We are expected to build on skills we should have gained earlier. But I am still learning these basics.*"

Generative session 2nd year bachelor student

Figure 20: Student insight 1

Students' perspective

2. Students perceive Inclusive Design (and other aspects of design) as a skill they either master or do not master. They do not preceive it as a learning process.

"*I am not good at Inclusive Design. My talents rather lie in other things, like technology.*"

Generative session with 2nd year master student who followed Inclusive Design

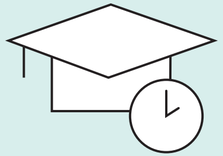
"*I am not talented in technology, so I let someone else do that part. I don't dare to start with that part.*"

Generative session with a second year master student

Figure 21: Student insight 2

Students' perspective

3. Students indicate that it takes time to master a new skill like Inclusive Design.



"*We could find our way into this [Inclusive Design] by facilitating the sessions, which improved over time.*"

Report Inclusive Design Elective Team 1 (2022)

"*You have to do it [Inclusive Design participatory sessions] to understand it.*"

Generative session with a second year master student who followed Inclusive Design (2022)

Figure 22: Student insight 3

Students' perspective

4. Students experience time constraints when applying Inclusive Design.

> *Between the first and second session, we are already started on the ideation. Before the actual session, we conducted the brainstorming session because it took quite a while until we got an interview.*

Generative session with a second year master student who followed Inclusive Design (2022)

> *Now it felt rushed to find a solution as fast as possible while there was still so much to discover.*

Report Inclusive Design Team 2 (2022)

Figure 23: Student insight 4

Students' perspective

5. Students find it challenging to discuss sensitive topics during Inclusive Design (moral aspects)

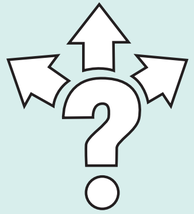
> *I was very nervous, for example, I was afraid I might say the wrong things and offend them.*

Generative session with 2nd year master student who followed Inclusive Design course

Figure 24: Student insight 5

Students' perspective

6. Students find it challenging to have many uncertainties at once.



> *I find it scary to approach people immediately when I still have little knowledge. I want to prepare well.*

Generative session with 2nd year bachelor student

> *Don't know the skills of the experts.*

Interview expert 1

Figure 25: Student insight 6

Students' perspective

7. Students have high expectations during Inclusive Design.

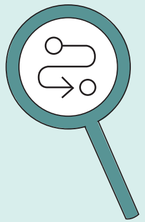
> *A high level was expected. But we had no experience with inclusive co-design sessions.*

Interview Expert 1

Figure 26: Student insight 7

Students' perspective

8. Students instead focus on the result rather than the process.



> *There was relatively much focus on the outcome (testing of assumptions, ideas and interviewing than co-creation) rather than the process (how to approach Inclusive Design). Students created design requirements, but whether that was done in consultation with users or based on a literature review.*

Evaluation form Inclusive Design Lab (2022)

Figure 27: Student insight 8

Students perspective

9. Students want information, tools, and guidance to apply Inclusive Design. They work based on that information instead of experiencing it by trial and error.

> *What we missed was information about inclusive design practice in general. It would be nice to invite people who are often excluded in some way to talk about their experiences. Also, it would be nice to invite design practitioners who worked a lot on inclusive design projects.*

Interview expert 1

Figure 28: Student insight 9

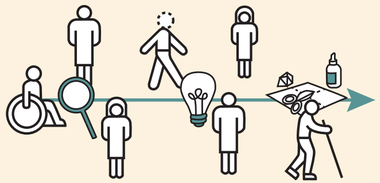
2.9 Experts' perspective

From the research a collection of insights from the experts' perspective emerged on how they (want to) experience Inclusive Design activities. The experts have participated in Inclusive Design projects at Industrial Design Engineering. The experts who attended the participatory sessions work for Visio and have a visual impairment. Through the collaboration between Visio and the Inclusive Design Lab, these experts are available to serve as co-designers during Inclusive Design projects at Industrial Design Engineering.

Seven insights were derived from this, which are presented in *Figure 29* until *Figure 35*. These insights are supported by quotes obtained from the study. More information about this can be found in *Appendix D*.

Experts' perspective

1. Experts want to be involved early in the design process.



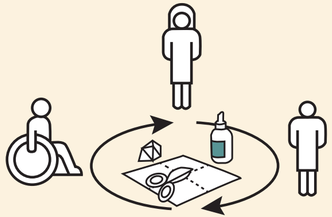
> *Actually, everyone [the design team and the experts] should start at the same level of knowledge of the case.*
>
> Interview expert 1

> *They approached me late in the process. The design team already had a vision for the project.*
>
> Interview expert 2

Figure 29: Expert insight 1

Experts' perspective

2. Experts want to be a design team with the students and be seen as co-designers instead of advisors.



> *The session is more about presenting ideas, validating and checking the assumptions.*
>
> Interview expert 2

> *Currently, the design team does not fully include people with visual impairment. They are often seen as advisors rather than team members.*
>
> Report PIP Design team 1 (2022)

Figure 30: Expert insight 2

Experts' perspective

3. Experts prefer an informal activity instead of a formal meeting.

> *I like doing something concrete rather than sitting opposite each other. It is less formal.*
>
> Interview Expert 1

Figure 31: Expert insight 3

Experts' perspective

4. Experts notice when students have experience with Inclusive Design activities.

He also followed another Inclusive Design course, and I noticed that he did benefit from this basic knowledge and experience for the Inclusive Design course. It is a way of thinking that was more natural for him.

Interview expert 1

Figure 32: Expert insight 4

Experts' perspective

5. Experts notice when students feel discomfort.

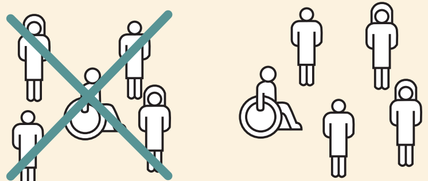
Now there is still much discomfort during such a session. When you no longer have that barrier, it is much easier to have a conversation. I feel that students are afraid of saying the wrong thing and afraid to approach people and make it broader.

Interview expert 1

Figure 33: Expert insight 5

Experts' perspective

6. Experts do not want themselves or their disability to be the centre of attention.



Do not make people with a visual impairement feel like they are special.

Report PIP Design Team 1 (2022)

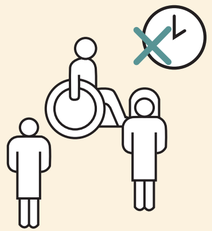
For example, an assignment where the design team does not get details, and I do not see any details either. Then they have the same experience.

Interview expert 1

Figure 34: Expert insight 6

Experts' perspective

7. Experts want no time limit to connect with the design team.



During a project, you have such a short time. It is difficult to empathise.

