Pedalling towards sustainable urban mobility

Design of an interactive exhibit to inspire visitor's attitude transformation

Master thesis | Zola Zwerver
Design for Interaction

TU Delft

museon omniversum
WE ARE ONE PLANET

Colophon

Pedalling towards sustainable urban mobility
Design of an interactive exhibit to inspire
visitor's attitude transformation

Master thesis
by Zola Zwerver
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With the help of
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Figure 1: “I think, therefore I cycle” protest poster Cycling bond (Archive Fietsersbond Amsterdam, April 1980)

Preface

Dear reader,

I am happy and above all proud to share my graduation thesis with you. This project marks the end of my time in Delft, the end of my years as an industrial design engineering student. In 2017, as a first-year student, I never envisioned where these six years would take me. In this thesis, I combined two passions I have developed over the past years: people and interactive technology.

Looking back at the last six months, I am amazed by the large number of people that inspired, guided and challenged me throughout this project. Therefore, before we get into the content of this report, I would like to take a brief moment to thank them.

During this thesis, I got the chance to work with Museon-Omniversum. I appreciate how much responsibility they have given to me as a graduate intern. You trusted me to design and develop an actual exhibit for the new mobility zone, something I never could have imagined starting this journey. **Hub**, thank you for providing me with this challenge. It was an inspiring journey to get to know you and your work at the museum. **Diederik** and **Willemien**, thank you for your inspiring and refreshing insights on the content and design of the exhibit. Your ideas and input were truly valuable. **Oscar**, **Maarten** and **Bashim** thank you for all the help building the actual installation.

Secondly, a thank you to my TU Delft supervisors for their support and guidance. **Arnold**, at the beginning of this quest, you helped me connect with different museums, to devise the right project. Thanks for introducing me to the world of transformative experiences and inspiring me with the knowledge and dedication of the MuseumFutures Lab. **Aadjan**, you took me on and showed me the world of interactive technologies. Thank you for asking difficult questions at the right time to let me think twice. You truly inspired me with your passion and dedication to this field.

Thanks to my parents, friends and housemates for being there to comfort, challenge or laugh at me when I got home with yet another secondhand TV screen to dismantle. You genuinely helped me to enjoy every second of this project!

Finally, thanks to you, the reader, for stopping by and having the curiosity to delve into my work for Museon-Omniversum.

Enjoy the read!

Zola

Figure 2: Overview of the designed exhibit: 'pedalling towards sustainable urban mobility'

Abstract

Environmentalists recently attracted a lot of international attention with controversial actions, including throwing food against famous paintings in art museums. Which is worth more, art or life? The fragility of art is similar to the fragility of the earth itself. But as quickly as the bunch of climate activists appeared in all the newspapers, they also disappeared from the public's mind.

The general public has become accustomed to yet another climate stunt. Some form of awareness is there, but acting on it, many people omit. Before even a slight adjustment of behaviour, our fast-paced society is already distracted by the next new soap opera, a new car or pondering about the impact of our next plane trip.

Museums recognise their changing role in this society. Museums should no longer just entertain and amaze, they should from time to time be able to chafe, awaken us and urge us to change our behaviour. Topics such as sustainability, climate change and the energy transition lend themselves well to this. The urge to change a behaviour can be caused by a transformative learning experience. For example, experiencing the real-life effects of climate change in rural countries can completely change a person's relationship with their self-world, thereby producing lasting changes in attitude and behaviour. Museon-Omniversum, a science museum, would like to research such a transformative learning experience for a new exhibit in a mobility zone of their current exhibition One Planet NOW!.

Several research activities have been done to understand transformative experiences and place them in a museum context. A literature review, expert interviews, museum visits, and observations resulted in a set of 12 guide cards that can support the design of a transformative museum exhibit.

Following from research, cycling as a sustainable mode of transport was chosen as an exhibit topic. Besides, the findings resulted in a transformative museum experience journey, which in turn inspired a specified design goal.

Design a playful and interactive exhibit that…

1. Raises awareness for a personal sustainable mobility conflict
2. Stimulates self-reflection about the influence of bike usage on urban design
3. Inspires the visitor to feel enabled to be the change-agent for the future bicycle rich city
4. Plant a seed of hope for a future planet where more bikes are used

… to be cooperatively experienced by parents and their children (6-10 years old) for a sustainable mobility exhibition zone at Museon-Omniversum.

Subsequently, various ideas were generated in brainstorming and creative sessions and translated into physical prototypes. Evaluation tests with these prototypes gave insights into the experiences and effects of the developed ideas. These insights resulted in the development of the final exhibit: 'pedalling towards sustainable urban mobility'. An exhibit which aims to let visitors explore and reflect on the mode of transport they travel with throughout the city.

The interactive exhibit is a hands-on experience that introduces visitors to a city where bikes are the main mode of transport. Visitors can magically discover a hopeful future vision of a bicycle city, where an intersection has been transformed into a version without cars. They are encouraged to explore what is going on in this world. Would they want to live in a city like this? The connecting part of the exhibition deals with the influence of transport on urban planning. Visitors will have the opportunity to reflect on how transport choices affect the construction of a city.

Overall the exhibit successfully aims to inspire a sustainable urban mobility transformation. However, further alterations are needed to improve the design and test the impact over a longer period. Short-term design recommendations for improving the exhibit to be fully stand-alone and operational have been given. In addition, suggestions for long-term research and design activities have been made.

Reader's guide

The structure and approach of this thesis

During this project, inspiration is taken from the reflective transformative design process from Hummels & Frens (2009), see figure 3. This model consists of five activities that take place within a societal setting but without a specific order. Dependent on the cycle within this project, different starting points and order of activities are used. The central activity of this design approach is ideating, integrating and realising interaction solutions between the design and the target audience in the context of use; the central circle. In this continuing process, gained insights are transformed into design opportunities. Where after these insights are physicalised and result in prototypes and solutions. Moreover, every time there is a switch of activities an opportunity for reflection occurs, indicated by the lines connecting each activity or phase. Hummel & Frens (2009) thus stimulate frequent changes from one activity to another, ensuring a reflective transformative approach.

In this thesis, you will go through 6 different cycles (figure 3), each inspired by the reflective transformative approach (Hummels & Frens, 2009). The analysis, results and reflections from each cycle will provide ground for subsequent cycles.

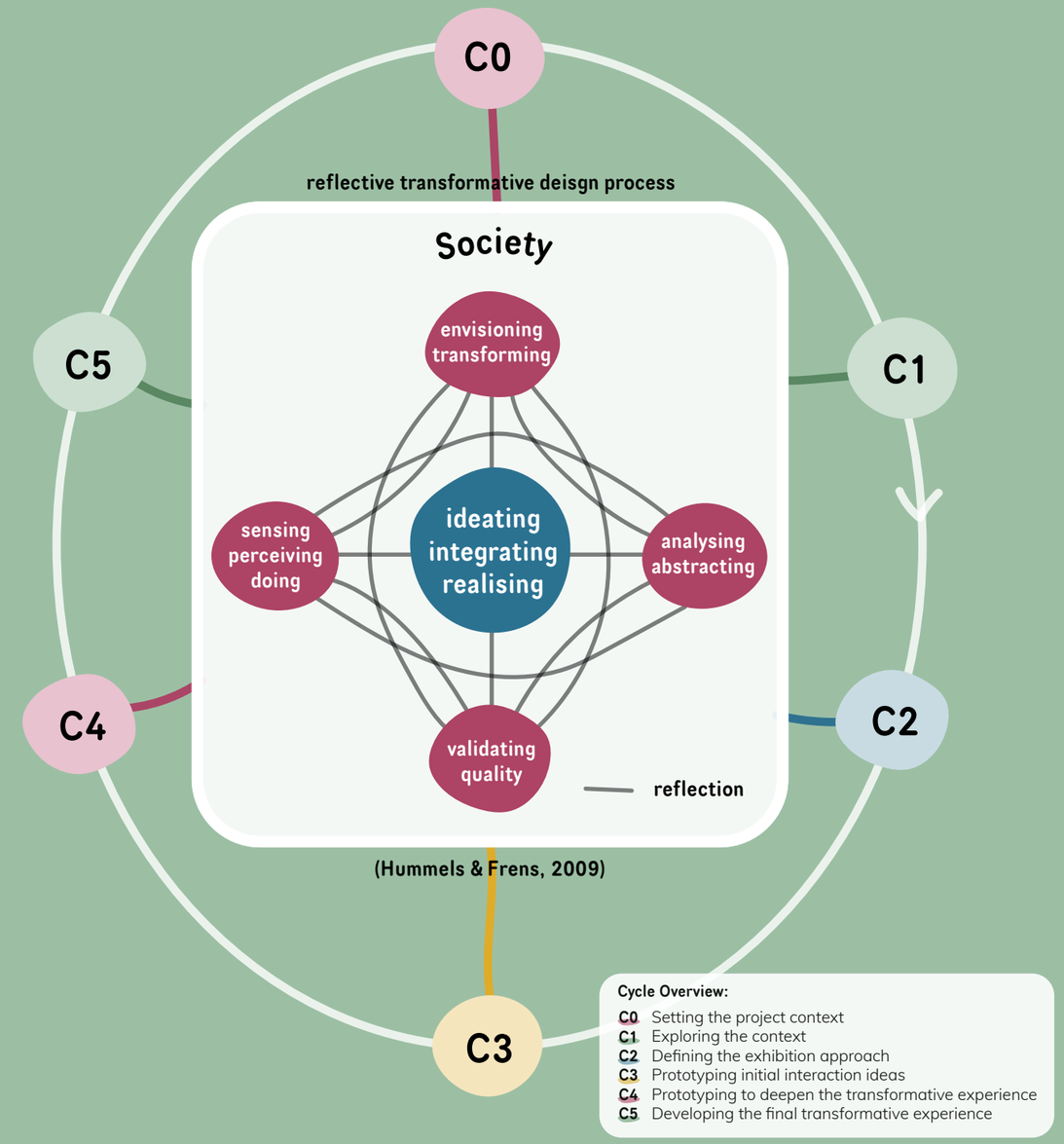

Figure 3: Project approach inspired by Hummel & Frens (2009) adapted by Zwerver (2023)

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Setting the project context

Exploring the initial brief and boundaries to understand the background of the assignment.

Figure 4: exterior of Museon-Omniversum

Introduction

Introduction to the assignment

Museon-Omniversum is an interactive family museum that motivates its visitors to take an active attitude as global citizens. Their exhibitions inspire and enthuse us to treat our planet with respect and thereby improve it. They strive for an adventurous search for solutions to make the world a better place. Museon-Omniversum attracts a wide audience. and have a dedication to lifelong learning. Whatever your age is, there is always something to see, experience or learn from the exhibitions (Museon-Omniversum, 2020).

Museums are faced with their changing role in society. A museum is no longer an organisation that collects, preserves and displays cultural heritage at the service of society. According to the International Council of Museums (ICOM), museums are *"democratising, inclusive and polyphonic spaces for critical dialogue about the past and the future"* (ICOM, 2019). Topics such as sustainability, climate change, diversity and the energy transition are prominent. Visiting a museum is no longer just fun and relaxing, a museum can play a role in addressing a social cause (ICOM, 2019).

A transformative experience can completely change a person's relationship with their self-world. The individual builds a new worldview, which supports a lasting change in their attitudes and actions. An effect of a transformative experience can thus produce lasting changes in self-perception and behaviour (Gaggioli, 2016). Such a transformative experience can therefore be an interesting concept for a museum to explore.

Currently, on the ground floor of Museon-Omniversum, the 'One Planet NOW!' exhibition is hosted. It consists of five temporary exhibition zones covering topics we deal with every day. For example, food & drinks or fashion & clothing. Zones will be renewed biannually. Currently, a future mobility zone is being developed (Museon-Omniversum, 2023).

The form of this new mobility exhibition zone in One Planet NOW! has not yet been devised. There lies a great opportunity to explore how a transformative experience for this sustainable mobility exhibition zone can be created.

Initial direction

A transformation of attitudes and actions is needed for a more sustainable life on our planet. This creates an opportunity that museums, such as Museon-Omniversum, can make use of. An exhibit that raises awareness is no longer enough, research has to be done about how an exhibit could let visitors explore behavioural change. In this thesis, it is researched how an exhibition can lead to more than just awareness, it is explored how an exhibition can be transformative. The focus mainly lies on the second step of the transformational process adapted from Bergevin (2018) and Kitchenham (2008), self-reflection (figure 5). However, the first and third steps will also be touched upon in this thesis. Further elaboration on the initial project direction is presented in the initial project brief in Appendix A.

To create an initial focus, a target group is specified. The contact between two generations while visiting the exhibit is used: the interaction between parents and their children (6-10 years old) while visiting Museon-Omniversum.

Design goal

"Design a **playful** and **interactive** exhibit that stimulates **self-reflection** and initiate explorative steps towards (everyday life) transformation for **parents and their children** (6-10 years old) for a sustainable mobility exhibition zone at Museon-Omniversum."

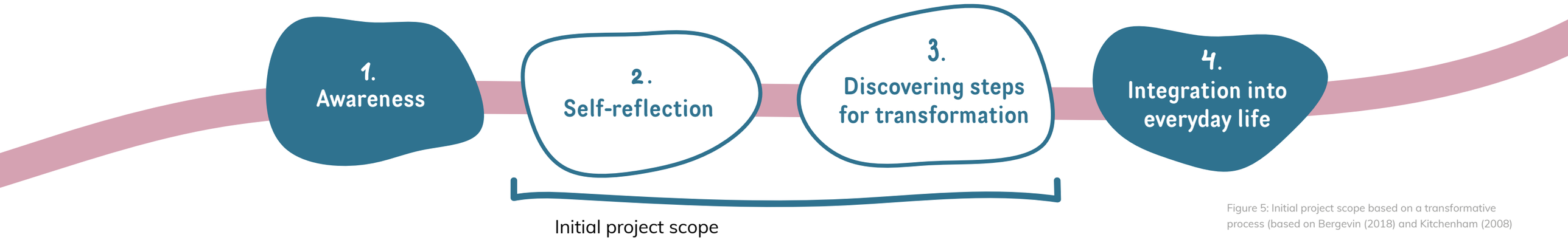


Figure 5: Initial project scope based on a transformative process (based on Bergevin (2018) and Kitchenham (2008)

C0.2 Museon-Omniversum

An introduction to the museum

Museon-Omniversum is all about the earth, people and a sustainable future. The current programming throughout the entire museum is called ‘One Planet’. This programming inspires visitors to work towards a liveable planet for all. Only recently, in January 2022, Museon-Omniversum was established. It is a merger of Museon, founded in 1904, and the adjacent Omniversum. Museon is a science museum in The Hague with geology, biology, history, archaeology, physics, engineering and ethnology collections. The Omniversum is a large-screen movie theatre in which the screen is positioned as a hemisphere around the audience, providing a more immersive film experience than a flat screen (Museon-Omniversum, 2023). The merger of the neighbouring museums was not motivated by financial need. The organisations were keen to combine their tasks so that more money and time would be left for presentation and collection management, among other things (Hub Kockelkorn, Museon-Omniversum, personal communication, 19 January 2023).

Mission and Vision

Museon-Omniversum is an up-to-date and interactive museum for science and culture with an extraordinary educational collection. Museon-Omniversum’s goal is to motivate its visitors to take an active attitude as global citizens. The museum inspires new generations to work towards a liveable planet for all. Its range of exhibitions inspires and enthuses us to treat our planet with respect and thereby improve it. The museum environment appeals to all the senses and shows how fascinating the world is. Both individual visitors and school classes come into contact with major global themes, such as the United Nations’ sustainable development goals. Museon-Omniversum aims to make a visit an adventure, to playfully search for solutions to create a more sustainable world. This mission and vision are accompanied by four values (figure 6): learning, curiosity, inclusiveness and creativity (Museon-Omniversum, 2020).

A safe learning environment is offered for global issues. The focus is on stimulating discovery together and learning together. For that purpose, a unique educational collection is used.

Curiosity is considered a starting point for research and learning. Visitors are offered an environment that challenges discovery, investigation and learning. The curiosity of others is used to define and fill programmes.

Creativity is seen as a prerequisite for finding solutions. Creative thinking is encouraged. Traditional but also innovative forms are used in exhibitions and educational activities.

Museon-Omniversum connects with all communities. Visitors are a reflection of Dutch society. The museum is an open, multi-voiced institution.

Figure 6: Four values of Museon-Omniversum

Target Audience

Museon-Omniversum attracts a wide audience; it is a family museum. The museum emphasizes its dedication to lifelong learning, their programming endeavours to provide enjoyment not just for children aged six to fourteen, but also for their parents and grandparents. This inclusive approach aims to attract both seasoned and new museum visitors, fostering a dynamic and engaging experience for all. There is always something to see, experience or learn in Museon-Omniversum’s exhibitions. As a child, you visit with your class or parents, and as an adult, you can visit the museum individually or together with your children.

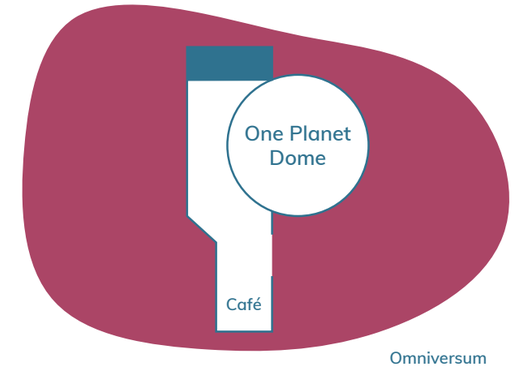
Exhibitions

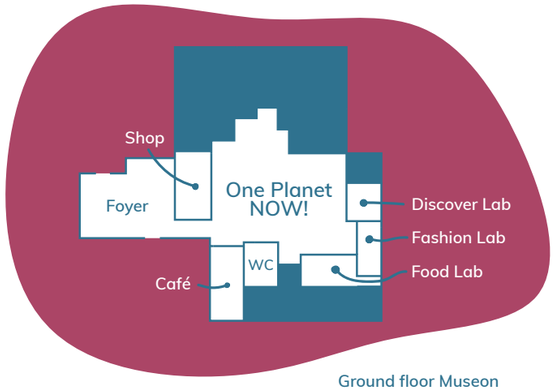
Museon-Omniversum offers most of its programming as One Planet. The One Planet programming reflects exactly its mission: to inspire new generations to work towards a liveable planet for all. One Planet consists of three sections and, in addition, a number of themed rooms can be found. Figure 7 presents the floor plan of the museum.

One Planet Dome: One Planet Dome is a big-screen movie theatre, where you marvel at the beauty of our planet. You watch breath taking documentary-style films about nature, culture and science on a huge dome-shaped screen.

One Planet Expo: At the permanent interactive One Planet Expo exhibition, you will learn all about the United Nations (UN) 17 Sustainable Development Goals (SDGs). The UN wants to achieve these goals by 2030 to make the earth a better place. Here, you will learn how you can do your bit on each SDG by thinking about different propositions.

One Planet NOW!: One Planet NOW! is a temporary exhibition on the ground floor. It is a dynamic meeting place and a hotspot for everyone who cherishes our earth. It consists of 5 temporary exhibitions covering topics we deal with every day.