Interview Expert 1

Figure 35: Expert insight 7

2.10 Conclusion: Design opportunities

Using context mapping, a method in which context is mapped based on user input, user experiences, emotions, and needs were obtained (Sanders & Stappers, 2012). These insights were then mapped in an overview to investigate their connections. After that, I saw where design opportunities existed for me as a designer in the area I defined earlier: The difficulties that students participating in Inclusive Design projects experience. This overview is presented in this chapter (*Figure 36*).

The main conclusion is that students do not experience Inclusive Design as a learning process. They mainly work towards the results and are afraid to make mistakes. Mainly due to their insecurities, uncertainties, time pressure, high expectations, and moral concerns regarding talking about sensitive topics, they experience barriers to exploring Inclusive Design.

Therefore, the students express a need for (more) information and guidance which they can directly apply because they would like to work from existing knowledge rather than explore and discover it themselves. As *Chapter 2.4* points out, there are tools to support Inclusive Design projects. However, they do not consist of fixed, predetermined steps that can be followed, which means they cannot be applied literally, and students have to try things out themselves. So they must start discovering this themselves. Besides, this will also help students to get a better understand of Inclusive Design and master Inclusive Design.

During my research, there was only one student group who perceived their Inclusive Design project as a learning journey. They organised a weekly co-creation session, which is way more frequent than other groups, and they were not afraid to make mistakes. They believed that they would master it during the process. By reflecting on the project, they could confirm this. This supports the idea that students should discover Inclusive Design activities for themselves. As one Master student said during a generative session (*Appendix G*):

> *"We had no trouble with the sessions since we considered them as try-out sessions and we did so many sessions."*

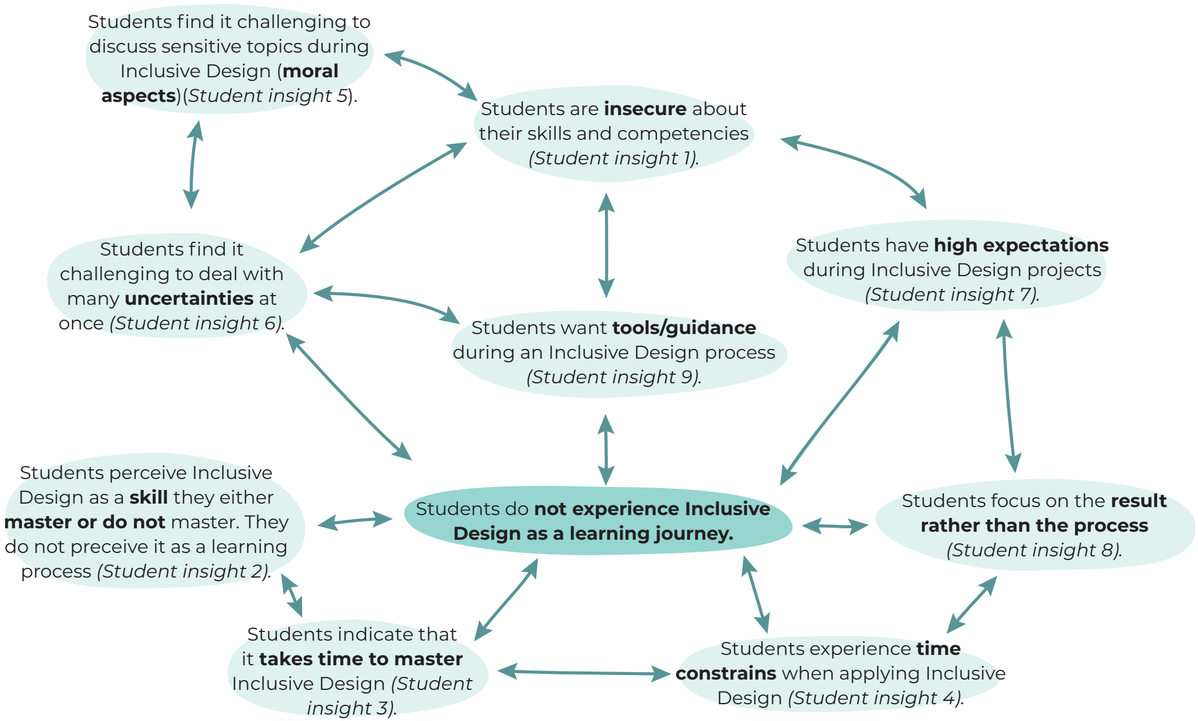


Figure 36: Overview contextmapping

3

Design goal

In the research phase, I gained an understanding of the context and the problem. Based on this understanding, this chapter presents the design goal. The design goal is the touchpoint between the research and the design phase of this project. The learnings from the research phase are used to formulate a design goal and create design criteria, which will serve as a guide to base choices on in the design phase.

3.1 Introduction

As stated in the previous chapter, the barrier for students to do Inclusive Design activities is high because of their insecurities, uncertainties, moral aspects, time pressure, and high expectations. Another conclusion that can be drawn is that students often involve experts late in the process and see them as advisors to validate their ideas instead of considering the experts as co-designers. However, experts indicate they want to be involved early in the design process (*Expert insight 1*) and be considered co-designers (*Expert insight 2*).

To overcome the barrier to doing Inclusive Design activities, students express the need to have guidance and feel better prepared to be less likely to make mistakes. However, it is difficult to provide this since every person has different needs, so students must discover this for themselves. Therefore, the intervention should lower the barrier for students to start Inclusive Design activities. This can be achieved when students experience support, safety and comfort as they look ahead to the session; this will reduce their insecurities, uncertainties, moral aspects, time pressure, and high expectations. So to lower the barrier, a safe learning environment has to be created. It is essential for the design team, consisting of experts and students, to get to know each other, trust each other, and build a connection. This safe learning environment should ensure that each team member feels safe and comfortable to explore during the project, even though this can lead to mistakes. This way, the design team will learn about this approach and become more skilled. A safe learning environment is essential for successful collaboration.

A visual representation of the current situation (*Figure 37*), the desired situation (*Figure 39*), and the intervention (*Figure 38*) that should achieve this are presented on the following pages.