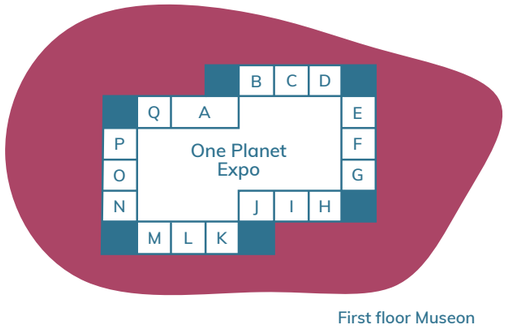


Figure 7: Floor plan Museon-Omnniversum

Figure 8: One Planet Dome

The people behind Museon-Omniversum

A small yet dedicated team drives the range of exhibitions showcased in Museon-Omniversum. Employees specialized in collection, education, and programming collaborate, occasionally with third parties, to develop exhibitions that align with the museum's vision. A team of three technicians serves as the executive force, the workshop is their base to develop the necessary components for the exhibitions and ensure their installation in the museum space. They are also responsible for the maintenance and updates of the current 5000m^2 of interactive exhibitions.

C0.3 One Planet NOW!

An introduction to the target exhibition

One Planet NOW! is a collection of zones, each housing its own exhibitis and thematic focus. The exhibition debuted in February 2022 and was originally scheduled for two years. However, the museum has devised a biannual rotation strategy to continually refresh and maintain the exhibition's relevance for years to come. In each zone, designers, researchers and entrepreneurs showcase their creative initiatives by introducing visitors to phenomena and intelligent solutions that shape the future (Hub Kockelkorn, Museon-Omniversum, personal communication, 19 January 2023).

Pillars

One Planet NOW! is built upon four pillars, represented in figure 11. Through integrating *curiosity, together, creativity,* and *hope*, the museum strives to make a profound impact on the worldview of its visitors (Museon-Omniversum, 2023).

Figure 9: One Planet NOW! - People & Nature zone

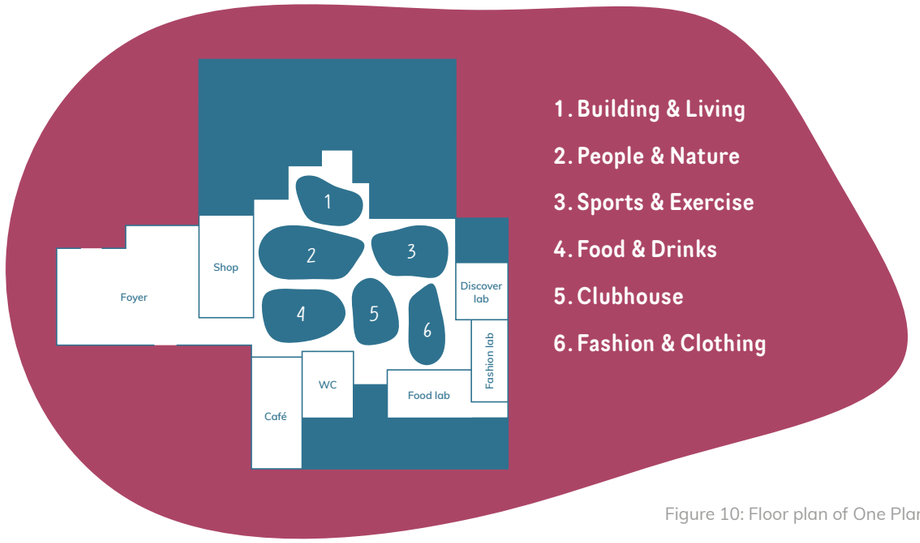
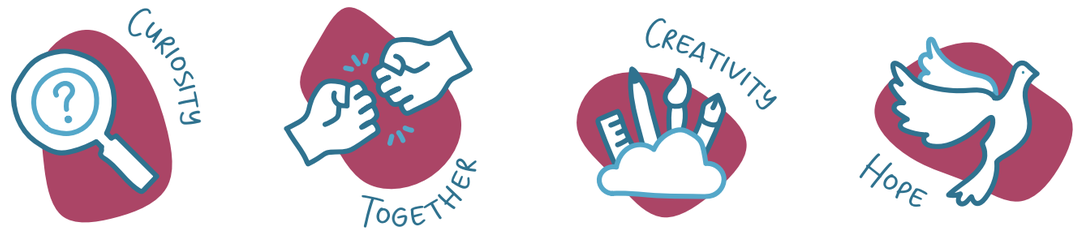


Figure 10: Floor plan of One Planet NOW!

Set-up

The architecture of the Museon-Omniversum building does not lend itself well to a predetermined visitor route and flow. As a result, One Planet NOW! adopts a playful arrangement, allowing visitors to access any zone at any time during their visit, without a set route. The clubhouse, positioned at the center, serves as the vibrant core of One Planet NOW! and serves as a hub for activities. From there, visitors can venture into any of the zones to delve into specific themes. Additionally, creative workshops related to these themes are offered, such as learning to make fresh mint tea from urine or participating in a cooking workshop that uses vegetables typically overlooked by supermarkets. The current zones are displayed on the floor plan in figure 10.



Everyone is a pioneer, engaging in a collective exploration of solutions through wonder and discovery.

Sharing questions, stories, and knowledge becomes a catalyst for mutual inspiration among participants.

Prepare to be pleasantly surprised by the emergence of new creative initiatives, innovations, and insightful perspectives.

Rather than focusing solely on problems, active involvement in hopeful initiatives and potential solutions is encouraged, fostering a collaborative approach.

Figure 11: Pillars of One Planet NOW! (Museon-Omniversum, 2022)

Figure 12: One Planet NOW! - Fashion & Clothing zone

C0.4 Transformative Experiences

An introdcution to transformative experiences

A transformative experience can completely change a person's relationship with their self-world. The individual builds a new worldview; this perspective supports a lasting change in this individual's attitudes and actions (Gaggioli, 2016). An effect of a transformative experience can thus produce lasting changes in self-image and behaviour.

In the field of education, a transformative experience has been manifested as a transformative learning experience. This process, as proposed by Mezirow (2003), is accomplished through the presentation of dilemmas and subsequent self-reflection. By exposing individuals to "disorienting dilemmas" (Mezirow, 1997), established cognitive structures are challenged, thereby prompting self-reflection. An example of a transformative learning experience concerning sustainability has been depicted in figure 13. The duration of a transformative learning experience is not predetermined, as it varies from case to case. While some individuals may transform after a single experience, others may require months or even years. Moreover, the process is non-linear and susceptible to setbacks characterized by periods of regression (Bergevin, 2018).

The need for transformative experiences

Today, a growing number of social issues are being addressed and recognised around the world. From global health to inequality and from poverty to sustainability. Just some of the many topics in which there are increasing societal challenges. Developments in these areas call for a social transition, the world and its inhabitants must change something, on a human level, but also on a global level.

But what is needed for a societal transition? A transition often requires a radical change in people's lifestyle, motivation, attitude, behaviour and values. These people need to completely renew their worldview and thus learn to build a new perspective. In other words, a person needs to transformatively learn new perspectives and behaviours (Mezirow, 1978).

Transformative experiences in museums

Museums have a changing role in society (ICOM, 2019). There is room for critical dialogue, which many museums are trying to respond to. There is an attempt to play a role in raising awareness and knowledge about social issues (Bergevin, 2019). In many museums, this is mainly about how can we teach the visitor something in a fun and exciting way. However, there is not much to be found about how to design exhibitions that encourage visitors to transformationally learn. The answer to the question, of how to design a transformative museum experience, therefore, remains unanswered. The research and design in this thesis aim to shed light on this.

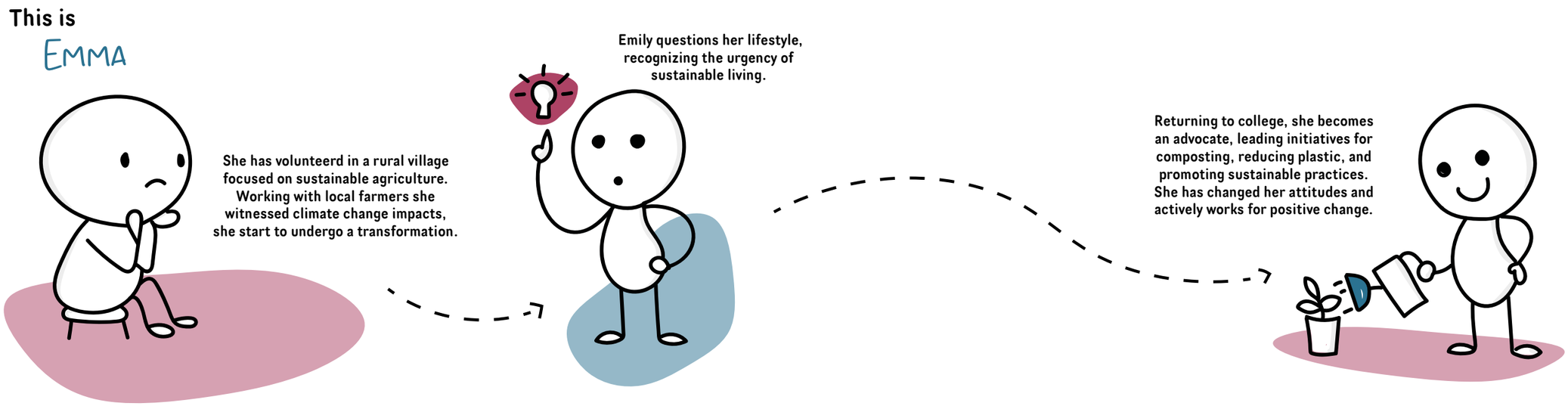


Figure 13: Example of a transformative experience

cycle 1

Exploring the context

In this cycle, research is conducted to identify how a transformative museum experience could be designed for Museon-Omniversum visitors. Both theoretical insights and deepened insights are gained through literature research, observations, interviews and museum visits. The key findings have resulted in the development of a set of design guide cards, which will be a foundation for upcoming cycles.

Figure 14: Workshop in Museon-Omniversum's Future Food Lab

C1.1 Establishing research areas

The identification and delineation of the research domains

This cycle is aimed at gathering information about the problem and the context. An attempt is made to get to the core of the problem, principles and phenomena. Through the main research question, research areas are identified. Four research directions emerged, each with its research question (figure 15). These four research questions each have sub-questions that are presented in appendix B. With all these questions together, an attempt is made to get an overall and holistic picture of the context.

Research activities

To find out the answers to the research questions, several activities were accomplished. Figure 15 shows the identification of research questions and which methods were used for which research area.

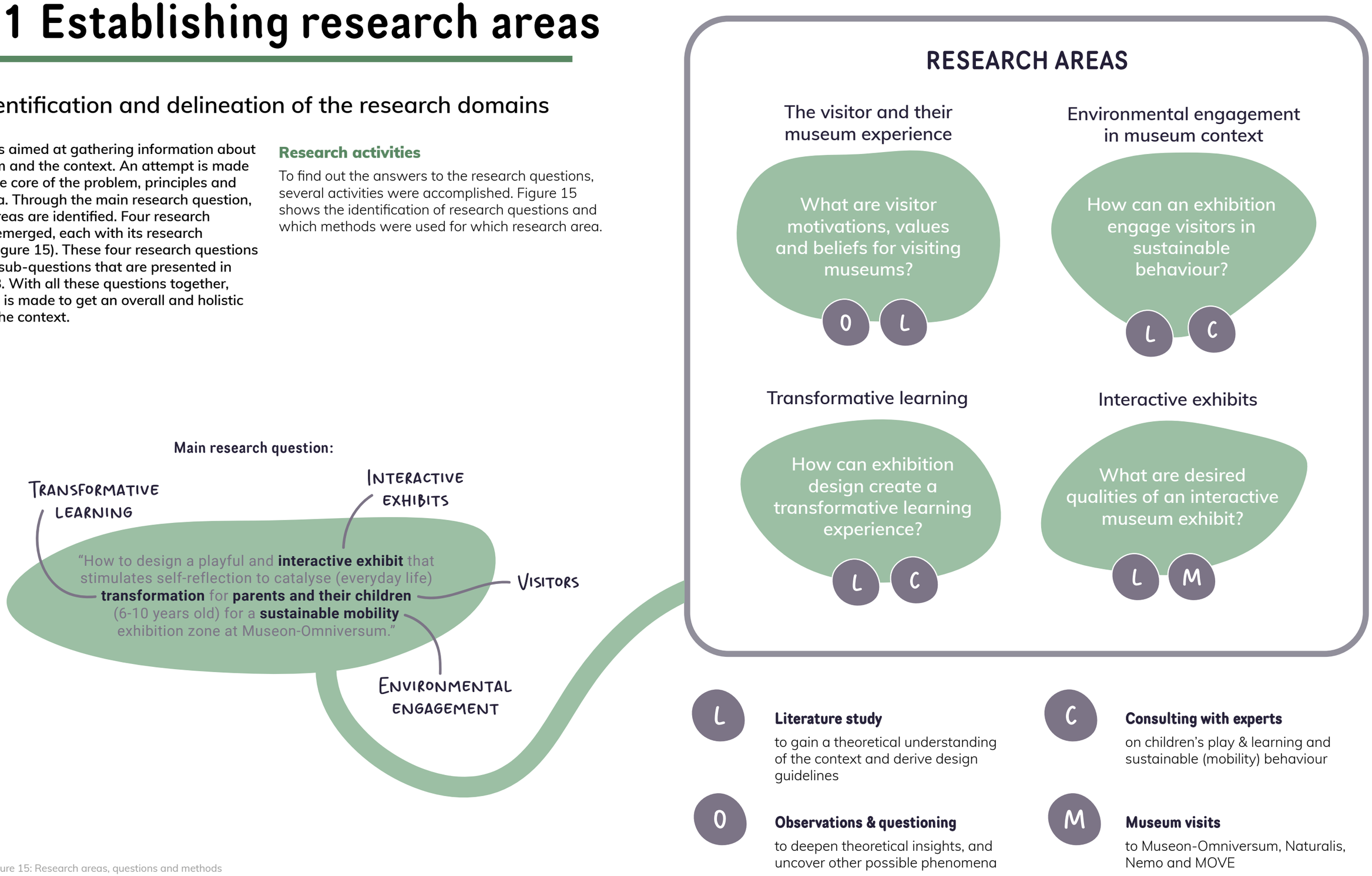


Figure 15: Research areas, questions and methods

C1.2 Discovering the unknown

Describing the research activities and outcomes

The following sub chapters document on the research activities that are performed.

Figure 16: Exhibit on inclusivity at Museon-Omniversum's One Planet expo

C1.2.1 The visitor and their museum experience

What are visitor motivations, values and beliefs for visiting a museum?

Museon-Omniversum would like to use its collection and knowledge to show as many people as possible how to treat our planet and everyone living on it with respect and love. To achieve this, exhibitions will have to be attractive, educational and meaningful for their visitors. To find out what visitors find attractive, educational or meaningful, it is essential to find out who these visitors are.

Today, parents place much emphasis on the importance of ''quality time'' with the family (Snyder, 2007). The word 'quality time' originates from the Victorian era. At that time, the phenomenon arose that families had less and less time together and therefore increasingly valued the time they did get to spend together (Gillis, 1996). Today, this time can be filled with a frenzy of leisure activities. One of the activities that can be chosen to do is visiting a museum.

But what makes a family choose a museum? Specifically, why do these visitors choose Museon-Omniversum? With what intention do they enter the exhibitions, and what role does a visitor assume? In this chapter, the visitor and their museum experience answer these questions.

Museum motives

Reasons for people to visit a museum differ. In 1997, Moussouri extensively researched and interviewed hundreds of visitors at museums in England and devised six different general categories (figure 17). These categories each fulfil a function in a visitor's socio-cultural life.

Upon doing some general observations and questioning of Museon-Omniversum visitors it appears that it is rarely the case that a visitor falls into only one of the categories. Visitors almost always have a combination of factors as to why they can be found in the museum. Education and entertainment are the reasons mentioned by most interviewees.

> "We are here for a fun day out, sometimes we choose a fun outing and sometimes an educational outing. Today is such an educational outing."

translated, personal communication, 18 January 2023

More importantly, it turns out that visitor motivations are directly related to what visitors learn during a museum visit. It becomes clear that visitors who visit a museum with an educational motivation learn different things from visitors who came to the museum with purely entertainment motivations (Falk, Moussouri & Coulson, 1998). Both groups do in fact learn something, just different things.

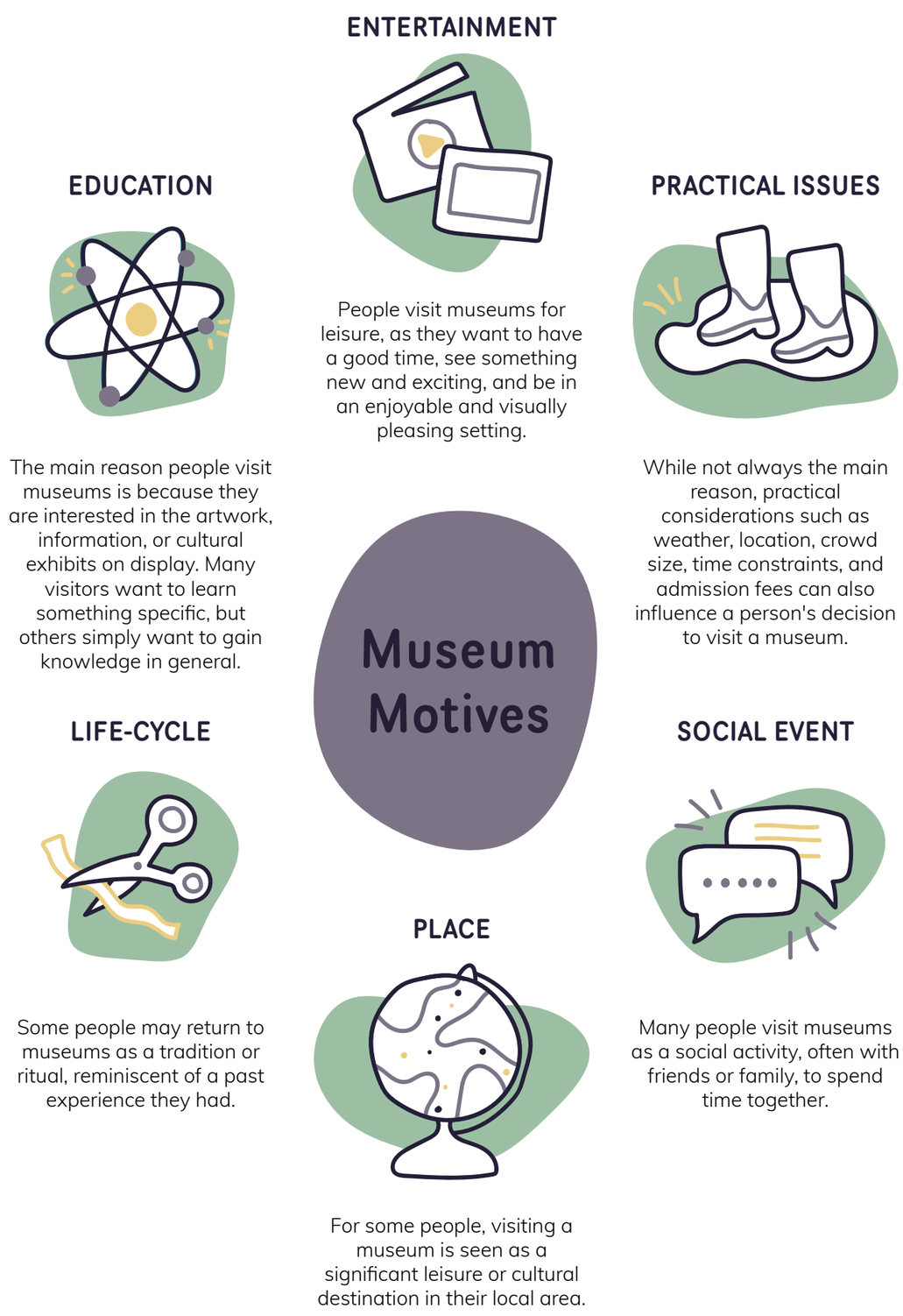


Figure 17: Reasons to visit a museum (Moussouri, 1997)

Identity roles

Visitors, perhaps unconsciously, do not enter an exhibition blank. There is always a personal situation to consider. Every visitor has well-formed interests, knowledge, opinions and experiences gained in other museums. These entry conditions are generically referred to as the visitor's "personal context" (Falk & Dierking, 1992).

Literature also mentions that a person's motivations, personal context and degree of learning relate to what kind of 'identity' this visitor adopts in a museum. This identity can be seen as a certain role you assume during the visit (table 1). This identity is specific to one visit and one day and may therefore be different on the next museum visit (Falk, 2006).

The Explorers: These individuals said they visited because of curiosity and a general interest in discovering more about the subject or the content of the institution.	**"learners" or "discoverers"**
The Facilitators: These individuals said they were visiting in order to satisfy the needs and desires of someone they cared about —in particular their children.	**"parents"**
The Professionals: These individuals said they possessed a strong knowledge and interest in the content of the institution, and their primary motivation was not general but more specific.	**"specialists" or "hobbyists"**
The Experience Seekers: These individuals, often tourists, were motivated to visit primarily in order to "collect" an experience, so that they could say they've "been there, done that."	**"the tourist"**
The Spiritual Pilgrims: These individuals visited in order to reflect, rejuvenate, or generally just bask in the wonder of the place.	**"the holistic"**

Table 1: Identity roles (Falk, 2006)

The research on which these identity roles are based took place at the California Science Center (CSC), based in Los Angeles. The museum is the largest hands-on science museum on the west coast of the United States. It offers a range of interactive exhibitions on different science-related themes, mostly targeted at children (California Science Center, n.d.).

The distribution of California Science Center visitors across the different roles was not equal. The vast majority of surveyed visitors (87%) fell into the first two categories or a combination thereof (Falk, 2006).

1. They visited the CSC primarily to satisfy their explorer identity.
2. They visited based on their desire to satisfy their facilitator identity (primarily in the role of a parent).
3. They visited for some combination of these two reasons.

Since the target audience and types of exhibitions are fairly similar we can assume that most of the visitors of the California Science Center adopt the same identity role as the Museon-Omniversum visitors. On-site observations and interviews at Museon-Omniversum's One Planet NOW! confirm this presumption. A lot of children were identified as explorers. While (grand)parents were either identified as facilitators or a combination of facilitator and explorer. It appeared that the content of an interactive installation and the age of the children greatly influenced the role a (grand)parent took upon themselves.

"

"I think we should do something with this right? Should we do something with this Joris? Just press the yellow button!"

traslated, personal communication, 19 January 2023

Besides, their role was fluid throughout the visit. For example, in the sports & exercise zone, parents more often stayed on the side watching their playing child. While at interactive tables with propositions and questions, parents often explored with their children. When parents were asked why they chose to distance themselves more in some activities, they said it was because of the content. They did not feel comfortable or young enough to participate in building, playing or exercising. While some other activities they did participate in were also more educational for them. Besides, the parents who did participate in the play and build activities did so mainly because their children were still very young (below 5 years old).

"

"A play corner like this is more of a childish thing, where those boys can have a good rant."

translated, personal communication, 19 January 2023

Supporting parents

Parents and caregivers, as a facilitator of a museum visit, play a crucial role in helping children understand and become engaged in science. However, many adults tend to lack confidence in actively supporting their children in science and instead tend to rely on exhibitions or educators from the institution to facilitate their children's learning. This may be due to concerns about their own scientific knowledge, a lack of confidence in their ability to facilitate learning, and a lack of understanding of the importance of play and inquiry-based learning in the process of learning (Linnemann et al., 2013). By providing support to parents, they can assist their children's learning and also gain knowledge, skills, and attitudes themselves to become scientifically literate citizens in a society that is increasingly dependent on science and technology.

"

"I do try to support her a bit sometimes, but sitting so low on the ground I often can't do that anymore."

translated, personal communication, 19 January 2023

Figure 18: Practical exhibition guidelines

A way parents can be guided to aid their children is to help them engage their children in the investigative process. This can be achieved by supporting them with open-ended questions they can ask their children. A study by Benjamin et al. (2010) discovered that children tend to remember more information about their experiences when their mothers used open-ended questions starting with "wh" such as "what, where and why?" compared to when their parents used more closed-ended questions. The researchers also recommend that parents talking about the shared experience with their children after the visit can help to solidify the event in the child's memory.

Furthermore, a few practical exhibit design considerations to encourage inquiry need to be considered. Borun et al. (1997) suggest a few practical guidelines (figure 18).

Conclusion

This chapter started with the research question: Who are museum visitors and how do they experience their museum visit? By conducting a literature review, as well as doing observations and interviews at the Museon-Omniversum, insights have been gained regarding the museum visitor, specifically the visitors at Museon-Omniversum.

1. The motives behind families' museum visits cannot be attributed to one single factor. Research indicates a multitude of reasons. A significant amount of families visiting Museon-Omniversum do so for educational or entertainment purposes.

2. Visitors can assume various identity roles during their museum visit. The vast majority of observed visitors fit into two identity roles, the explorer or facilitator or a combination thereof. Children consistently adopt the role of explorer, while parents tend to adopt either the facilitator role or that of facilitator-explorers.

3. For children and parents to engage in cooperative learning and reflection, both the child and the parent must have the willingness to explore. Thus, the parent must become a facilitator-explorer. To give parents the confidence to become facilitator-explorers, it is essential to support them. This support should enable them to assist their children's learning and also equip them with the necessary knowledge, skills, and attitudes to become scientifically literate citizens. For example, teaching about the power of open-ended questions.

4. There are some practical exhibit design guidelines in place to help support both parent and child to get the most out of the particular exhibit.

This chapter has provided valuable insights and background information in terms of the visitor and their experience. These insights can serve as tangible design guidelines for upcoming cycles. *C1.3 Guide cards* delves into the structure and subsequent utilisation of these cards. This cycle is concluded with two guide cards: *guide card 1* which focuses on enabling cooperation between parent & child and *guide card 2* emphasises facilitating cooperation around a museum object (figure 19).

The insights gained in this cycle answer the research questions. Despite conducting observations in the museum across multiple days, there remains a gap in a comprehensive understanding of the Museon-Omniversum visitor. One possible explanation for this limitation could be the relatively low visitor turnout during school days. More observations and interviews are needed within the Museon-Omniversum context to get to the core of visitor behaviour, engagement and experiences.

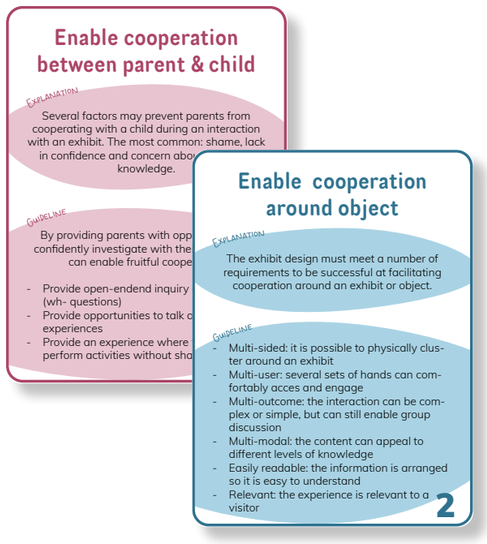


Figure 19: Impression of guide card 1 and 2 (see C1.3 Guide cards)

Figure 20: Future food game at Museon-Omniversum's One Planet NOW!

C1.2.2 Transformative learning

How can exhibition design create a transformative learning experience?

How can exhibition design create a transformative learning experience? A transformative experience can completely change a person's relationship with their self-world. The individual builds a new worldview; this perspective supports a lasting change in this individual's attitudes and actions. The individual must learn to build a new perspective and transform themselves; transformative learning. For Museon-Omniversum, which is focused on revitalising our planet, this would be extremely valuable. But how can an experience offered by Museon-Omniversum contribute to this transformation?

This chapter seeks to explore how museums can effectively incorporate transformative learning. Its main focus is to gain a deeper understanding of what transformative learning entails and how it can be achieved among museum visitors. The chapter examines the process of transformative learning in both adults and children, while also addressing the practical application of transformative learning in a museum setting.

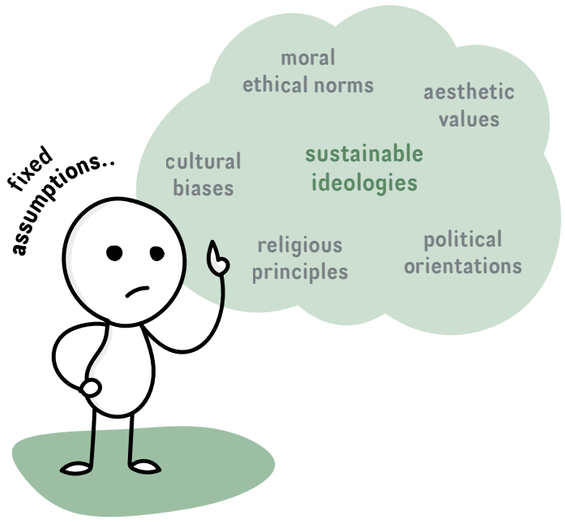


Figure 21: Examples of fixed assumptions

Defining transformative learning

Jack Mezirow is the founding father of the concept 'transformative learning'. He describes transformative learning as:

> "Transformative learning is learning that transforms problematic frames of reference— sets of fixed assumptions and expectations —to make them more inclusive, discriminating, open, reflective, and emotionally able to change. Such frames of reference are better than others because they are more likely to generate beliefs and opinions that will prove more true or justified to guide action."
>
> (Mezirow, 2003)

In other words, the type of learning that enables you to step out of your frame of reference, challenge fixed assumptions (figure 21), and generate new insights that trigger action. These reactions to the learnings could involve strong emotions, the discovery of significant and personally relevant insights, and personal changes in values, beliefs, intentions, or self-perceptions (Duerden et al., 2018).

In 1978, Mezirow pointed out ten different steps that people encounter in the process of transformative learning. His theory has often been challenged and contested and has therefore evolved. Looking at the steps of Mezirow's transformational process, the steps can be roughly sorted into four possible challenges or themes. Such a challenge can include several steps of the transformation process (figure 21).

A transformational process can take place over various lengths of time. Sometimes a process can be undergone by a single experience while other processes could take years. The process is non-linear and can be disrupted by periods of regression. Through different phases, individuals can become stuck, for example when trying to understand their thoughts, feelings and actions relating to a certain subject (Bergevin, 2018).

It is unrealistic to design a museum experience that is transformative for every visitor. In *c1.1: the visitor and their museum experience* it was found that each individual brings their own unique background, interests and perspectives on their museum visit. However, museums can aim to create an environment that tries as well as possible to facilitate meaningful learning for their visitors (Falk, 2006), thereby supporting the transformative learning process.

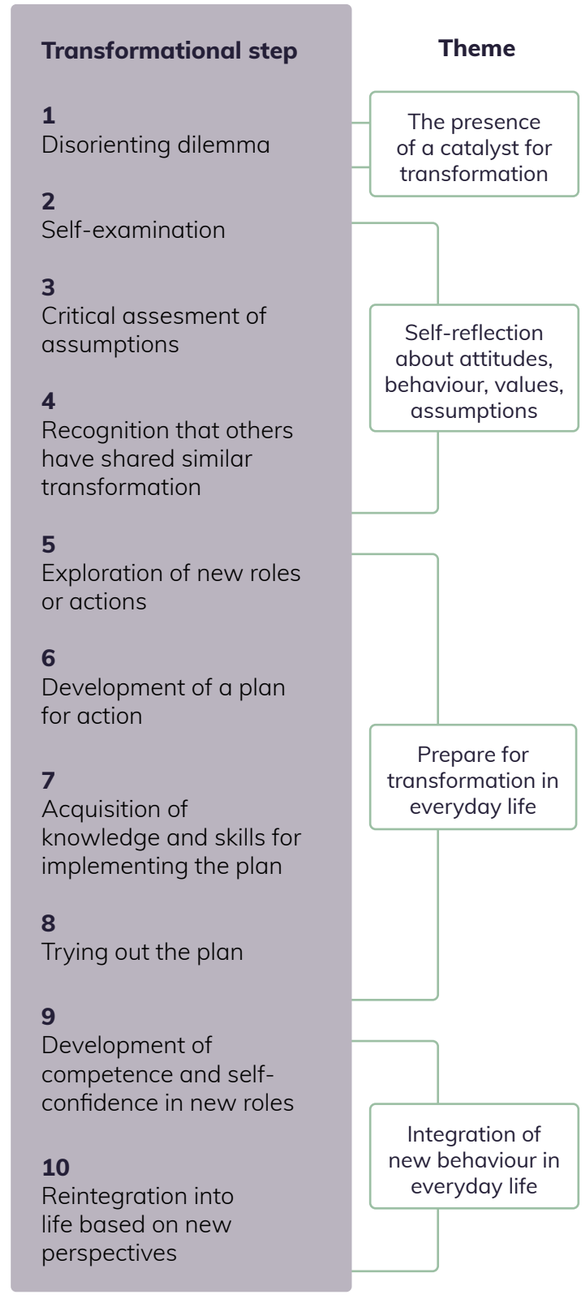


Figure 22: Transformational process adapted from Mezirow (1978)

Museum roles in transformation

Bergevin (2018) explored in her PHD-study various narratives for transformation for a museum to implement (figure 23). These roles co-exist with each other, and there is a possibility they will overlap within the transformational narrative of one individual. For example, a visitor might be not only reminded of injustices from the past but also stimulated to gather a deeper understanding of oppression. In the end, the visitor might be personally motivated to act. Bergevin stresses that the role of a museum within a transformational experience is contextual, nuanced and personal.

Design elements for transformative learning

To create a transformative learning experience for Museon-Omniversum, design tools and guidelines are necessary. Sitzia (2016) performed a study on the way narratives are constructed and discourses are displayed in museums. She identified a significant aspect of learning in contemporary art exhibitions: the perceived conflict between immersive exhibition designs and those that are discursive.

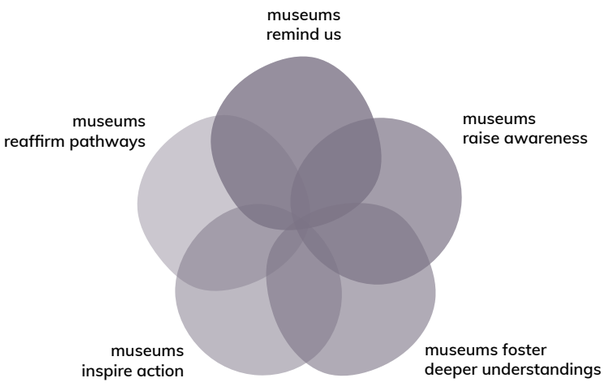


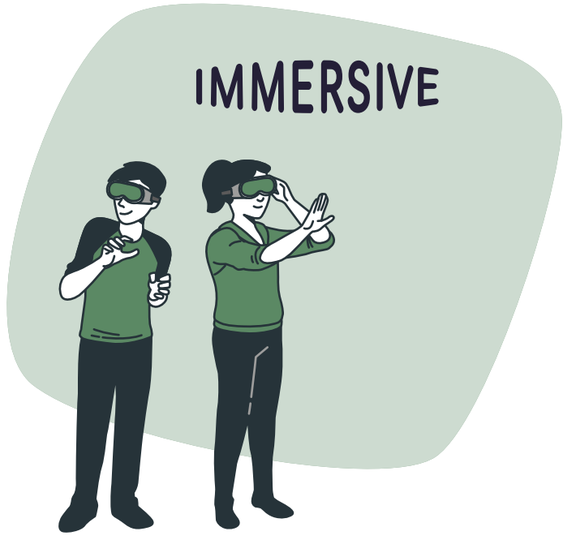
Figure 23: Narratives for transformation (Bergevin, 2018)

Immersive: Aims to create knowledge that is based on personal experiences and emotions. They intend to activate the visitors' senses and imagination by immersing them in different worlds that enhance their understanding and receptiveness to the exhibition's messages (Sitzia, 2016)

Discursive: The generated knowledge is often cognitive of nature. Discursive exhibition spaces are created to encourage dialogue and debate, create polarising and politicised spaces, and spark discussions with conflicting perspectives (Macalik et al., 2015).

She further claims that depending on the narrative, the effects on visitors of immersive and discursive types of exhibitions are vastly different. An immersive museum visit becomes a part of the visitor's autobiographical narrative. It becomes something that has happened to the individual and is integrated into their personal history. However, it does not leave much room to allow the visitor to critically reflect or have analytical engagement with the exhibit. In exhibitions that use discourse, the narratives presented by the museum are experienced alongside the visitor's narrative. The information can be critically evaluated and analysed by the visitor. These displays provide a space for reflection, but the emotional engagement of the visitor is lessened as the narratives are not part of their personal history (Sitzia, 2016).

Using this information, we can therefore classify the 10 steps, defined by Mezirow, where they are best suited. Figure 24 depicts which steps of the transformative learning process fit in immersive models, and which in discursive. As can be seen in the figure, both immersive and discursive models can be beneficial for transformative learning when used complementary. It could be an interesting opportunity to design an exhibit that allows visitors to transfer between immersive and discursive, to best fit the transformative learning process.



Step 1: creation of a disorienting dilemma

Step 2: creating time and space for self-examination

Step 5: allowing the exploration of options for new roles and actions

Step 6 & 7: providing space to acquire knowledge and skills

Step 8 & 9: providing time and space for provisional trying of new roles and the building of competence and self-confidence

Step 2: creating time and space for self-examination

Step 3: critical assesment of assumptions

Step 4: recognition that others have shared similar transformation

Step 10: reintegration of new perspective into daily life

Figure 24: Transformative learning process devided over immersive and discursive exhibition models
Inspired by Sitzia (2016), adapted by Zwerver (2023)

Besides an exhibit being immersive or discursive, Gaggioli (2016) presents a framework for Transformative Experience Design. The study stresses that it is important to remember that transformative learning can only be invited upon visitors, it cannot be forced upon them. True transformation requires the individual to actively participate in creating new meanings and to see the experience as being relevant to themselves. In the framework, it is argued that there are particular transformative affordances, and design guidelines, for facilitating, inviting or eliciting a transformative experience. The framework focuses on four aspects: medium, content, form and purpose (figure 25).

This framework, together with the knowledge gathered on immersive and discursive exhibition design, can be used to map out the interactive experience design for Museon-Omniversum.

Transformative learning for children

Literature on transformative learning is greatly available for adult learning. Children's transformative learning is truly underexposed and not addressed in literature. Therefore, a thorough understanding of the abilities of young children to do scientific inquiry and learn is needed, in order to translate this to the transformative learning understanding.