Current situation

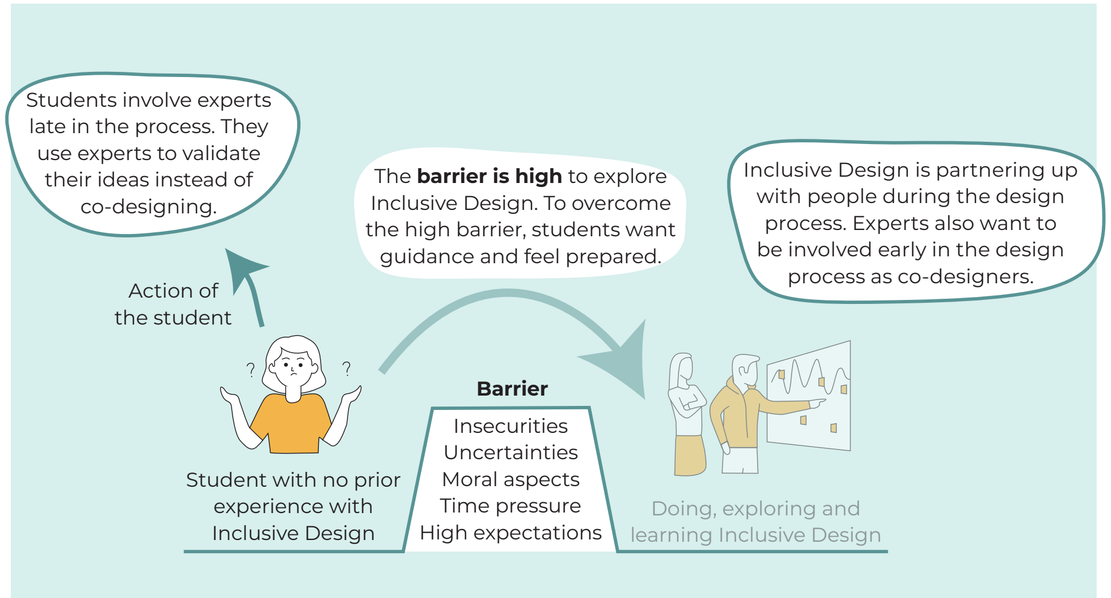


Figure 37: Current situation

The intervention

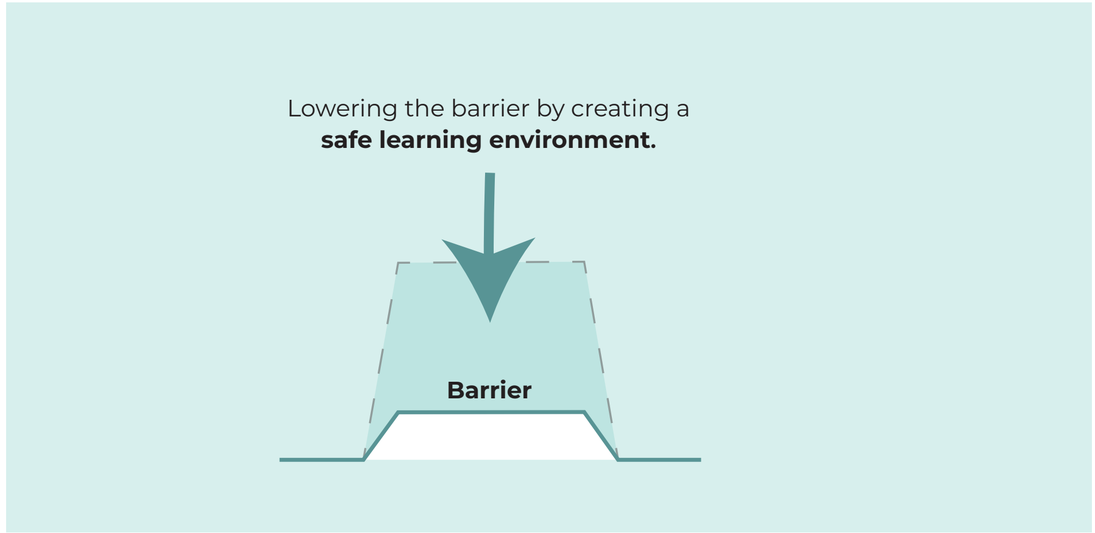


Figure 38: The intervention

Desired situation

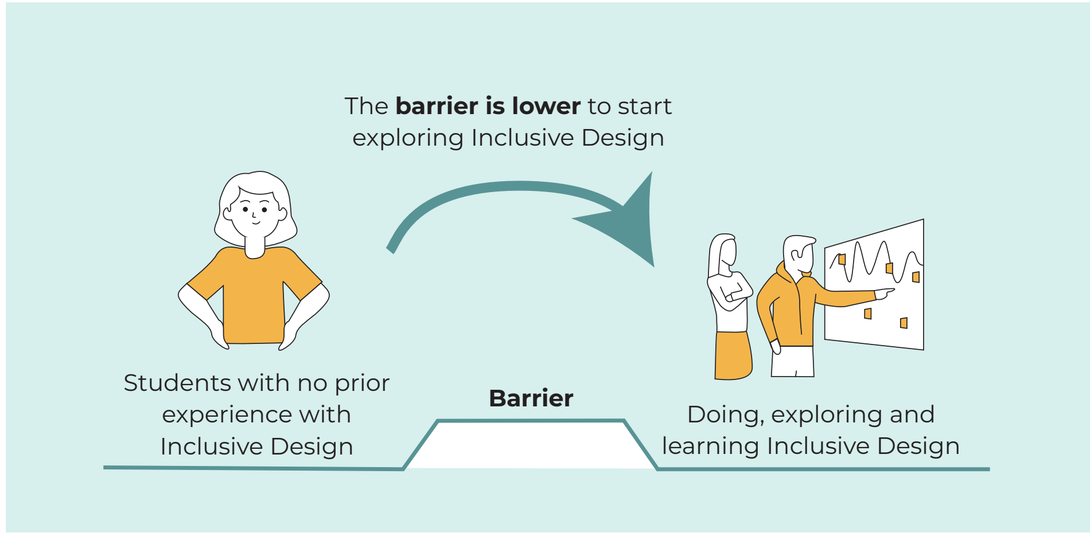


Figure 39: Desired situation

3.2 Design goal

As a result of my research, the opportunity emerged to create a safe learning environment so students will experience a lower barrier to exploring Inclusive Design activities. The design goal is defined as: *"To enable Industrial Design Engineering students who are starting with Inclusive Design at the Delft University of Technology to do and experience Inclusive Design by creating a safe learning environment."*.

To create a safe learning environment, students must feel safe and comfortable exploring in order to improve their Inclusive Design skills. Several factors are essential to creating a safe learning environment (*Figure 40*). First, during my research, a design team *(Appendix J)* indicated that it was important for them to build a connection with the expert to feel more secure during their Inclusive Design process (Chen et al., 2023):

> *"Having an introductory session helped us build a bond with our experts and made us more confident in future sessions."*

The expert stated that this could be achieved by trusting each other and getting a feel of the personalities and interests of the design team (Chen et al., 2023):

> *"The expert explains that it is very helpful to quickly get a feel of our personalities and interests."*

Lastly, an expert indicated that building a connection is important in order to feel comfortable with the design team. Otherwise, you will show socially desirable behaviour rather than genuinely exploring the topic. This is not always taken into account when doing a co-design session:

> *"If you are not comfortable with your team, you will show socially desirable behaviour." (Appendix D)*

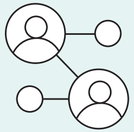
> *"The expert emphasizes how important it is that students dare to ask questions during sessions, and people must dare to answer them. Specifically, the latter is something that has not been taken into context in regards to group dynamics." (Chen et al., 2023)*

Design goal

"To enable Industrial Design Engineering students, starting with Inclusive Design at the Delft University of Technology, to do and experience Inclusive Design by creating a **safe learning environment**."