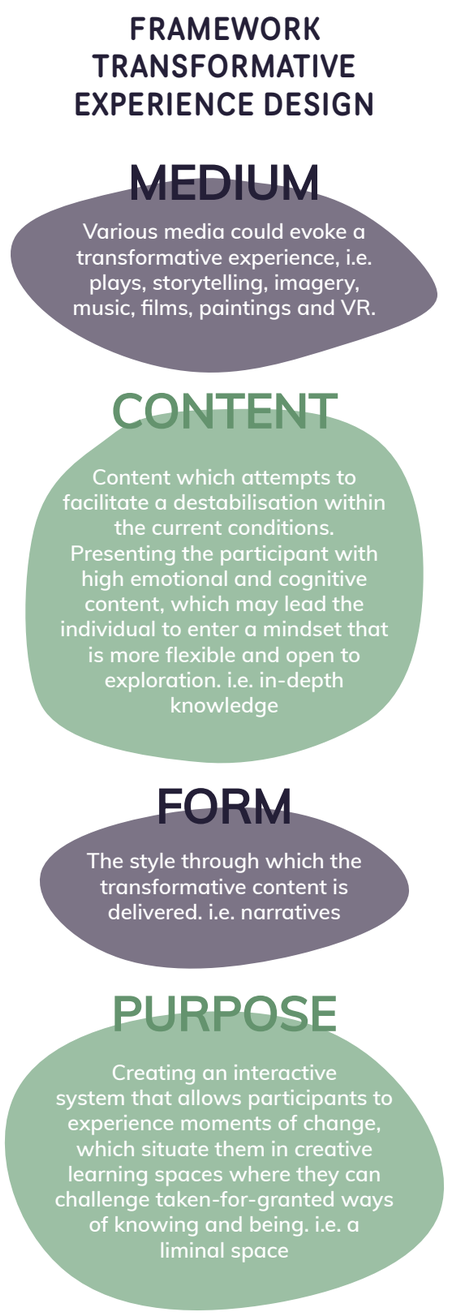


Figure 25: Framework for transformative experience design (Gaggioli, 2016)

The National Research Council states that the science education standards for children 6-9 years old are:

- Ask a question about objects, organisms, & events in the environment
- Plan & conduct a simple investigation
- Employ simple equipment & tools to gather data & extend the senses
- Use data to construct a reasonable explanation
- Communicate investigations & explanations

(National Research Council, 1996)

Personal communication with Mathieu Gielen, assistant professor of Design for Children's Play at the Faculty of Industrial Design Engineering and director of the Play Well Lab, revealed that children's play closely resembles a scientific experiment. He referred to Kolb's cycle of experiential learning (figure 26). Through play, a child experiences something, reflects on actions and sees the consequences of them. The child then uses this new knowledge to actively experiment again. There is always some friction between play and education. Playing is free and should have no limits or preconceived assignments. Whereas with education, of course, you want to teach something specific to the child. Gielen is convinced that you have to design the playful learning experience in such a way that the user has the idea that by experimenting he finds out something himself, that the person who is learning is in control (M. Gielen, personal communication, January 30, 2023).

In addition, he indicates that children are very susceptible to role models. At a young age, these are often their parents and later shifts to siblings or other acquaintances as well. And once they are a bit older, role models can also become persons they see on TV, in films or on YouTube. These individuals are important to them, what this person likes and does, they also want to like and do (M. Gielen, personal communication, January 30, 2023).

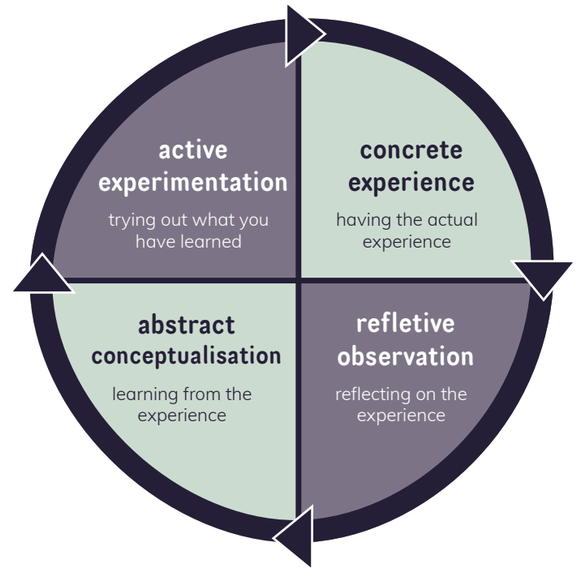


Figure 26: Cycle of experiential learning (Kolb, FIXME)

Conclusion

This chapter started with the research question: How can the design of an exhibition create a transformative learning experience? By conducting a literature review, as well as consulting an expert on children's learning and play, meaningful insights have been gained regarding transformative learning experiences.

1. The transformative learning process as defined by Mezirow (1978) consists of 10 steps that should support transformation. Four themes can be distinguished in these steps.

2. Museums can play different roles to support this transformative learning process. Several actions can contribute to visitors' transformation. However, for each visitor, this process is personal and implementation of this role will not guarantee successful transformation.

3. Both immersive and discursive exhibition models can be beneficial to aid visitors' transformative learning. Various steps of the process require a different approach. While self-examination might benefit more from a discursive approach, provisional trying of new roles might do so from an immersive model.

4. Four transformative affordances are identified, which are important to consider when designing an experience for transformation. Medium, content, form and purpose all have their guidelines for facilitating, inviting or eliciting a transformative experience.

5. Research on transformative learning is solely based on adult learning. Science education standards for children can be considered, but further practical experimentation about the transformative qualities of children's learning should be done.

6. Children's play is experimental learning. A playful learning experience has to be designed so the learner feels in control, and should not feel like walking down a preconceived path.

This chapter has provided important insights into the transformative learning process and experiences. Several insights can be translated into tangible design guidelines for subsequent cycles. *C1.3: Guide cards* presents the structure and utilisation of these guide cards. This cycle can be concluded with five guide cards. *Guide card 10* presents a guideline to enable visitors to self-reflect by using the discursive exhibition model. *Guide cards 4, 5, 8 and 9* introduce how the transformative affordances can be translated into a learning experience (figure 27).

The insights in this cycle provide guidelines to answer the research questions and serve as a source of inspiration for designing an exhibit that responds to the transformative learning process. The research methods did not provide sufficient information about the manifestation of the transformative learning process in children. Thus, much experimentation in ideating, integrating and realising will be needed within these affordances to find the right design combinations for the Museon-Omniversum context.

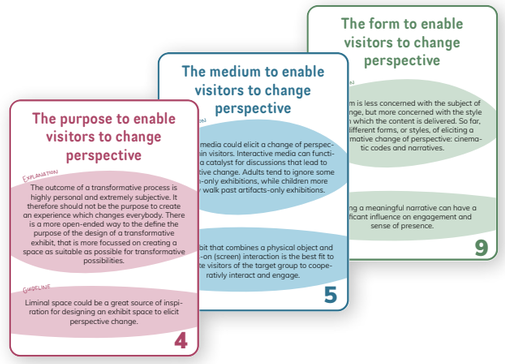


Figure 27: Impression of guide card 4, 5 and 9 (see C1.3 Guide cards)

Figure 28: Exercise square at Museon-Omniversum's One Planet NOW!

C1.2.3 Environmental engagement in a museum context

How can an exhibition engage visitors in sustainable behaviour?

We are in a global climate crisis. Our planet is at risk, as well as human societies and biological ecosystems. The daily lives and choices of billions of families have an impact on this climate crisis. For example, a family's CO2 emissions. It is a global challenge to address the needs of our planet and people develop a more sustainable attitude towards it. Urgent action from families all across the world is needed to become more involved in sustainable development. Museon-Omniversum has a unique position to convey these values to its visitors.

A better understanding of how a person can be engaged with the environment is needed to devise a narrative and interaction for the exhibit. This chapter analyses how a museum can engage its visitors in sustainable behaviour. The chapter dives deep into how sustainable attitudes can be adopted. Besides, it approaches sustainability from a children's perspective.

Sustainable attitudes and behaviour

Museums, as informal education institutions, can be involved in sustainable development and education. By explaining and involving the general public in sustainability topics, a role can be played in accelerating progress towards a more promising planet (Tilbury et al., 2002). People visit museums in their leisure time, allowing museums to use this time to introduce topics that otherwise might not be discovered.

Sustainability is closely related to people's attitudes and behaviour towards sustainable development. A certain behaviour arises because a person adopts a certain attitude. An attitude can thus be seen as the precursor to a behaviour that a person exhibits. An attitude can be defined as "the learned tendency to respond to an object in a consistently favourable or unfavourable way" (Onkvisit & Shaw, 1994). When an attitude is stable over time and easily accessible, it strongly correlates with future behaviour (Glasman & Albarracín, 2016). It could thus be relevant for a museum to learn how a stable and favourable attitude can be generated.

Attitudes consist of three components:
Effective component: feelings or emotions toward the attitudinal object

Cognitive component: knowledge, awareness and beliefs toward the attitudinal object

Behavioural component: the intention to act
(Marcinkowski & Reid, 2019)

Adopting sustainable attitudes

A museum is seen as a free-choice learning experience, it is not part of a curriculum that needs to be followed. People with different backgrounds, knowledge and attitudes come together. Thus, it is difficult to assess which factors could contribute to the success factors of sustainable learning. However, based on qualitative data Ballantyne & Packer (2005) have identified three factors that are effective at influencing the adoption of sustainable attitudes (figure 29).

CHALLENGE BELIEFS

It is crucial to **challenge the belief** that individuals have it in their ability to make a difference in environmental issues. Giving people positive experiences that show them **they can have an impact** on their local surroundings can motivate them to take **action** based on their environmental beliefs. Even young children can play a role by making simple changes in their daily routines, like walking or biking to school, using less water, and conserving energy.

To create effective educational experiences, the educator must understand the **different perspectives and understanding** that learners have about environmental issues. These may either **aid or hinder** the new information being taught or the intended learning goals. This approach emphasizes on **identifying** the learners' current understanding, helping them to be aware of their own and other perspectives, and then providing them with new information or learning experiences that are meant to **challenge** their inaccurate or incomplete understanding.

ENHANCE ENVIRONMENTAL CONCEPTIONS

AROUSE EMOTIONS

Emotion influences the way we learn by motivating us to **pay attention** to certain things and consider them important. Moderate levels of emotion, such as those caused by new, surprising, or complex stimuli, can lead to **curiosity and a desire to explore**. But also, feelings of guilt or affinity towards nature can **stimulate** sustainable attitudes.

Figure 29: Factors effective at influencing the adoption of sustainable attitudes (Ballantyne & Packer, 2005

Attitude or impulse

It is important not to confuse an attitude with an impulse. An impulse is not stable and therefore will not lead to certain behaviour in the future. Several factors affect a stable attitude, factors like difficulty or strenuous effort can prevent the development of attitudes (Blythe, 2013).

Also, facilitating sustainable behavioural change in just one museum visit has shown to be problematic. To make a meaningful impact on attitudes or behaviour more time and recurrence are needed. Only one isolated experience, an exhibit, does not have sufficient ground to be a meaningful learning opportunity. Attitudes might shift for a while, but no evidence supports long-term behavioural changes. However, the accumulation of the exhibit and other interactions with learning experiences can leave an impact on visitors' world views over time (Falk & Dierking, 2000). So, the key is to set up the exhibit in the best possible way for maximum impact on the whole process. A lack of confidence in one's capabilities, lack of determination and lack of the feeling of control over the events can interfere with the process of adopting sustainable attitudes (Marcinkowski & Reid, 2019).

So it is very important to keep these factors in mind when designing for an exhibition where your goal is to promote sustainable behaviour. To counteract the interfering factors, it is helpful to ensure the environment is most optimal for the sustainable development of visitors, you need to consider:

- *Keep it simple*
- *Provide an environment that encourages visitor's belief in their own capacities*
- *Provide freedom to act*
- *Let the visitor be in control*

Contradiction in effective factors

Raising awareness of environmental problems is step one in transformational change of visitors' attitudes and behaviour. However, nowadays there is an awareness overload, it is known that people feel overwhelmed when they are continuously alarmed by multiple environmental topics. This phenomenon is called apocalypse fatigue and encompasses the exhaustion of having to make endless sustainable and moral choices that, in your opinion, don't seem to make a difference anyway. Accompanying, there is a psychological rebellion against always having to worry about every choice (Zehner, 2020).

In extreme cases, repeated alarmation about serious subjects might even call for counteractive behaviour, such as moral licensing. Moral licensing is a behaviour in which a person feels free to act immorally after an initial moral act. Bad sustainable behaviour is personally justified based on a previous moral action. For example, after implementing an energy-efficiency measure in one's home, a person may feel morally allowed to use energy less frugally (Dreijerink et al., 2021).

Thus, when designing an experience for adapting sustainable behaviour certain principles are necessary to consider. Confronting visitors with negatively charged media can trigger emotions such as sorrow or compassion. However, negatively charged media often also affects an individual's self-confidence to act. "Although these images made climate change seem important, they also distanced and disengaged participants, as they struggled to comprehend how they could be empowered to act on climate change." (O'Neill et al., 2013). Furthermore, it is stated that positive imagery promotes the self-efficacy of participants. Media picturing positive energy futures appeared to powerfully impacts the feeling of self-efficacy in the attitudes and demeanours of people corresponding to the topic (O'Neill et al., 2013). So a well-thought-out combination of optimistic communication tools that both can evoke emotions and promote self-efficacy can be useful when designing an exhibit on a sustainability topic.

Also, Ballantyne & Packer (2005) stress the importance of demonstrating how acquired knowledge should be applicated to actions in their daily lives. Demonstrating such information makes the knowledge more reliable, feasible and useful for decision-making. Besides, it should be able to apply to measures they take in their own lives (Alsop & Watts, 1997). A possible exhibit should thus contain actionable steps towards the application of knowledge in the visitor's daily life.

Lastly, it is reported that constructive hope, hope based on positive reappraisal, is a motivational force associated with the environmental engagement of students (Ojala, 2015). One way this can be implemented, as is already visible in Museon-Omniversum, is by presenting promising sustainable innovations. But it is also useful to discover if other hopeful elements can be incorporated into the design that is not solely related to sustainable innovations. Perhaps hope can also be raised by, for example, reporting on positive steps already taken by society.

Environmental engagement of children

Personal communication with Mathieu Gielen reveals that around the age of eight or nine, children develop a strong internal drive to do good. This manifests itself, for example, in not wanting to eat meat anymore because they feel sad for the animals, or saving seals that have been brought to shelters. The children run campaigns at school or craft posters to raise money. Children are unaware of the perhaps small impact they are making, and can therefore be overjoyed and proud that they have raised 10 euros.

Besides, Gielen argues that it may well be possible for children to demand accountability from their parents. Suppose they have learnt something with a catchy slogan, this awareness might cause them to recount it to their parents in everyday life. He stresses, though, that this learning moment must have been a shared experience. The child must know that parent and child have the same knowledge about the phenomenon, otherwise, the child might feel hesitant to ask for accountability (M. Gielen, personal communication, January 30, 2023).

Conclusion

This chapter started with the research question: How can an exhibition engage visitors in sustainable behaviour? By conducting a literature review, as well as consulting an expert on sustainable mobility, valuable insights have been gained regarding engaging individuals in sustainable behaviour.

1. Attitudes are precursors to behaviour. Thus, to positively change behaviour, you have to address someone's favourable attitude. Arousing emotions, challenging beliefs and enhancing environmental conceptions could be possible approaches to influence the adoption of sustainable attitudes.

2. Several factors related to self-perception can influence the adoption of behaviour, including a lack of self-confidence, an absence of determination and a sense of being out of control. To ensure an engaged experience, the design of the exhibit should establish an environment where these factors do not hinder the visitor's engagement.

3. Awareness can be raised with the help of negatively charged content or hopeful content. Constructive hope could be the right strategy for a family museum context. Based on this hope and positive reappraisal, an exploration of future roles can be motivated.

4. At the age of 8, children begin to develop an awareness of sustainability issues, marking the beginning of their activism. However, they have yet to grasp the full extent of the impact their actions can have. Harnessing their enthusiasm for small victories can serve as a source of inspiration within the exhibition, encouraging the initiation of transformative steps. Shared experiences for parents and children can lead to children demanding accountability.

These insights serve as tangible design guidelines for upcoming cycles. *C1.3: Guide cards* delves into the structure and subsequent utilisation of these cards. This cycle is concluded with four guide cards. *Guide card 3* provides guidelines to enable visitors to adopt stable attitudes. *Guide cards 6 and 7* contain information on the exploration of sustainable behaviour change. Lastly, *guide card 12* displays how children could hold their parents accountable for newly learned sustainable attitudes.

The insights gained in this cycle answer the research questions and provide guidelines to devise an exhibition to obtain sustainable attitudes. The research activities have so far provided enough information for the subsequent cycles.

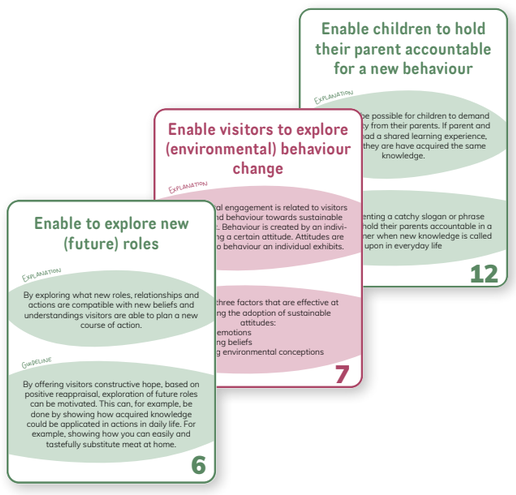


Figure 30: Impression of guide card 6, 7 and 12 (see C1.3 Guide cards)

Figure 31: 'From pee to tea' exhibit at Museon-Omniversum's One Planet NOW!

C1.2.4 Interactive exhibits

What are the desired qualities of an interactive museum exhibit?

A returning challenge for museums is how they can keep engaging their visitors and provide meaningful learning opportunities. A museum is no longer merely of intellectual matter. To keep visitors engaged, the experience of the visitor should also touch upon the emotional and sensory domain.

Therefore, in many museums, you can experience various interactive exhibits. But what exactly is such an interactive exhibit? What current interactive installations are available for children & their parents to experience together? And what are the desired interaction qualities of such an exhibit? This chapter provides more insights into interactive museum exhibits and their perception by visitors.

Social interactions

Social factors such as competition, collaboration, and recognition from others can enhance people's internal motivation during the learning process (Malone & Lepper, 1987). Thus, increasing visitor involvement with the topic. This is also confirmed by relating it to Jarvis' model of learning. Social interaction is needed for a visitor to be enabled as a learner (Sitzia, 2016). It can be stated that the exhibit, must encourage interactions by providing the visitors with a social environment, to enable the visitors to learn.

Immersive elements

To make an exhibition immersive, one can look at a sensory approach. The senses can be used to captivate visitors in their imagination. Especially multisensory exhibits offer benefits to museums. By appealing to the senses, the exhibit provides an experience with emotional value, it can also offer a more memorable experience and the appealing power of the exhibit is greater (Wang, 2020). The choice of which senses to incorporate is dependent on the specific situation and should be based on the goals of the exhibit.

Another immersive element can be a hands-on approach. Visitors are no longer passive observers, they act along the interactive storyline. A hands-on interactive experience allows visitors to better grasp the core message of the exhibition. Interactivity in museum exhibits can function as a catalyst for communication and collaboration between visitors (Falk & Dierking, 2000). Exhibitions, where the use of your hands is required, tend to attract children but also adults if it is combined with physical collection artefacts. Adults tend to ignore screen-only exhibitions, while children more easily walk past artefacts-only exhibitions (Honecker & Stifter, 2006). Thus, a combination of a physical collection property, a screen and a hands-on exhibition can stimulate visitors of all groups to interact and engage.

Discursive elements

In discursive exhibitions, the exhibit object transforms into evidence. Around this evidence, dialogue, discussion and debate are facilitated. Cognitive knowledge is generated. In practice, elements that aid such conversations are mostly textual, while immersive experiences are rarely textual (Wigley, 2016). Discursivity can offer a means or facilitate a way to effectively discuss the differences in opinions, leading up to a possible consensus or even multiple outcomes (Lázár, n.d.).

Examples of interactive museum exhibits

Four museums were visited to see how interactive exhibits function in museums. A selection of analysed exhibits can be found in appendix C. The purpose and the interaction of the exhibit can be divided over two different axes (figure 32). It is checked whether the interaction is alone or together. In addition, it is examined whether the interaction is of playful or informative nature. In the figure, a target area is also pointed out for the exhibit to be designed. It is striking that there are almost no exhibitions in the target area.

Figure 32: Clustering of observerd museum exhibits

Conclusion

This chapter started with the research question: What are the desired qualities of an interactive museum exhibit? By conducting a literature review, as well as four museum visits, meaningful insights have been gained regarding interactive exhibits.

1. Encouraging social interaction among visitors is needed to enable these visitors to have effective learning experiences.

2. Combining immersive elements, such as physical collection properties, screens, and hands-on elements, can stimulate engagement and interaction among visitors from various age groups.

3. Discursive exhibition elements, primarily in textual form, have the potential to encourage visitors to actively participate in dialogues and discussions.

4. Inspirational elements from existing exhibits have been identified and can be used as a source of inspiration for ideation.

This chapter has provided insights and guides on interactive exhibition elements. These insights can serve as tangible design guidelines for upcoming cycles. *C1.3: Guide cards* delves into the structure and subsequent utilisation of these cards. This cycle is concluded with, for now, one guide card. *Guide card 11* is a reminder of incorporating social interactions in the design of an exhibit.

The insights gained in this cycle answer the research questions and provide a guideline on the social interactions for the exhibition. During the museum visits a lot of inspiration. Throughout the various museum visits, much inspiration was gained. However, it is difficult to summarise all this inspiration in concrete steps. It is recommended to take frequent trips back to the museum visits to keep this inspiration freshly involved in the process.

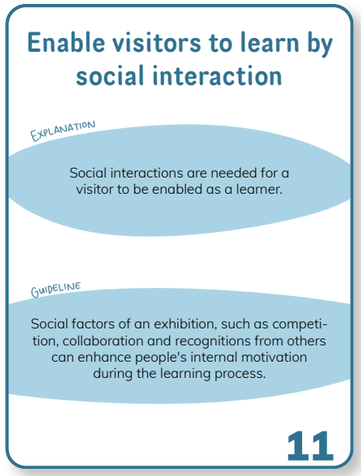


Figure 33: Impression of guide card 11 (see C1.3 Guide cards)

Figure 34: Interactive exhibit on water use at One Planet expo

C1.3 Guide cards

The creation and implementation of the guide cards

The research done in cycle 1: exploring the project context resulted in several conclusions and insights. To ensure these conclusions and insights are carried along to the next cycle in a manageable way, the choice was made to document the insights in so-called 'guide cards'. These cards can provide guidance in subsequent cycles.

The guides are a set of 12 guide cards that can support establishing an experience timeline but also inspire in ideating towards a final design. The cards can also provide an easy way to refer back to delivered research to test, analyse and assess design choices. The guide cards are depicted on the following pages.

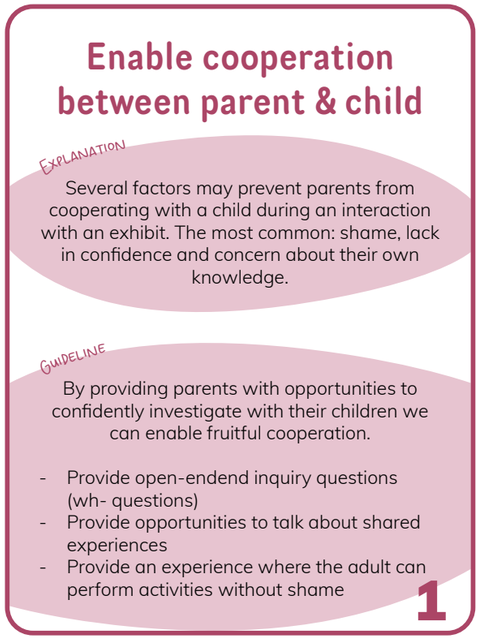
It is important to consider that these guide cards are the result of a research period of less than a month. In this short time, it is almost impossible to get a comprehensive and complete picture of the whole system of museum experiences and transformative learning. It is therefore important always to remain critical, stay alert for new insights and conduct additional research where necessary. It is also possible that the guides may be more applicable to the specific Museon-Omniversum context and less appropriate to another museum context. More research will be needed to generalise the guides for other museums.

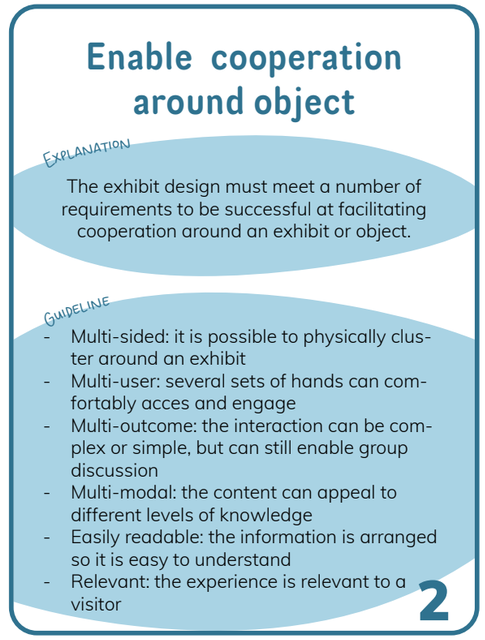
All guide cards have the same core structure. At the top, a statement is presented, something you want to enable for a visitor. Below there is an explanation of this statement. The bottom represents the actual guide, ways in which to implement the feature in the design or phenomena to consider.

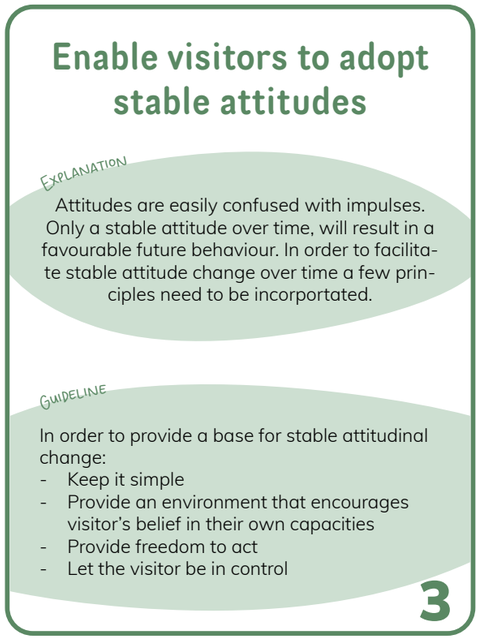
Evaluating newly gained knowledge

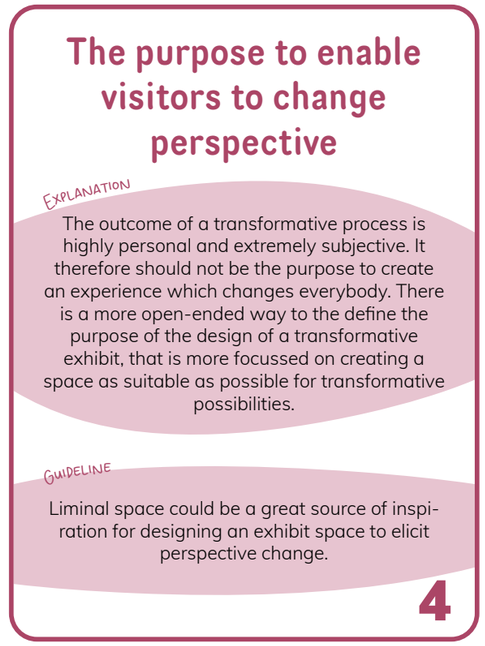
The guide cards function well as an easily accessible and visual conclusion to the research done in this cycle. However, the guidance is often still abstract and ways must be found to implement it concretely in the context of Museon-Omniversum. The upcoming cycles will first have to look at how these abstract guidelines can be implemented in the design process.

For example, to enable visitors to explore environmental behaviour change, three factors are identified. Arousing emotions, challenging beliefs and enhancing environmental conceptions. These factors themselves inspire where to start, but there will still be a need to explore: how do you arouse emotions? How do you challenge a visitor's beliefs? And so on. In the upcoming cycles, questions like these are asked to develop a further understanding of how to implement the guide cards in the design. With these understandings, the guides could be updated and extended.









The medium to enable visitors to change perspective

EXPLANATION

Various media could elicit a change of perspective within visitors. Interactive media can function as a catalyst for discussions that lead to perspective change. Adults tend to ignore some screen-only exhibitions, while children more easily walk past artifacts-only exhibitions.

GUIDELINE

An exhibit that combines a physical object and a hands-on (screen) interaction is the best fit to stimulate visitors of the target group to cooperativly interact and engage.

5

Enable to explore new (future) roles

EXPLANATION

By exploring what new roles, relationships and actions are compatible with new beliefs and understandings visitors are able to plan a new course of action.

GUIDELINE

By offering visitors constructive hope, based on positive reappraisal, exploration of future roles can be motivated. This can, for example, be done by showing how acquired knowledge could be applicated in actions in daily life. For example, showing how you can easily and tastefully substitute meat at home.

6

The form to enable visitors to change perspective

EXPLANATION

The form is less concerned with the subject of the change, but more concerned with the style through which the content is delivered. So far, two different forms, or styles, of eliciting a transformative change of perspective: cinematic codes and narratives.

GUIDELINE

Creating a meaningful narrative can have a significant influence on engagement and sense of presence.

9

Enable to self-reflect

EXPLANATION

By enabling self-examination, a visitor can start to question their own beliefs and understanding. Ultimately, this may cause a perspective change on a certain topic.

GUIDELINE

By using discursive exhibition methods, visitors can critically evaluate and analyse the information that is presented to them. It provides a space for discussion and reflection.

10

Enable visitors to explore (environmental) behaviour change

EXPLANATION

Environmental engagement is related to visitors attitudes and behaviour towards sustainable development. Behaviour is created by an individual adopting a certain attitude. Attitudes are precursors to behaviour an individual exhibits.

GUIDELINE

There are three factors that are effective at influencing the adoption of sustainable attitudes:

- Arousing emotions
- Challenging beliefs
- Enhancing environmental conceptions

7

The content to enable visitors to change perspective

EXPLANATION

Various content could elicit a change of perspective within visitors. Content which attempts to facilitate a destabilisation of current beliefs and understandings is most successfull.

GUIDELINE

Presenting the visitors emotional and cognitive content may result in the individual entering a new mindset that is more flexible and open to exploration. For example, hopeful content, content that disgusts or content that provides new knowledge.

8

Enable visitors to learn by social interaction

EXPLANATION

Social interactions are needed for a visitor to be enabled as a learner.

GUIDELINE

Social factors of an exhibition, such as competition, collaboration and recognitions from others can enhance people's internal motivation during the learning process.

11

Enable children to hold their parent accountable for a new behaviour

EXPLANATION

It may well be possible for children to demand accountability from their parents. If parent and child have had a shared learning experience, both know they are have acquired the same knowledge.

GUIDELINE

By implementing a catchy slogan or phrase children can hold their parents accountable in a low key manner when new knowledge is called upon in everyday life

12

cycle 2

Defining the exhibition approach

This cycle is the touchpoint between the research-focused *cycle 1: exploring the context* of this thesis to the design-focused *cycle 3: prototyping initial interaction ideas*. The bridge aims to enrich the knowledge and insights from the previous cycle with more practical criteria that can serve as a starting point for ideation. The cycle starts by establishing an exhibit topic and narrative and concludes by deriving an exhibition approach.

Figure 35: Welcome square at Museon-Omniversuam's One Planet NOW!

C2.1 Establishing the exhibit topic

Defining the subject of the exhibit

After the development of the guide cards in cycle 1: exploring the context, a strong need developed to get a more concrete grasp on the project. This was necessary due to the abstract nature of the guidelines. The initial step to achieve this involved defining a specific topic for the exhibit, thereby enabling the identification of target behaviours for transformation and potential avenues for self-reflection. The establishment of the exhibit topic played a crucial role in outlining certain aspects of the transformative process and adjusting the design goal accordingly.

The context of sustainable mobility in the Netherlands was investigated (see appendix D). These findings were presented and discussed with several design students and supervisors from TU Delft. Considering the discussions choosing cycling as a sustainable mode of transport in the city is proposed as the exhibit topic to Museon-Omniversum. This topic is suggested because it is about attitudes and behaviour. It is a subject that resonates with both parents and children, as cycling is an accessible way for families to learn about sustainable behaviour change. In comparison to more complex topics like electric cars or 'mobility as a service (MaaS)', cycling provides a relatable and feasible option. After all, it is not every day you are faced with the choice of buying an electric car. While it is widely acknowledged that we should incorporate cycling into our daily routines, it remains an underutilised mode of transport. The challenge, therefore, is to find a creative angle on this accessible topic to create a transformative learning experience. As this proposal sparked interest at Museon-Omniversum it was decided to delve further into this topic.

Positioning in the mobility zone

Besides the accessibility of the topic, it is important to consider the positioning of the to-be-designed exhibit in the mobility zone. How does this exhibit relate to the other exhibits in the mobility zone? For Museon-Omniversum the zone must provide a story that covers multiple facets of the future of mobility.

Currently, three exhibits of the zone are known, each of which has its position in the story (figure 36). The vision for the zone as a whole is: to inspire people to make different choices in their travel behaviour. Partly by letting people experience a hopeful future scenario. A car of the TU/Ecomotive student team from Eindhoven and a wind tunnel will both respond to technological developments in the mobility sector. They answer the question: how can we make existing means of transport as sustainable as possible? For example, through material use and streamlining. The third known element is an enormous wall covered in a collage of 24 different modes of transport for the future. This wall serves as a source of inspiration for the visitor. How will you get from A to B in the future?

It is proposed that the to-be-designed exhibit should cover another point of view, namely, behavioural change. How can we create a more sustainable mobility future by changing our behaviour? The cycling exhibit will provide an opportunity to do so. How can we let the visitors reflect on which mode of transport they choose to take? And how can we enthuse visitors about a sustainable cycling future? These are questions that are asked in the first design cycle, cycle 3: prototyping initial interaction ideas.

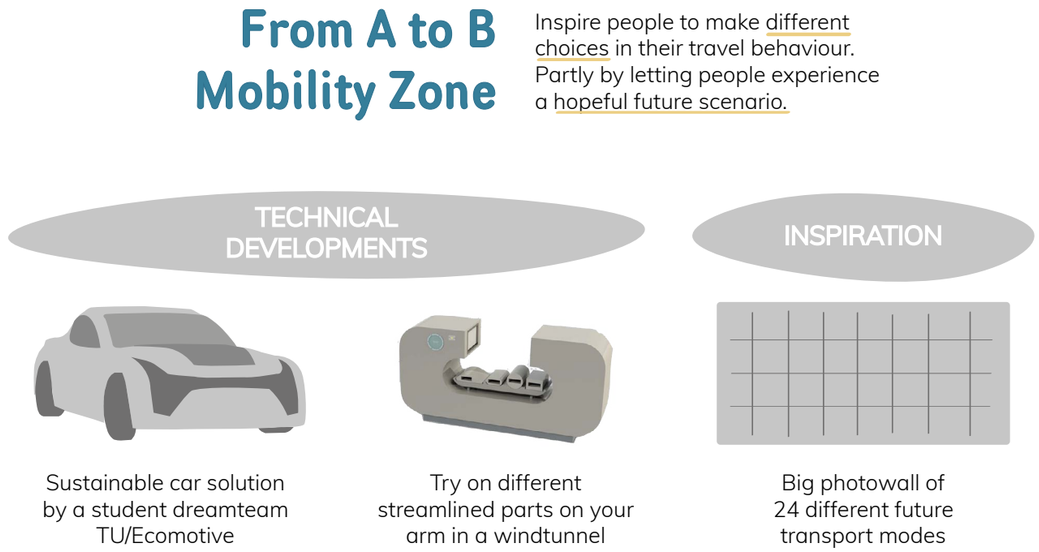


Figure 36: Positioning of the exhibit in the mobility zone

C2.2 Exhibition approach

Defining the backbone structure of the exhibit

The results of *cycle 1: exploring the project context* and the exploration of the exhibit topic in this cycle have led to the realisation of an exhibition approach, which will be presented in this sub-chapter. In the exhibition approach, an experience journey is constructed, layer by layer. Furthermore, high-level design criteria are devised. Concluding, the design goal is updated to fit the current state of affairs.

Experience journey

The experience journey is a timeline of the experience that a Museon-Omniversum visitor should have during their visit to the exhibit. The timeline is based on a goal that needs to be achieved. Below, it indicates the experience the visitor is supposed to have. Then it is noted, from what the previous cycle has taught us, how this could be done. A selection of guide cards has been matched to the timeline that could be of value at that certain moment in the experience.

Scoping

In *cycle 0: setting the project context*, the initial project direction focussed mainly on what comes after raising the awareness of the visitor. However, research has shown that awareness of personal conflict is of major importance in ensuring a transformative experience. In this new experience journey for a transformative museum experience, we can therefore revise what the scope of this project will be. This scope now includes a more explicit focus on the first part of the timeline than initially decided in *cycle 0*.

The last step of the timeline is not included as a focus in the exhibition design as it is more of an internal personal consequence of a successful experience. It is complicated to have an exhibit achieve this step in itself.

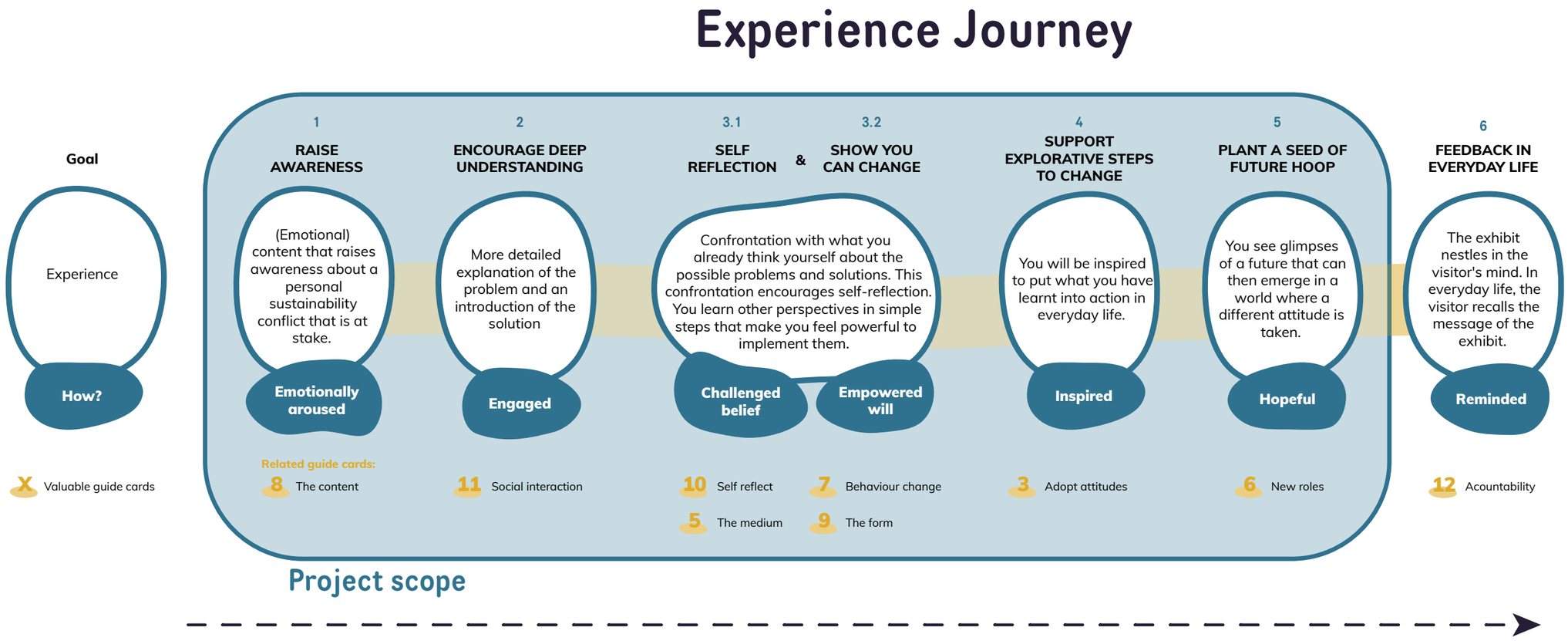


Figure 37: Experience journey of a transformative museum experience at Museon-Omniversum

Design criteria

Seven design criteria can be distinguished to which the design should conform. In essence, these criteria dissect the problem and offer tangible guidance for the direction of the solution. Furthermore, during the final evaluation of the design, they serve as a benchmark against which the solution can be evaluated. Considering the project's timeframe, a select number of high-level design criteria were chosen instead of an exhaustive set of requirements that would cover every aspect of the design. The blue text boxes show the origin step from the experience journey and analysis source.