Key elements of a safe learning environment

Safety
- Avoiding socially desirable behavior
- Encouraging students to ask questions and receive honest answers



Trust and connection
- Design team building a connection
- Trusting each other to foster a sense of security
- Discover everyone's needs
- Discover everyone's norms and values

Comfort
- Get to know each other
- Understanding personalities and interests of the design team
- Dare to explore
- Dare to make mistaks

Figure 40: Design goal

3.3 Design criteria

Seven design criteria emerged during the research phase and the participatory sessions with students and experts throughout the project. These requirements will be used later in the project to assess whether or not the design meets the design goal.

The intervention should provide a safe learning environment for the design team (*Chapter 3.2*):

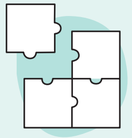
- The design team should feel safe to explore Inclusive Design activities.
- The design team should get to know each other.
- The design team should discover every member's needs.
- The design team should trust each other.
- The design team should quickly build a connection.
- The design team should understand that it is allowed to make mistakes.

The intervention should provide equality within the design team (*Expert insight 6*):

- The team members should all have the same starting point in the project.
- The expert should not be the centre of attention.

The intervention should be accessible and understandable for people who do not have much knowledge of design or inclusion.

The intervention should feel useful/ beneficial for the project so that the design team will see its value.



The intervention should fit into the current Inclusive Design courses.

The intervention should give team members the feeling that there is no time pressure (*Expert perspective insight 7, and student perspective insight 2 and 3*).

4

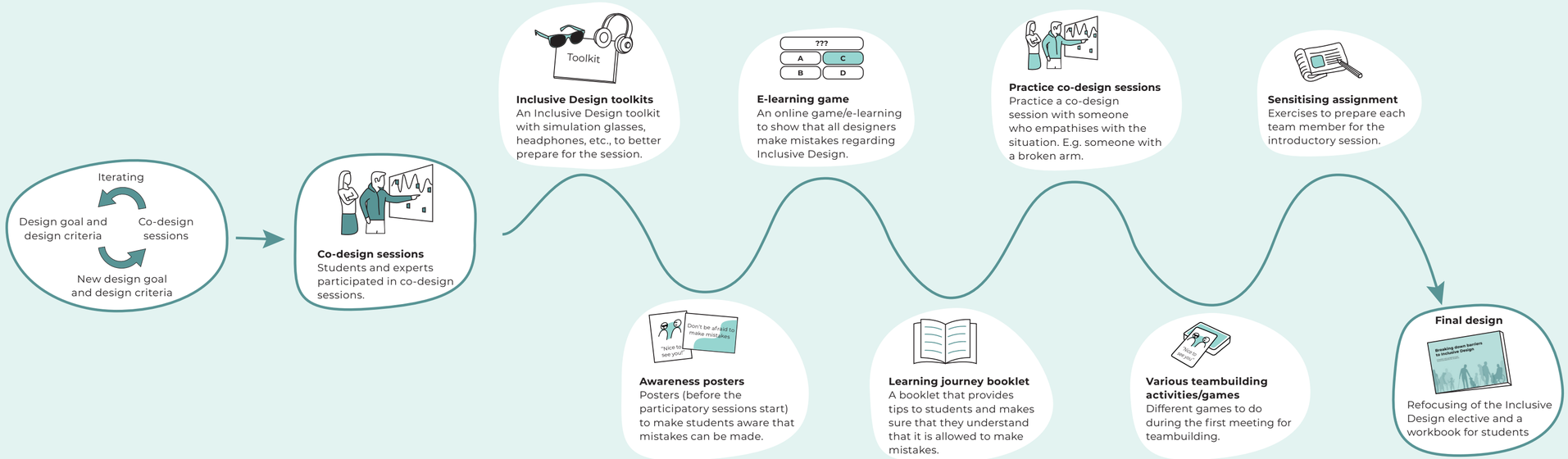
Design

In this chapter, I will present the final design. First, I will briefly discuss the process of this design phase. Then, I will present the final concept with all the findings. Lastly, I will present the final design: A booklet for students.

4.1 Design approach

During the design phase, I conducted participatory sessions with Industrial Design Engineering students. In addition, I involved experts, who are also direct stakeholders, in several co-design sessions. Each session provided new insights, which were taken into account during iterations on the design goal, design criteria, and final design. More information on the co-design sessions can be found in *Appendix J*.

Figure 41 briefly presents my iteration steps to arrive at my final design. In the following chapters, I will discuss some important, relevant decisions and steps I made during the design process and present my final design.



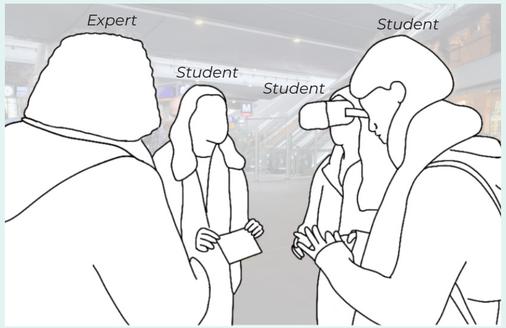
4.2 Refocusing of the course

This project's research and design activities resulted in the co-design of a refocusing of the Master elective Inclusive Design. It intends to break down barriers to explore Inclusive Design (activities) by creating a safe learning environment for students.

An edition of the Inclusive Design elective started during my graduation project, in which interventions throughout the course were made using insights from my thesis. The progress of this course was investigatively followed so new learnings could be extracted from it. This chapter describes which interventions were applied in the elective.

Supported ''experience first'' introductory session
As part of the refocusing of the course, the elective started immediately with a supported ''experience first'' introductory session (*Figure 42*). This aims to build a connection between the design team, consisting of students and experts, to create a safe learning environment. When a safe learning environment is created from the start, the most benefit can be derived from it. In comparison, in previous editions, the course started with only staff and students, and later, the experts were introduced.

Meeting the design team

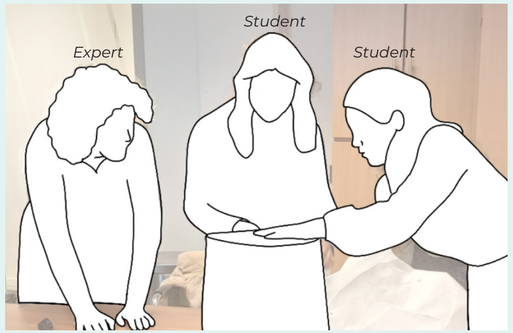


The course staff organised the supported ''experience first'' introductory session. All people involved in the project attended this session; this way, experts will be involved from the start of a project (*Expert insight 1*) and can position themselves as team members or co-designers (*Expert insight 2*).

Activity related to the project case: Experiencing a visual impairment

The course staff set up the session consisting of activities related to the project case; no preparation is required from the students for this session. Even though students indicate they want to feel prepared (*Chapter 3.1*), it does not mean everything has to be prepared. They want to have a sense of comfort and not want to make mistakes. Therefore, the supported ''experience first'' introductory session consisted of activities where no preparation is needed from students, and no mistakes can be made, providing comfort.

Activity related to the project case: Exploring the product



By doing the activities related to the project case, the design team can already gain the first insights. Additionally, the students were able to get to know the experts in an approachable way, creating a safe learning environment.

Figure 42: A supported ''experience first'' introductory session

As I noted during my research, students indicated they want to feel well-prepared for a session. Nevertheless, when students prepare for a session, there is no equality within the design team because the experts do not have the preparation the students have. As one expert said about a co-design session on which she reflected:

> *''I was stressed when I heard we had to devise a painting for an exercise. I immediately started thinking about whether I could come up with something good... It made me feel uncomfortable.''*

Because of this, a design team who did a project related to my thesis (*Appendix J*) did the first session without preparation. They had not created an interview guide. This resulted in their first session with the expert feeling unstructured to them:

> *''Structured preparation is very important for facilitating an effective and fluid session.''*

Therefore, I experimented with a sensitising assignment to let the design team feel prepared, but it did not require the design to prepare together before the first meeting. A sensitising assignment consists of small exercises each team member receives a few days before the first meeting. These assignments can be done in your own environment and time, making people feel more at ease and easier to express their feelings. These assignments encourage the design team to reflect on and express their feelings and experiences before starting the session (Stappers & Sanders, 2012; Sleeswijk Visser et al., 2005). The study of Woertink (2021) also confirmed that participants who had done a sensitising assignment showed more comfort and felt more well-prepared than participants who had not completed a sensitising assignment.

Despite these findings, the students did not use the sensitising assignment during the introductory session (*Appendix N*), which was provided to them beforehand. The activities of the session already allowed for a natural conversation. So even though students indicate they want to feel prepared, they actually want to have a sense of comfort.

Focus on process instead of result

Another intervention that was applied during this edition of the Inclusive Design elective was: putting more emphasis on the process than the result. Students often overlooked the importance of the learning process in previous editions (*Student insight 8*). Therefore, it is explicitly mentioned multiple times during this edition that priority is the process.

When focusing on the process, the value of these steps should be clear according to my research. As a Master's student and an expert, respectively, pointed out during co-design sessions:

> *''Highlight why it [the introduction session] is important because not everyone has patience for doing that.''*

> *''I want that first meeting to be useful. Otherwise, it feels extra and time-consuming. It has to be designed as a method so I know that meeting will be valuable.''*

Therefore, the design of the introductory session ensures that its value and purpose are clearly communicated for the overall process; activities are related to the project case, so first insights can already be gained during this session. In addition, a workbook the students receive at the start of the course also clarifies the purpose of the introductory session. The workbook will be explained in *Chapter 4.3*.

Lastly, the deliverables and assessment have been adjusted to focus more on the process than the result. Students do not have to work towards a final concept but towards learnings/recommendations that can be presented individually.
In addition, a lengthy report is no longer required as a deliverable. Besides reducing workload and allowing more time to focus on the sessions, this is also more accessible for experts with a visual impairment because listening to a lengthy report is exhausting.

Having a say in the course
Besides the interventions applied in this edition of the elective, another essential element in co-designing a course with students is allowing them to express their opinions and influence the course. Giving students a say in the course design allows them to make a meaningful impact in a low-threshold way.

Throughout the elective, I actively engaged with students, closely observing their experiences and perspectives. In addition, a feedback session was facilitated halfway through the course, creating a space for students to provide feedback. This approach enabled adjustments to be made during the course itself, benefiting the students directly as these could be implemented in real-time instead of a future course edition.

By encouraging students to communicate with the course staff, it ensures an environment of openness and transparency, contributing to lowering barriers.

4.3 Workbook

Besides lowering the barrier of Inclusive Design for students by the refocusing of the Inclusive Design elective, I also designed a tangible product that would address students directly to achieve the same goal. I created a workbook for students that bundles all the insights to help lower the barrier to Inclusive Design. The workbook is presented in *Figure 43, 44, and 45.* The whole workbook in larger format can be found in *Appendix M*.

A workbook is educational material that supports learning because it contains summarized simple content and various practices that can help students understand the materials more effectively. It also has a positive influence because it is an additional resource besides the lecturer's explanations. Lastly, when it has a variety of practice exercises, it also results in high(er) effectiveness of students' learning (Ulu Kalin, 2017; Utami, et al., 2020).

Students will receive the workbook when they start with the Inclusive Design elective, and can be used during their whole process. The workbook provides information which will be reflectively and iteratively processed through exercises in the workbook during an Inclusive Design project.

The workbook was designed in the same style as this thesis, as an effort was made in this report to strive for inclusion by, for example, a large font and text supported by images.

The workbook will first introduce Inclusive Design, because during my co-design sessions I came to the conclusion that this term causes many questions to arise. By defining Inclusive Design in an exploratory way, I will not present the definition, but I will guide students in discovering what Inclusive Design means. As described in *Chapter 2.7*, Inclusive Design has a different meaning for each stakeholder, so it is valuable to have a mutual understanding of this.

Then it will be discussed what barriers former Inclusive Design students encountered and how to break down these barriers. By being able to recognize themselves in the information in the workbook, students can feel that they are heard. I also gave all this information to a design team during their Inclusive Design project (*Appendix J*), and they indicated that this had helped them to know where students might encounter problems and how experts experience them.