7 high-level design criteria:

1. *The exhibit should have an element that raises awareness of a personal (sustainability) conflict in an emotional way.*

Step 2 — Defining transformative learning (in C1.2.2)
Adopting sustainable attitudes (in C1.2.3)

2. *The exhibit should enable the visitor to discuss and reflect upon the information with their family in a way that is socially engaging.*

Step 2 — Defining transformative learning (in C1.2.2)
Step 3.1 — Social interactions (in C1.2.4)

3. *The exhibit should present the visitor a meaningful narrative to empower visitors with the will to change.*

Step 3.2 — Design elements (in C1.2.2)
Adopting sustainable attitudes (in C1.2.3)

4. *The exhibit should provide an environment in which visitors feel free to confidently act.*

\- — Identity roles (in C1.2.1)
Attitude or impulse (in C1.2.3)

5. *The exhibit should showcase the implications of the newly learned future sustainable behaviour are, in order to provide a hopeful future scenario.*

Step 4 — Contradiction in effective factors (in C1.2.3)
Step 5 — Design elements (in C1.2.2)

6. *The exhibit should enable fruitful cooperation between parents and their children, in order for both visitors to be enabled to learn.*

\- — Supporting parents (in C1.2.1)

7. *The exhibit should physically enable visitors to cooperate around the installation.*

\- — Supporting parents (in C1.2.1)

Refined design goal

Cycle 0: Setting the project context proposed the initial design goal. The insights *cycles 1 and 2* have led to a specification of the design goal.

New design goal

Design a playful and interactive exhibit that...

1. Raises awareness for a personal sustainable mobility conflict
2. Stimulates self-reflection about bike usage
3. Inspires the visitor to feel enabled to be the change for the future mobility of society
4. Plant a seed of hope for a future planet where more bikes are used

... to be cooperatively experienced by parents and their children (6-10 years old) for a sustainable mobility exhibition zone at Museon-Omniversum.

Figure 38: Artist impression of bicycle mobility in 2050 (Algemeen Dagblad,2022)

cycle 3

Prototyping initial interaction ideas

This cycle explains and evaluates a first iteration of a design concept for the mobility exhibit. An attempt was made to translate the insights and criteria from previous cycles into a first interactive concept. This concept focuses on a specific area of the experience journey. The interaction was made experienceable through a prototype, allowing the concept to be evaluated. The gained insights are transformed into actionable tasks for the subsequent cycles.

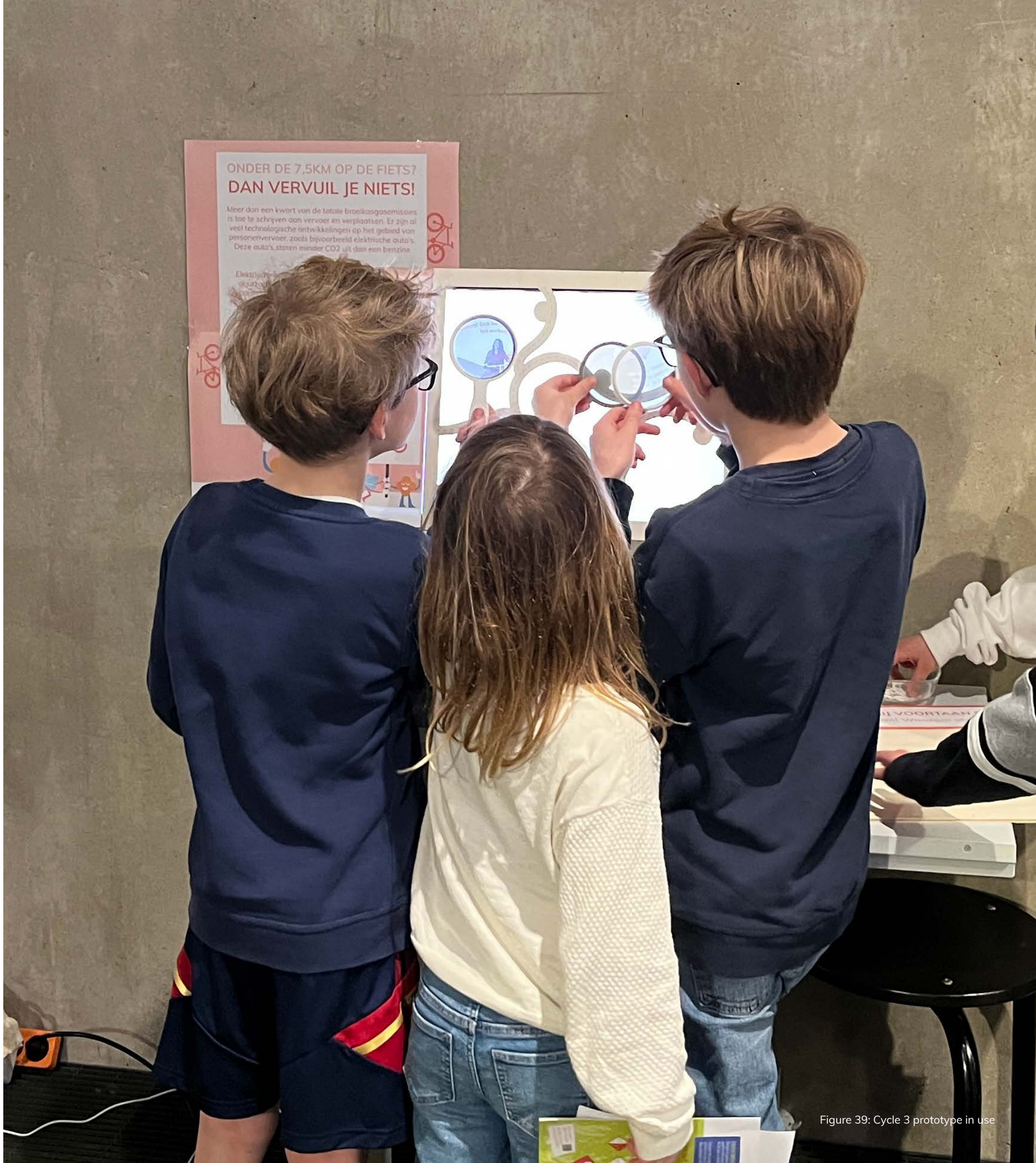


Figure 39: Cycle 3 prototype in use

C3.1 Ideation focus

Directing the focus of this cycle

The experience timeline described in C2.2 *exhibition approach* is too complex to come up with a design that is comprehensive for this entire timeline in one go. It was therefore decided to highlight only part of the timeline in the first design cycle. A conclusion about this solution can be formed which can be taken to the next design cycle where a larger part of the timeline can be addressed.

The choice was made to focus the main interaction on the middle part of the timeline (figure 40), because this will be part of the main focus of this thesis. At this point in the process, a need for insights into ways to elicit self-reflection in an exhibition is developed. However, in order to create self-reflection, there must be some form of awareness and understanding (C1.2.2 *transformative learning*). Therefore, the concept will include the two steps that come before the focus area in the timeline, but these steps will not have the main focus. As a result, they may thus not have the optimal shape for a stand-alone exhibition.

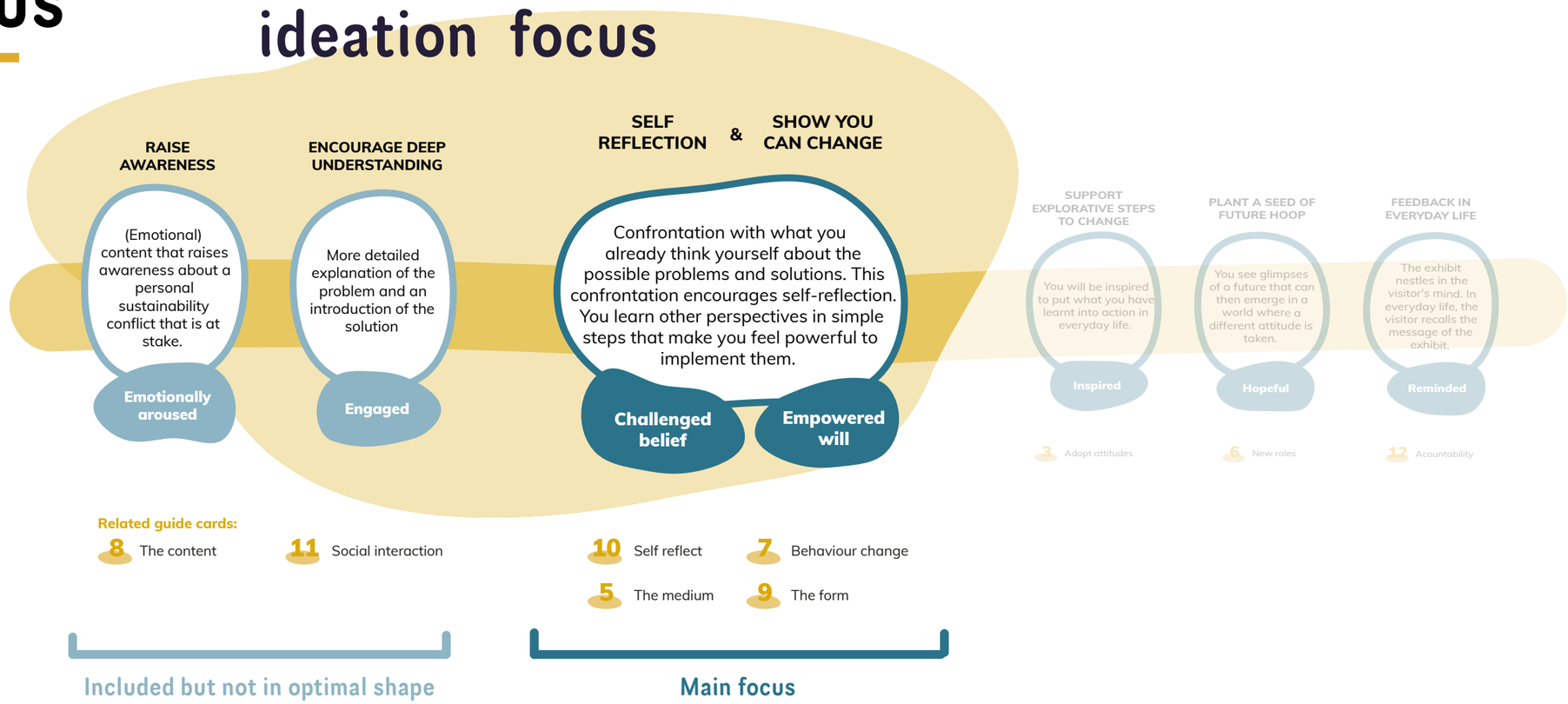


Figure 40: Cycle 3 ideation focus, ideating for selfreflection

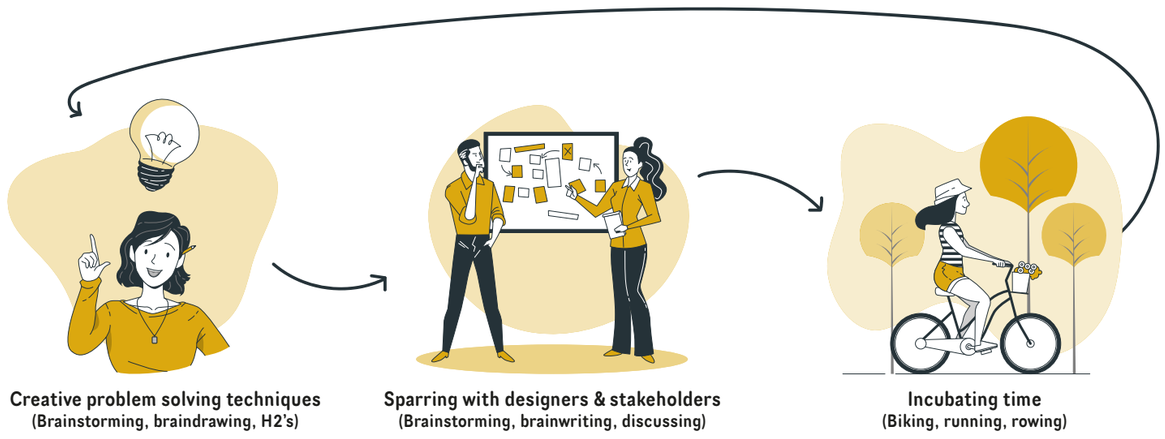


Figure 41: Design methods and techniques cycle 3

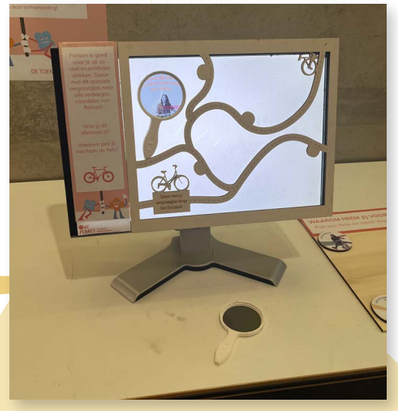
Methods

Various techniques (figure 41) were used to generate ideas for the first concept. Through individual brainstorming sessions, sparring with design students, inspiration from guide cards and inspiration from existing exhibitions, a large number of ideas were generated. Regular 'incubating breaks' were held to give the ideas time to develop. Three directions emerged and were discussed with museum stakeholders. Based on the gathered insights, independently, a direction was chosen and further developed into a first interaction concept.

C3.2 Concept: ‘hidden bicycle benefits’

Explanation of the first interactive concept

The concept “Hidden bicycle benefits”, depicted in figure 42, lets visitors explore the hidden benefits of cycling. Not only are these cycling benefits hidden in everyday life, but they are also literally hidden in the exhibit. At first glance, the display appears completely blank. If you move the special magnifying glass along the screen, you can suddenly discover and see things on the screen. Along a bike path hanging in front of the screen, you can discover all the things you can read, the invisible bike benefits. Have you finished discovering the benefits? Then use a small magnet in the shape of a bicycle to vote for the benefit that you find most important. Why would you take the bike in the future? Appendix E presents more in-depth details about the hidden bicycle benefits concept, such as the full-scale picture of what is hidden on the screen.



2.

The screen is used to interact with the magnifying glass. Aimed at gaining knowledge and the first step towards self-reflection. The hidden benefits show how little changes can result in major benefits, to empower the will to change.

The exhibit incorporates a voting board where visitors can actively participate in the topic, aiming to encourage self-reflection and foster discussions among visitors based on the knowledge they have gained.

3.

THE FOCUS OF THIS CONCEPT DOES NOT LIE ON THIS PART OF THE CONCEPT, SO THIS IS NOT THE OPTIMAL FORM BUT SHOULD STILL WORK TO PRIME THE VISITORS FOR THE SUBJECT.

1.

An introductory poster to the topic. Functions to create awareness and understanding of the problem that is at stake.

Figure 42: Concept idea ‘Hidden bicycle benefits’

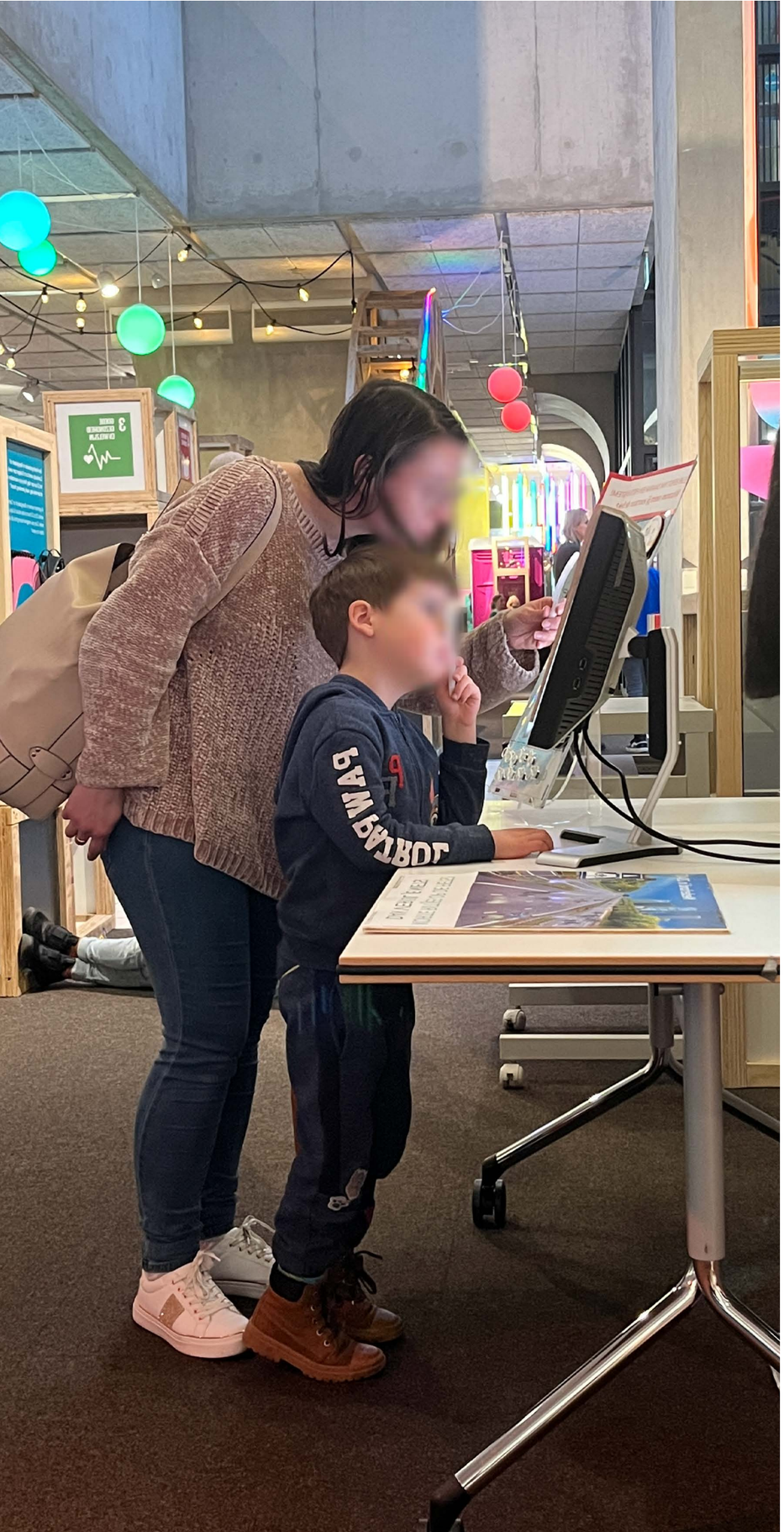


Figure 43 & 44: Cycle 3 prototype in use.