Figure 43: Render of the workbook

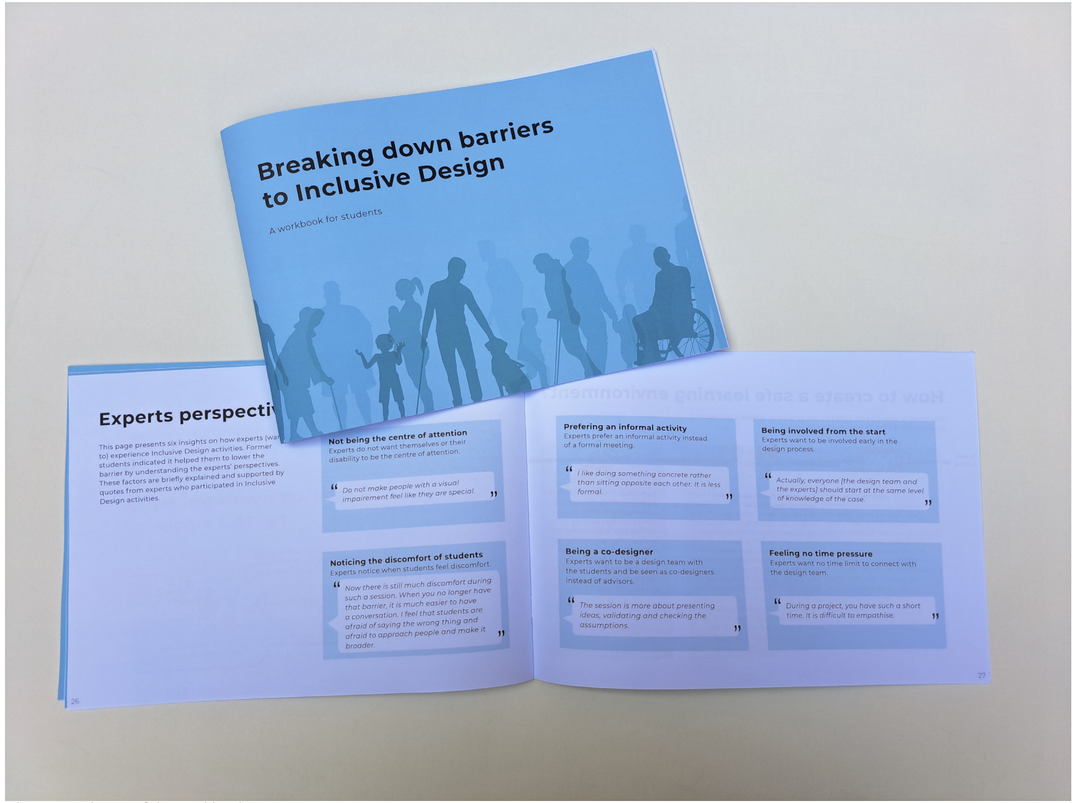


Figure 44: Picture of the workbook

Figure 45: The workbook

5

Evaluation

In this chapter, I will discuss the evaluation of the final design. In the first section, I will describe the evaluation approach. Next, I will present the findings that are derived from the evaluation. Lastly, I will conclude this chapter with an overview of recommendations.

5.1 Evaluation approach

The design must be evaluated to assess if the concept meets the design goal. Both the refocusing of the course and the workbook were evaluated in various methods. The different actions taken can be seen on the right.

How these evaluations were conducted and what questions were asked etc, can be found in *Appendix M*.

Evaluation refocusing of the course

Observing actions of the students and experts during the Inclusive Design elective.

Interviewing three students who participated in the Inclusive Design elective to go more in depth with the evaluation

Interviewing two experts who participated in the Inclusive Design elective to find out how they experienced this new edition of the elective compared to previous editions.

Having a short classical discussion and feedback moment about the course where the interventions have been evaluated.

Evaluation workbook

Interviewing two students who did a project on an Inclusive Design case. I provided them with my research insights; the insights were later available in the workbook.

Evaluating the workbook with two students who participated in the Inclusive Design elective.

Evaluating the workbook with three Master students who did not participate in an Inclusive Design project, because the workbook will be used by students with no prior experience regarding Inclusive Design.

5.2 Evaluation refocusing of the course

An introductory session lowers the barrier to starting the project
Starting the Inclusive Design elective immediately with a supported ‘‘experience first’’ introductory session *(Figure 46)* was received positively by students. It provided a low-threshold way to start Inclusive Design activities. As no preparation was required of students, it allowed students to participate without pressure, expectations, or assumptions. As students stated during the evaluation:

> *‘‘It was really low-key to start the course like this.’’*

> *‘‘It is good that you dive in it first and really experience it. There is no time to prepare, that is the most real experience.’’*

> *‘‘You cannot make mistakes during this activity, so no preparation is needed.’’*

> *‘‘If you give too much information, it can also create pressure for this first meeting.’’*

> *“If you have no preparation, you have no space to set expectations. You cannot think about it beforehand and thus cannot make a false assumption.’’*

On the other hand, a few students expressed the desire for more information, such as the design brief, to orient themselves before the session:

> *“I would have liked more information, like the design brief.’’*

Reflection on the introductory session
By diving into the deep during the introductory session, students indicate the need for more clarity and orientation afterwards:

> *“Dive into it first during the introductory session is good, but you should reflect on it. That was done at the end of the first meeting, but it was too much and too fast. Therefore, still, the orientation of the project is missing.”*

A reflection on the introductory session is necessary to validate the team members’ experiences, but this was not explicitly emphasized during the elective. Despite this, all three design teams conducted reflections during a subsequent session. This indicates students’ need for reflection. However, during these reflections, they did not take the time to discuss the approach, involvement, and team agreements.

Ideally, more time should have been scheduled for the introductory session because there was no time for a reflection at the end of the session. It should be explicitly mentioned that a reflection should occur at the end of the introductory session. When doing this reflection, students should be encouraged to reflect on the approach, involvement, team agreements, etc.

Figure 46: Activity during the introductory session

Involvement of the expert
One of the teachers of the Inclusive Design elective said she noticed more collaboration with the experts compared to the previous course edition. However, experts' involvement varied among the three design teams.

One design team experienced extensive collaboration with the expert throughout the entire process. The expert integrating into the team:

> *"She is neither a group member nor a participant, somewhere in between."*

Students indicated that this was because of the expert's alignment with the target group, both in terms of her visual impairment and age. *Figure 47* shows a picture of the design team during a co-design session, the group dynamics in this picture show that the expert is integrating into the team.

In contrast, another team had limited involvement from their expert, who had a visual impairment but did not match the age criteria of the target group. Furthermore, factors like the expert's holiday and travel distance hindered their active participation:

> *"We have an assignment which is about young people. In that case, he is no longer the expert. Besides, he strongly prefers meeting online because of the travel distance. Also, he was on holiday at some times when we wanted to meet with the design team. Therefore, he could not be very involved."*

The last design team had minimal engagement with their expert, mainly because the students did not officially recognise him as an expert because he has no visual impairment. This created dissatisfaction from the students as they struggled to achieve the desired outcomes without the expertise of an expert with a visual impairment. The expert himself also experienced that he was not involved in the process. He believes that although not all experts need to belong to the target group, the students could have utilised their expertise more effectively.

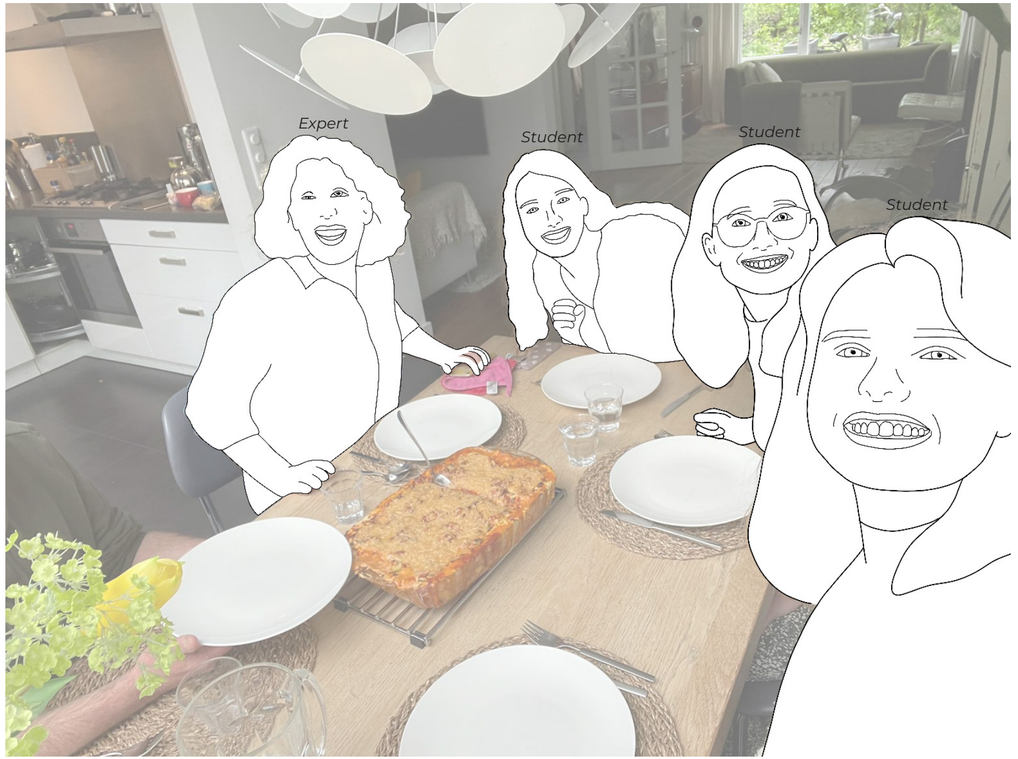


Figure 47: The design team during a co-design session about cooking

Focusing on the process instead of the result
Students acknowledged the focus on the learning process rather than the result because it was mentioned several times:

''I am reassured that the focus is not so much on the result, but my group members don't always realise that.''

But still, students find it challenging because the end goal is vague, making it difficult for them to work towards a final design.

Having an influence on the course
Students appreciated the opportunity to influence the course and the openness of the course staff to listen to them and make adjustments. However, students preferred not to have too much freedom when redesigning a course. This shows, again, that students want to feel supported by valuing guidance, structure, and support from the course staff. As one student said during the classical feedback moment:

''I want more structure instead of asking us what to do.''

Feeling supported, safe, and comforted
The introductory session played a crucial role in fostering a sense of support, safety, and comfort among students, enabling them to overcome their barriers:

''Where at the beginning of the introductory session I was still afraid of making mistakes, that quickly went away, especially in the following sessions I experienced no problems.''

''I learned a lot. For instance, experts like to be heard. I dare to start the conversation more easily. And dare to ask more stupid questions more easily.''

Despite experiencing increased comfort and support, students expressed a continued need for guidance, methods, inspiration, and information, similar to before the interventions. Despite this need, students have not utilised the available online resources, even though they were advised to do so. While there remains a need for more information on co-designing to break down barriers, my evaluation revealed an interesting observation: Students were already engaging in co-design activities during their sessions with experts without consciously recognising it. *Figure 48* and *Figure 49* show the extensive exploration and brainstorming during these sessions.

Students do not realise they are co-designing because the word co-design is already a barrier for students. Uncertainties surrounding the concept of co-design also act as a barrier for students during their Inclusive Design process:

''It was not yet clear to me what co-designing was. In retrospect, I realise that it is less daunting and less big than I initially thought.''

Although the barrier to starting Inclusive Design activities has been lowered since students are engaging in co-design, it is crucial to address their lack of recognition.


Figure 48: Exploring and brainstorm during a participatory session

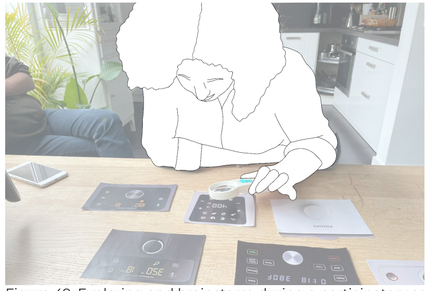


Figure 49: Exploring and brainstorm during a participatory session

5.3 Evaluation workbook

Three students who did not participate in the Inclusive Design elective evaluated the workbook because it is meant for students starting an Inclusive Design project and thus have no experience with Inclusive Design yet. All three students found the content understandable, giving them a good understanding of Inclusive Design.

> *"I now have a good understanding of what Inclusive Design means."*

An Inclusive Design student also expressed interest in this additional information because some information in the workbook was new to him, e.g. permanent, temporal, and situational disability. This shows that the information in the workbook can be valuable for new Inclusive Design students.

Recognising their experiences
Two students who had done an Inclusive Design project where they received insights from my research that eventually were incorporated into the workbook (*Appendix J*) stated in their evaluation that it helped them. They could identify themselves with the experiences from the insights. It allowed them to understand the experts' perspectives and confidently approach activities. Also, it reduced their fear of making mistakes and encountering barriers to Inclusive Design:

> *"Good that it shows what problems you can encounter as a student. That helped with the project."*

> *"If you do it wrong, you learn from it."*

> *"It is nice to understand experts. How it feels to be on the other side."*

I can also confirm this with my observations. The design team tried out a lot during the co-design session, not knowing whether it would work. For example, mind mapping and drawing with the expert. This did not turn out to be the most effective afterwards, but they learnt a lot as a result.

Wanting more examples and information
That students have a need for more information and inspiration has frequently been highlighted in my research. While the workbook fulfilled the need for information and inspiration, two students expressed a desire for more examples and case studies:

> *"What would be a further addition to the workbook for me would be case studies or examples."*

Addressing inclusion in the broader sense
Lastly, a total of four students mentioned that they expected the workbook to cover inclusion in a broader context, including gender, race, financial status, etc. They current workbook and elective scope was limited:

> *"Race, gender, etc. is not addressed in the workbook. Inclusion is much broader than what is currently covered."*

5.4 Conclusion

Whether the barrier to Inclusive Design for students is lower than in previous editions is difficult to compare, as students can not compare their experience with the experiences of former students. However, evaluating the elective and workbook with students allowed me to make some conclusions about how they perceive the barrier. Furthermore, experts and teachers can compare different editions of the elective.