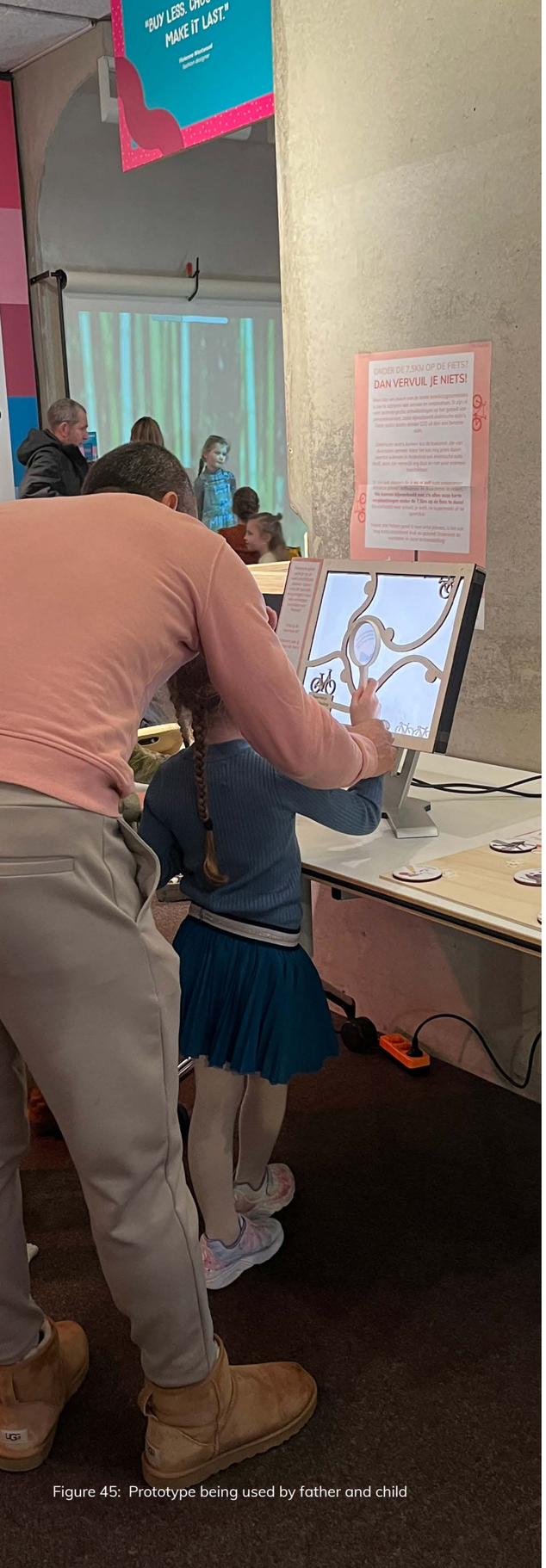


Figure 45: Prototype being used by father and child

Concept narrative

In the concept exhibit, the narrative revolves around the hidden benefits of cycling. The exhibit aims to explore and highlight inspiring advantages that appeal to visitors. The storyline provides a clear vision of the intended objective and purpose of the exhibit.

Storyline

Electric cars may be the future, but right now they are still little in private use. Not everyone has the opportunity to buy an electric car, to contribute to a sustainable future. We can also find other ways how we can make the future more sustainable. For instance, by changing the way we travel. A proposal: making more use of an active mode of transport, cycling! Cycling on short journeys, to school, the sports club, the supermarket or work.

If we all cycled all our short trips, we would save about 2.4 million tonnes of CO_2. For the same CO_2 savings, half of all Dutch people would have to buy at least a hybrid car. Currently, only 8% drives an electric or hybrid car. But besides CO_2 reduction, cycling also has tonnes of personal benefits. Explore those benefits in this exhibit! For example:

- Cycling makes you independent! You can do it yourself and are not dependent on someone else! You also learn more about traffic.
- Cycling can be a real social activity!
- Cycling improves your brain's ability to concentrate. You can concentrate better for up to 3 hours after your bike ride.
- With more cycling, you save money on petrol, parking and maintenance costs. You keep more money for fun outings or holidays!

Why would you take the bike in the future?

Concept meaning

Wondrously and interactively, the visitor searches for new information on a rather familiar subject. The anticipation starts to build, upon first interaction there is a sense of wonderment. Suddenly the screen reveals captivating elements that could not be seen at first glance. The visitors playfully start searching for more information. They reflect on the presented knowledge, enabling them to form an opinion. What do they find most important about cycling? After exploring the attention is moved to the voting board, where a cycling magnet can be placed in the category deemed most important by the visitor. Seeing the opinion of other visitors can influence the reflection on the topic. Besides, the hidden bicycle facts also contain small hints to show how easy it can be to change. For example, only 20 minutes of cycling a day will increase your concentration for 3 hours. Empowerment develops within the visitor, supported by recent discoveries.

Developing a prototype

The prototype consists of three parts. An introduction, an interactive display and a participatory board. For the introductory poster, two different versions are made, a simplified and a more elaborate one. The interactive display uses an LCD screen. The top layer of this screen is a polarising filter. If you remove this layer from the screen (figure 46), the light will no longer be polarised and will only be white. If you then hold another polarising filter in front of it, you will again be able to see what is on the screen. This polarising filter is put in a magnifying glass. A wooden laser-cut overlay, produced in the faculty's model making lab (figure 47), is used as a bike bath over the screen. For the participatory board, a wooden variant and a magnetic variant are used.

Figure 46: Removing the polarising filter from the LCD monitor

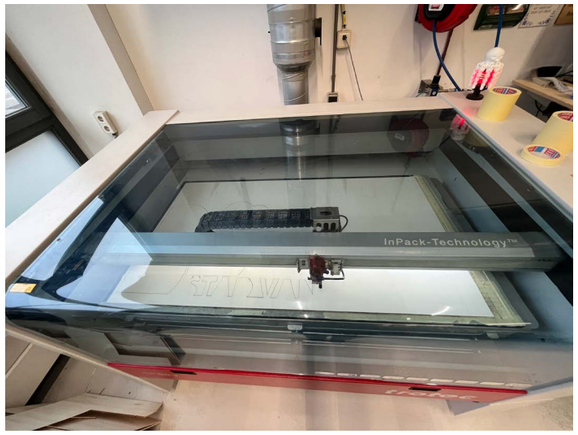


Figure 47: Laser cutting facilities at the PMB

C3.3 Evaluating the interaction

Evaluating and validating the intended interaction

To validate the intended interaction, an evaluation test was conducted at Museon-Omniversum. The purpose of this test was to assess how this concept scores on the part of the timeline highlighted at the beginning of this chapter. In addition, it was interesting to investigate whether this interactive technique caught on with the target audience. For testing, a test plan was made and a suitable location was found on the ground floor of the museum: the target location. Table 2 presents a summary of the test, the full test plan can be found in Appendix F.

Key findings

The analysis of the test results is done using guide cards and the research questions. A selection of important insights is visualised in the insight maps in figure 48. A complete overview of this cycle's insight maps can be found in Appendix G.

Set-up

Who **40 families** observation (children aged 4-14)
5 families qualitative interview

What Evaluating test according to research questions and guide cards **5, 7, 9, 10 & 11**

When **28 February - 2 March**
(during the school holiday)

Where People & nature zone -- Fashion & clothing zone
One Planet NOW!

Why To **evaluate** how the concept exhibit **fulfils** the **specified part of the timeline** in *cycle 3.1*

Research questions

- To what extent are visitors engaged in self-reflection on the topic?
- To what extent does the interaction prompt visitor-initiated discussions?
- What kind of social interactions can be observed during the interaction?
- How do visitors perceive the interactive experience?

Reflection

The initial prototype was tested with about 20 families on Tuesday. Thereafter a modified version of the prototype was tested with another 20 families on Thursday. A revision on the tests lead to **small changes in the prototype**. The poster was simplified to one that was more visual. On Thursday verbal support was offered to guide awareness (step 1 of the transformative timeline) instead of relying on the poster.

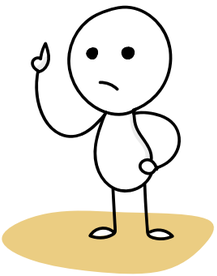
Anticipating the busyness of a school holiday in the museum proved difficult. The crowdedness meant that not every test participant could be spoken to before or afterwards, and the results of the test are largely based on **observations**. **Only 5 families could be invited for a qualitative interview**. As a result, children below 6 years old and above 10 years old are also observed while interacting with the concept. However, the many observations did provide valuable results on the concept as well as on the dynamics of the museum during school holidays and weekends. The crowds also provided a bustling environment were the **visitors felt free to confidently act** and did not feel observed.

A more extensive reflection on the test can be found in Appendix FIXME.

Table 2: Test plan summary

Enable to Self-Reflect

For young children, it is important to have a parent as a facilitator to enable them to reflect. During the interaction with the benefits on the screen, reflection is occasionally observed. More reflection is observed when voting on the board. The parent takes the role of asking the child why they will take the bike in the future. It is observed that the child then tries to think to make a decision. Sometimes a conversation follows between parent and child as to the reasoning.



QUOTES

**"A: Why do you go by bike? B: To save money
A: No haha, that's what mum always says, we go by bike because it's cheaper. What do you really like about cycling?"**

Learn by Social Interaction (children & adult)

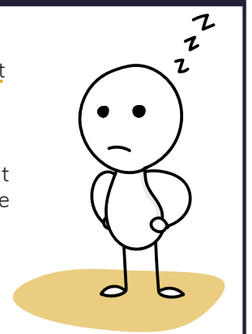
When parent and child end up at the object together, in most cases a facilitator-explorer interaction occurs between the two. The parent guides the child that performs the actions. The parent makes sure to interact on the actual content. Some parents explain extra information or ask questions.

QUOTES

**"When you cycle to [...] you feel very free, right? Then you are independent!"
"Which of these reasons do you consider important?"**

The Form

The narrative of the concept exhibition did not provide an additional level of engagement. It often caused the initial engagement to be broken. Children were amazed by the object, but however when they started the narrative it was seen that most did not engage in this. The narrative in this form and execution is engaging enough for a visitor to immerse themselves into the content.



QUOTES

"Cycling? BORING!"

Figure 48: Most important insight maps of cycle 3

Conclusions

The key findings from the evaluation tests of the prototype are translated into actionable points (figure 49) that can be implemented in subsequent cycles.

ACTION POINTS

1. The social interaction that occurs now when interacting is very valuable and should be ensured in future designs. To marvel together and help each other discover are key qualities that make the social interaction succesful.

2. More discursive approaches should be researched and implemented in further concepts to increase the level of self-reflection and discussion among visitors. How could other discursive approaches result in more reflection and discussion?

3. Further thought should be given to how the concept's polarising technique can be implemented in other ways. For example, by increasing the size of the exhibit and changing the task of the exhibit. Would this benefit the interaction?

4. In the current form and execution does not excite and engage visitors on the topic of cycling benefits. It does not reach it's full potential. Which form and execution would do this? Or is there another topic around cycling and mobility that would excite visitors more.

5. By implementing an updated topic, a new narrative will be construded. More research should be done on how to construct a coherent narrative that is understandable from all different kinds of interaction times with the exhibit.

Figure 49: A list of actionable tasks that can be performed in the upcoming cycle

Figure 50: test setup variation cycle 3

cycle 4

Prototyping to deepen the transformative experience

This cycle explains and evaluates the second iteration of a design concept for a mobility exhibit at Museon-Omniversum. After directing the design focus of this cycle, the action points of the previous cycle are considered in *C4.2: Diving deeper*. Thereafter, these insights are translated into a concept that addresses the specified design focus of this cycle. The concept is made experienceable through a prototype, allowing the concept to be evaluated. The gained insights are transformed into actionable tasks for the last cycle; the design of the final exhibit.

Figure 51: Cycle 4 prototype in use

C4.1 Design focus

Incorporating awareness while improving visitor's self-reflection

In this cycle, a larger part of the experience timeline will be addressed (figure 52). In ***cycle 3***, much was learned about self-reflection and visitor interaction. To create a design that aligns with the transformative experience journey outlined in ***C2.2: Exhibition approach***, the focus on self-reflection will be maintained in this cycle. It is attempted to deepen the visitor's self-reflection during the interaction to achieve a higher sense of engagement in the problem. Additionally, based on the findings in ***C3.3 Evaluating the interaction***, where it was discovered that insufficient arousal or engagement hindered the catalysis of transformative learning experiences, the initial segment of the timeline will be added to the main design focus in this cycle.

Cycle 3 led to a few actionable steps that will be further highlighted in this cycle. *C4.2: Diving deeper* conducts research on discursive methods that can be implemented to ensure that a concept can lead to more self-reflection and discussion among visitors. Furthermore, research is conducted to change the subject of the exhibit. These insights will be considered to devise a new concept, that will be explained and evaluated in the remainder of this cycle.

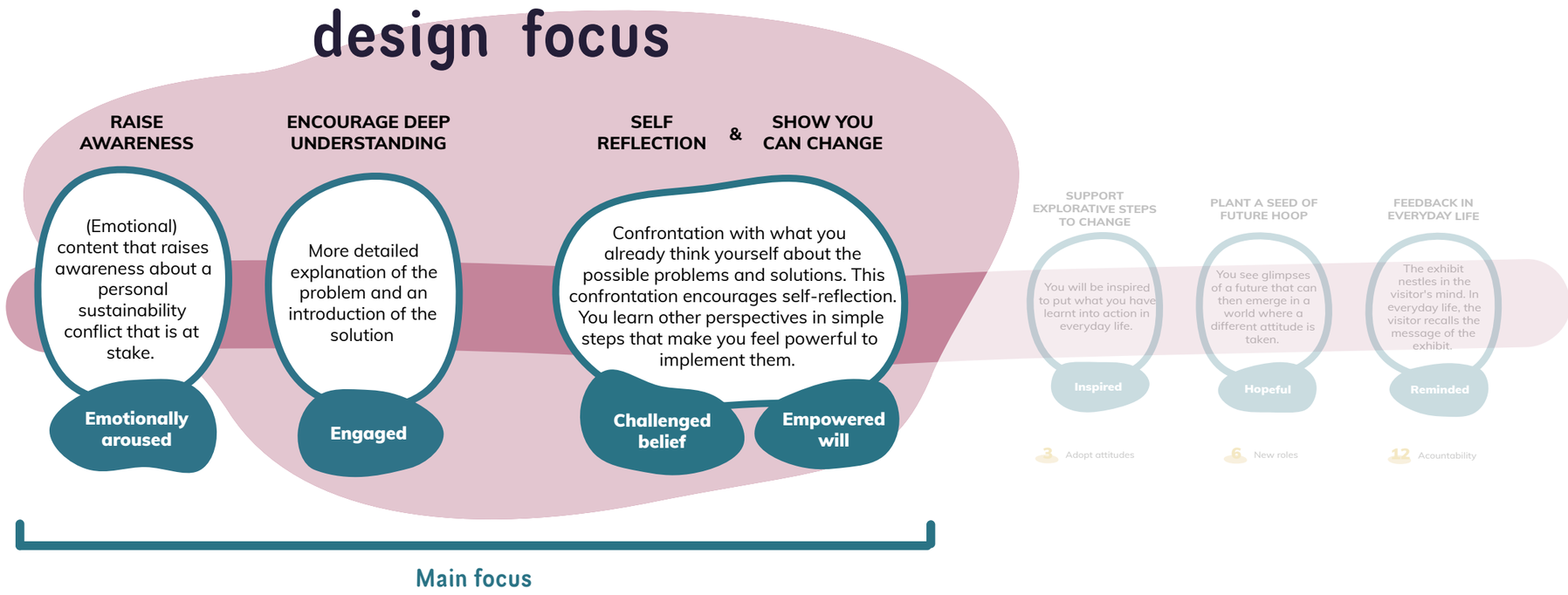


Figure 52: Cycle 4 design focus to incorporate awareness while improving visitor's self-reflection

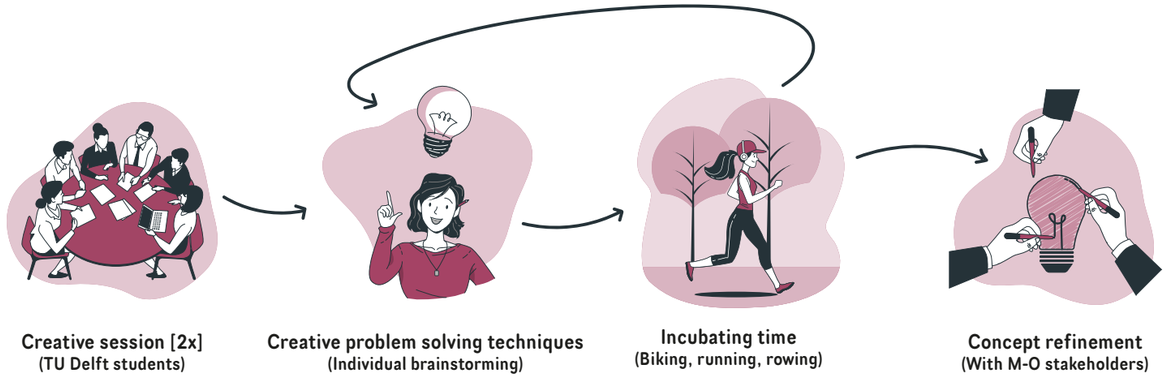


Figure 53: Design methods and techniques cycle 4

Methods

To generate ideas for the second iteration of the concept, a range of techniques (figure 53) were used. Initially, two creative sessions were conducted, followed by the application of diverse creative problem-solving techniques to stimulate a fresh wave of interaction ideas. Regular 'incubating breaks' were held to allow the ideas to mature. As a result, a novel concept emerged and was further refined based on valuable input from Museon-Omniversum stakeholders.

C4.2 Diving deeper

Zooming out in order to discover

Discursive exhibition

In a discursive exhibit, the object you are presenting becomes part of a system you can analyse. An object is no longer an object, but it is evidence for investigation (Wigley, 2016). Sitzia claims that discursive exhibition spaces “foster negotiation and debate, polarize and politicize space, and invite discussion fraught with contradictory views,” whereas immersive exhibition designs seek to generate information related to emotions and personal experiences (Sitzia, 2016). But how can a combination of these be achieved?

Museon-Omniversum is looking for a playful and interactive exhibition that yet also has a reflective element. How can elements of discursivity be brought into that playful experience, which could be called more of immersive nature? Developing a dialogue requires that participants are called upon to think actively. You also need multiple voices around a given theme (Kester, 2004). *Cycle 3* showed that one way to actively provoke participants to think is by asking them questions, specifically open-ended questions. Literature also suggests that discursive exhibits are often established textually or by a facilitator leading a discussion. This means that for the exhibition at Museon-Omniversum, more textual prompts to support parents can be used, to make the the exhibition more discursive.

Sustainable drive

In the previous cycle, it emerged that the narrative, the storyline, of the concept did not yet appeal enough to the visitor. In its current form, the story does allure visitors to deepen their interaction with the exhibit. It would be interesting to explore whether a different angle could produce a more gripping story about a bike-rich future for the visitor.

In light of these findings, a decision was made to organise a creative session with two groups of TU Delft students. One of these sessions was primarily focused on generating creative ideas about the current question, while the other session explored the potential impact of a bike-rich future. During the latter session, an interesting theme emerged: envisioning how our world could be transformed if cycling became the norm. An assignment in the session entailed drawing a picture of a future city characterized by cycling. The drawings showed numerous positive aspects of such a world, including clean and fresh air, abundant green spaces, and inclusivity for those who might currently be hesitant to cycle. These depictions portrayed cities that would appeal to everyone, offering a glimpse of a utopian cycling city. An example of such a utopian city is depicted in figure 54.