Supported ‘‘experience first’’ introductory session
The supported ‘‘experience first’’ introductory session was well received by the students. It was low-key to start a course this way by ensuring students have no pressure, expectations, and assumptions, as no prior preparation was required. They got to know their expert in an approachable way, and it was easier to keep them involved in the process.

Involvement of the experts
The extent to which the students involved experts during this edition of Inclusive Design varied based on several factors such as expert suitability, availability, and travel distance. When conditions were right, experts were perceived as more than just participants; they became co-designers in the process.

Focusing on the process instead of the result
While most students understood that the focus was on the process rather than the result because it was explicitly mentioned several times, they still found it challenging to shift their focus away from the final product. They want clarity on the final deliverable to guide their work, as it is still vague. Again, this confirms the students’ need to provide information and support. Although it was mentioned several times where to find information, the students did not use it.

The workbook fulfils the students’ need for information by providing understandable content and giving them an understanding of Inclusive Design. It enables students to identify with the insights presented, helping them break their barriers.

Feeling safe and comfort
The introductory session played a crucial role in fostering a sense of comfort, support, and safety among students, enabling them to overcome their barriers. However, despite experiencing increased comfort and support, students still expressed a continued need for guidance, inspiration, and information. While the need for more information on co-design still exists, the evaluation revealed that students were already unconsciously engaging in co-design activities during their sessions with experts. This indicates that the barrier to starting Inclusive Design activities has already been lowered without them realising it.

6

Conclusion

In this chapter, I will discuss the project's results and evaluate if the design goal is met. Next, I will list the recommendations that are made during this project. I will finish this chapter with a personal reflection on the project.

6.1 Conclusion

The project started with the goal of understanding the perspective of Industrial Design Engineering students from the Delft University of Technology involved in Inclusive Design projects. Through research, I could conclude that students experience a barrier to doing Inclusive Design (activities). To lower this barrier, students need to feel safe, comforted, and supported to explore Inclusive Design (activities), and then the barriers (insecurities, uncertainties, moral aspects, time pressure, and high expectations) will be reduced.

The insights from the research phase led to the formulation of the following design goal: To enable Industrial Design Engineering students, starting with Inclusive Design at the Delft University of Technology, to do and experience Inclusive Design by creating a safe learning environment.

Involving students in co-designing education resulted in the co-design of a refocusing of the Master elective Inclusive Design. It intends to break down barriers to exploring Inclusive Design (activities) by organising a supported ‘‘experience first’’ introductory session and focusing on the process instead of the result. Additionally, I designed a workbook for students that bundles all the insights to help lower the barrier to Inclusive Design to address students directly to achieve the same goal.

An evaluation was conducted to determine if the design goal was met. The evaluation showed that the supported “experience first” introductory session fostered a sense of safety and encouraged students to schedule the following sessions. An important contributing factor was the perception of the experts as team members rather than participants. However, the conditions had to be suitable for this group dynamic to occur. Moreover, the first session played an essential role in establishing a connection between the members of the design team. However, despite the students feeling more comfortable asking questions and being less afraid of making mistakes, students still expressed the need for information before starting co-design sessions. Despite the interventions ensuring a safe learning environment, the need for more information remains.

Figure 50 presents a visual summary of this conclusion.

Figure 50: Conclusion

6.2 Recommendations

As a result of the evaluation of the final design a number of opportunities were identified for further research in the future. These recommendations are focused on the next steps that can be taken relating to my design. In addition, there are recommendations listed for possible future steps related to the topic of Inclusive Design that emerged from my project findings. These recommendations are discussed in this chapter.

1

Involving students structurally in co-designing courses
The role I took as designer by involving students in co-designing education is one a teacher and student assistant cannot fulfil. Research further how this role can be made structural to be applied to other courses.

2

Evaluating and testing the workbook
The workbook requires more evaluation and testing. The concept could not be tested in the actual context because the workbook was not finished at the start of the Inclusive Design course.

3

Expanding the workbook's applicability to other courses
Research how to make the workbook more general, allowing usage in other courses.

4

Making booklets for other stakeholders
Besides learnings that have been obtained for students, there were also learnings extracted for experts and teachers. These insights should be further investigated and made available to them.

5

Making the workbook accessible for different learning styles
As students have diverse needs and learning preferences, it is important to research how to meet their individual desires (Ulu Kalin, 2017). Investigate further how the workbook can be made more accessible for different learning styles.

6

Integrating inclusion into the cases and assessments of design projects
Explore further how to integrate inclusion in students' design processes and how to integrate inclusion into the assessment of general design projects (*Appendix I*).

7

Meeting the student's need for information
Further exploration is required to address the recurring phenomenon of students expressing a continuous need for more information. When is this need fulfilled?

8

Exploring the terminology
'Inclusive Design' and 'co-designing' are terms that hold different meanings for everyone and often lead to uncertainty. Explore further how this barrier can be lowered.

6.3 Reflecting on my project

Inclusive Design is a topic that fascinated me even before I started my thesis. During my thesis, I have, of course, delved deeper and deeper into this topic. I took every opportunity to engage with and talk about this topic, giving me many new insights. I will take this new inclusive mindset into my future career and hopefully can inspire others with this. Apart from this, I have other learnings that I will take away from this project.

Stakeholder involvement resulted in a new direction
During this journey, my project went in a completely different direction than I had initially planned. This was due to the involvement of stakeholders in participatory sessions. This way, I deviated from my initial design brief; although this was sometimes scary, having stakeholders' involvement was very valuable to come to a final design.

Full responsibility
This project was the first time during my study career that I had complete autonomy and responsibility over my process. Whereas in previous projects, I always worked in a structured and ordered manner, during this project, I had more difficulty with this. Iterations were frequent, making my approach less structured. Therefore, I did not manage to keep to my schedule. In addition, I wanted to investigate every lead in the project, but there was no time for that, and choices had to be made, which I often found difficult. I went into too much breadth instead of depth sometimes.

Learned to dig deeper
I sometimes found it challenging to go into depth. Several times during my project, students indicated their needs, but they actually had other desires, and I had to dig deep to get this underlying layer. For example, students indicated several times that they want to be better prepared for the Inclusive Design activities. It took me a while to understand their actual need is to experience safety as they look ahead to the session, and this way, reducing the barriers: insecurities, uncertainties, moral aspects, time pressure, and high expectations.

Follow your gut feeling instead of following a more cognitive approach
I often take a more cognitive approach, as I want to be able to argue my motives. Therefore, I often have more difficulty following my emotions and feelings. However, I dared to follow my gut feeling more and more throughout the project. For example, I did not feel good about my first concepts and continued designing other solutions. This was the right choice because I can now finish my project with a positive feeling.

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Creating a safe learning environment for
Industrial Design Engineering students

Master thesis by Dana de Jong