It is important to note that this finding was derived from the perspective of students. Students’ perceptions are different from a child’s perceptions in various ways. Therefore, it is important to also investigate whether children respond similarly to this phenomenon.

Figure 54: Utopian cycling city

C4.3 Concept: ‘Stad van de Fiets’

Explanation of the deepend interactive concept

At the concept exhibit ‘Stad van de Fiets’ (figure 55), visitors can explore the future utopian city of the bicycle. Visitors playfully explore what this future city could look like and what the implications of cycling in the design of a city are.

Visitors can compare two images of an intersection: one depicting the current reality and the other showcasing a transformed city where bicycles and humans dominate. The second image is hidden behind a special screen, which allows the visitors to playfully uncover this alternative cityscape. What are the differences? Around the screen, open-ended questions encourage visitors to share their observations and impressions. What do you see? What do you hear in this city? On the back of the installation, a neighbourhood planning puzzle presents different modes of transport and their impact on the street layout. Visitors can engage in a hands-on exploration of spatial planning by selecting elements to design their neighbourhood.

Appendix H presents more in-depth details about the ‘stad van de fiets’ concept, such as the full-scale picture of what is hidden on the screen and close ups of puzzle results.

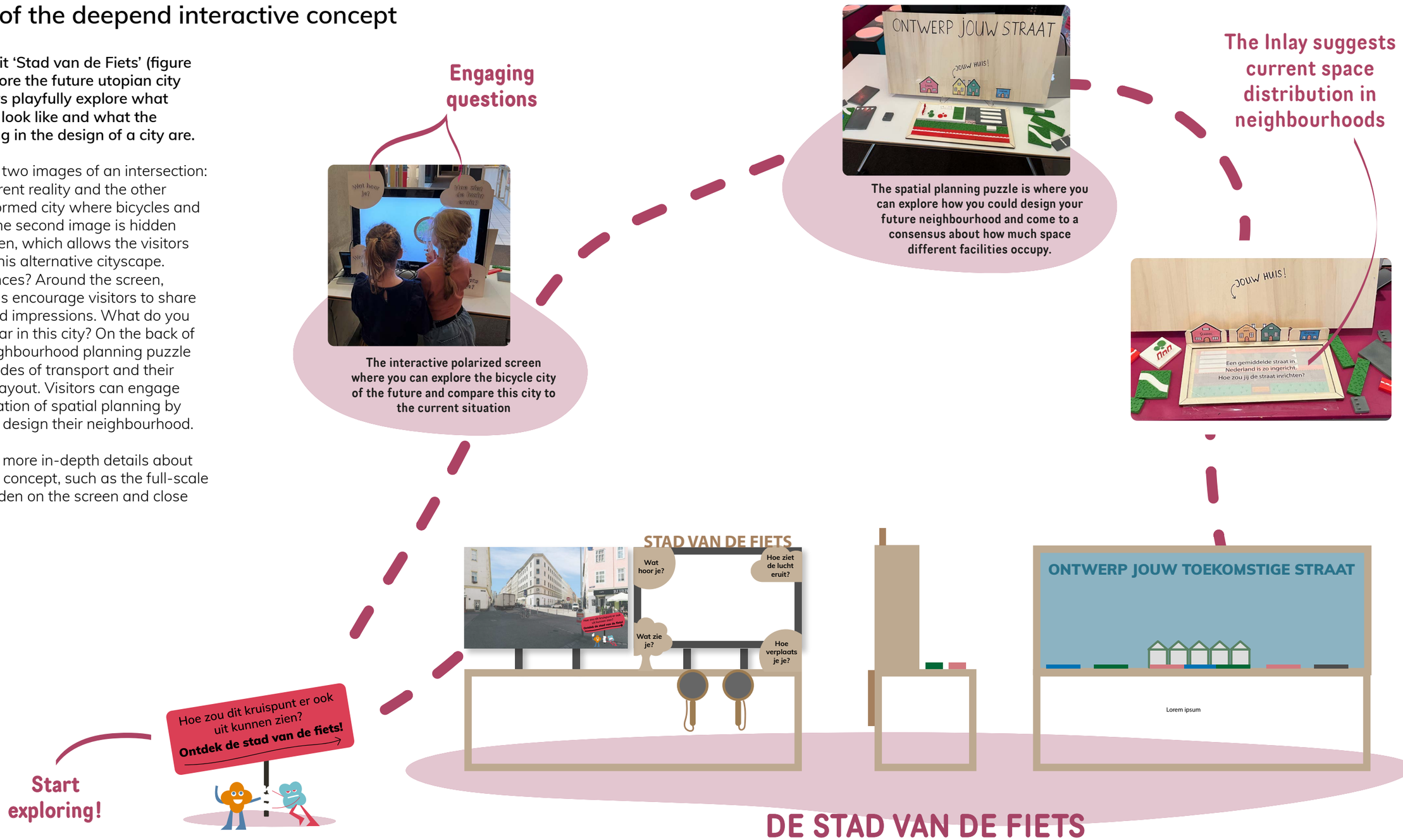


Figure 55: Concept visualisation: ‘Stad van de Fiets’

Figure 56 & 57: Cycle 4 prototype in use

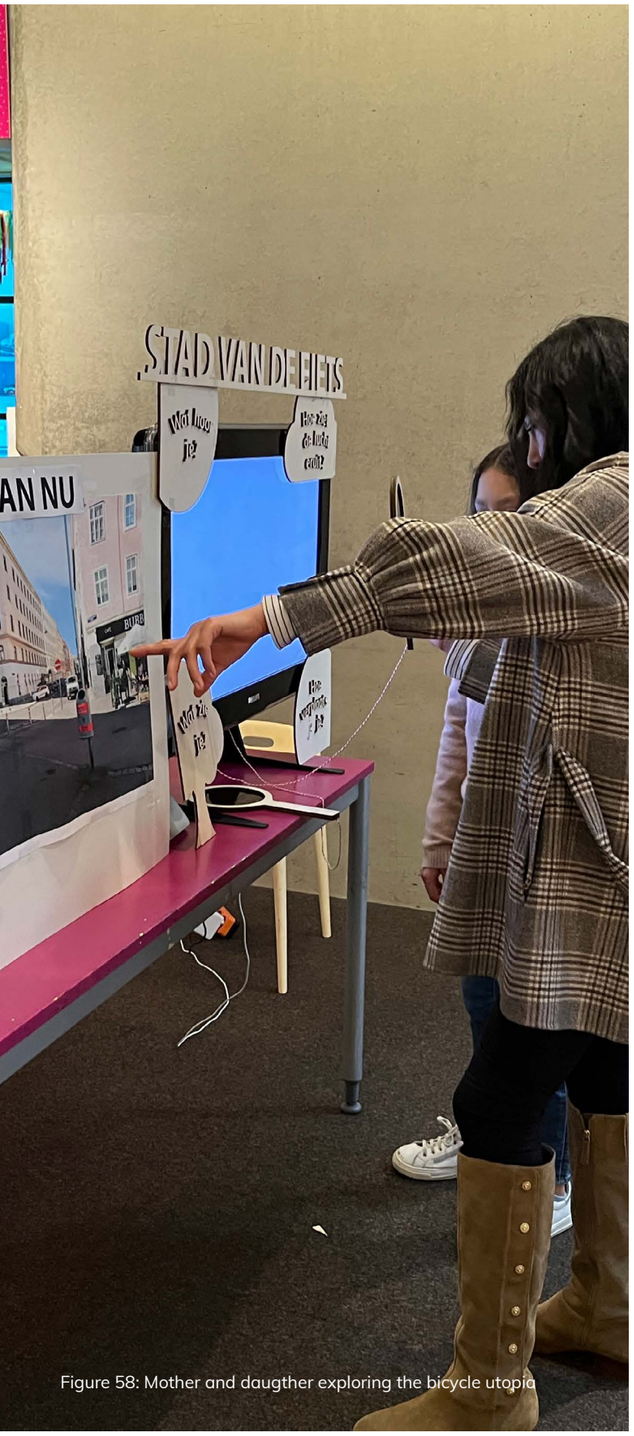


Figure 58: Mother and daugther exploring the bicycle utopia

Concept meaning

The visitor is interactively immersed in a world of a city designed for human-powered transport instead of cars. While searching along the large screen image with their magnifying glass, they reflect on what they see. What will the sky look like in this city? What modes of transport do I see? The visitor experiences this by searching across the screen. This part of the exhibit aims to raise awareness of a personal conflict and challenge the will and belief of the visitors on the topic of bicycles and the layout of the city. This city is beautiful, but what are its implications?

The second part of the exhibit is less utopian and more connected to real life. It hopes to deepen the understanding of the phenomenon at stake. What could happen in a neighbourhood if we could be less dependent on the car? What might our street look like, if a car no longer needed to be parked right outside our door? By experimenting with placing the different blocks in the restricted puzzle tray, visitors learn about space planning and reflect on their priorities. The puzzle attempts to create an entrance for self-reflection in the narrative of the visitor.

Developing a prototype

Both elements of the concept are prototyped. For the interactive screen, a 32-inch LCD television is used to display the utopian image. Again, the polarizing filter is removed to hide this picture (figure 59). The display is surrounded by wooden signs that introduce questions about this world. Nex towv the screen is a poster, the same size as the television, that displays the current situation of the intersection. Different intersections are used in the prototype. On the poster, there is an instruction about the objective of the task.

For the spatial planning puzzle, 3D printed parts (figure 60) are used as abstract puzzle pieces of neighbourhood elements. They are spray-painted to make it clear what elements they represent. A simple street is visualised on the backdrop, indicating school, your home and a sports hall. On the puzzle board the current street situation is displayed, printed on top of this image is the task.

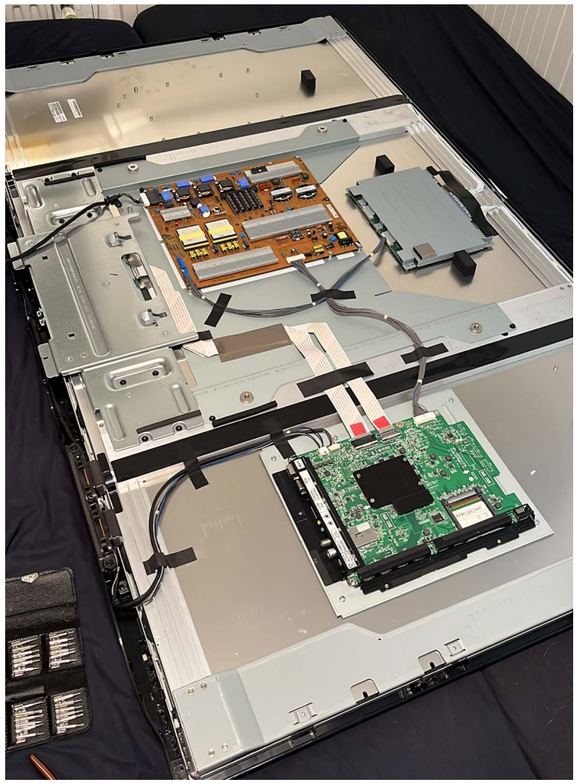


Figure 59: Dismanteling LCD TV to remove polarising filter

Figure 60: Variety of 3D printed and coloured parts

C4.4 Evaluating the interaction

Evaluating and validating the intended interaction

To validate the intended interaction, an evaluation test was conducted at Museon-Omniversum. The purpose of this test was to assess how this concept scores on the part of the timeline highlighted at the beginning of this chapter. For testing, a test plan was made and a suitable location was found on the ground floor of the museum: the target location. Table 3 presents a summary of the test, the full test plan can be found in Appendix I.

Key findings

The analysis of the test results is done using guide cards and the research questions. A selection of important insights is visualised in the insight maps in figure 61. A complete overview of this cycle's insight maps can be found in appendix J.

Set-up

Who **15 families** observation (children aged 6-14)
10 families qualitative interview

What Evaluating test according to **research questions** and guide cards **1, 5, 7, 8, 9, 10 & 11**

When **15 - 16 April** (during the weekend)

Where Fashion & clothing zone **One Planet NOW!**

Why To **evaluate** how the concept exhibit **fulfils** the **specified part of the timeline** in *cycle 4.1*

Research questions

- What kind of personal awareness is triggered?
- To what extent does the visitor understand the problem at stake?
- To what extent are visitors engaged in self-reflection on the topic?
- To what extent does the interaction prompt visitor-initiated discussions?
- What kind of social interactions can be observed during the interaction?
- How do visitors perceive the interactive experience?

Reflection

The initial prototype was tested on Tuesday with three families of which the children fell into the target age group. However, it soon became evident that a **regular weekday did not yield a sufficient number of families** within the target audience, as most of the children present were under the age of five. Consequently, a decision was made to **shift the remaining tests** to the weekend, in the hopes of attracting more families fitting the target criteria.

Insights gathered from the pilot test prompted slight **modifications to the concept's setup**. More space to interact and cooperate was provided and the task and explanation of the spatial puzzle was refined. Although the weekend testing did not replicate the bustling environment of a school holiday, which was the case in the evaluation test of cycle 3, it did involve an **additional 12 families** who participated in the experience. The relatively quieter museum setting resulted in **more in-depth qualitative interviews**. However, during the observation, it became apparent that visitors felt **less inclined to confidently engage and explore**, likely due to a heightened sense of self-awareness, and awareness of an observer in the less crowded surroundings.

A more extensive reflection on the test can be found in Appendix FIXME.

Table 3: Test plan summary

The Form

The narrative in this form already captures the imagination more than the combination in cycle 3. More discussion occurs and more content is sought for elements of the narrative. However, the exhibition can benefit even more if the interaction with the narrative becomes even more personal. The questions asked now are general and only personal in some areas. These personal questions would allow even more visitors to relate the reflections to themselves as well.

The Medium

The polarised screen, displaying the bicycle city, still works well as a medium for young and old. Visitors are still appealed by the medium. Compared to cycle 3, this combination of medium and content offers a more dynamic whole. The interaction is less likely to be cut off after the initial amazement about the technique. Visitors are engaged with the medium longer because of the content.

QUOTES

"Do you want to explore a bit more? What do you see in that corner? Green?"

Cooperation around Object

Placing two interactions behind another does not create a connection between the two objects. If something has more connecting edges, you can facilitate transition between these two elements. Now, often no transition between the two elements could be observed without verbal cues to this. The elements fit well together, however, a different arrangement could facilitate more transitions between the two.

QUOTES

"Oh here's another part too, look!"

Figure 61: Most important insight maps of cycle 4

Conclusion

The key findings from the evaluation tests of the prototype are translated into actionable points (figure 62) that can be implemented in subsequent cycles.

ACTION POINTS

1. The task and mission of both elements could be adjusted slightly further so that visitors experience even more personal involvement.

2. The middle ground between a visual and textual approach should be explored. The story needs to be made more complete through a good medium.

3. There should be clear feedback back to the ultimate goal. Is the transformation goal still to get more people on bikes? How is this embraced in the design?

4. More experimentation and learning is needed about the arrangement of the elements in relation to each other.

5. There is still a battle to be struck on the narrative. What is the middle ground between hopeful and realistic. What is desirable for a transformative experience?

Figure 62: A list of actionable tasks that can be performed in the upcoming cycle

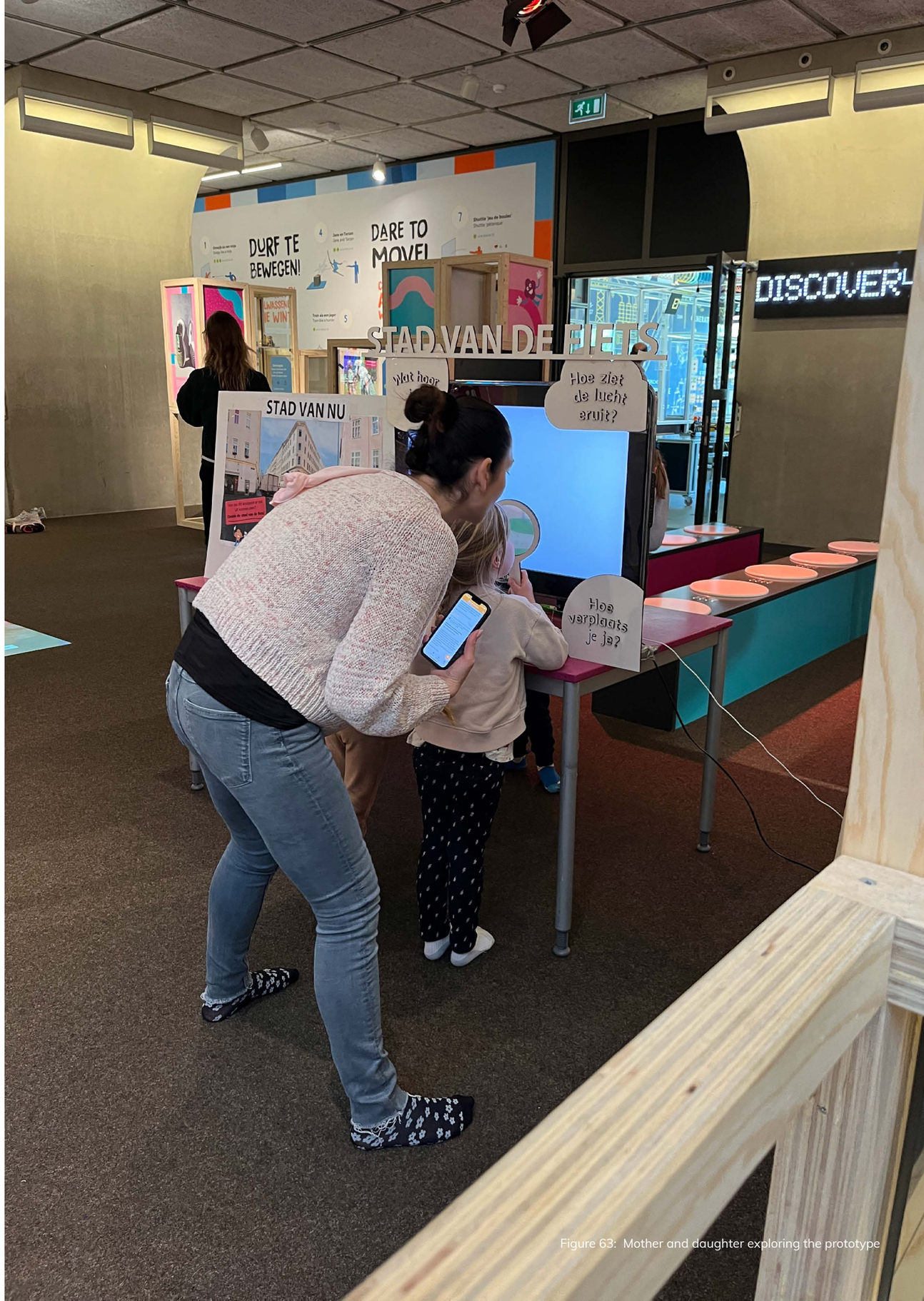


Figure 63: Mother and daughter exploring the prototype

cycle 5

Developing the final transformative experience

This cycle explains how the knowledge and insights from previous cycles have led to a final concept exhibit for Museon-Omniversum. First of all, the design and evaluation focus of this cycle is clarified. Thereafter, the latest discoveries are described, leading to the concept: *“Pedalling towards sustainable urban mobility”*. The concept is made experienceable as a standalone exhibit located in the mobility zone of the museum, allowing the exhibit to be qualitatively evaluated. Lastly, this evaluation is described and performed. The gained insights are transformed into short and long-term recommendations, whereby this thesis is concluded.

Figure 64: Final interactive exhibit

C5.1 Design and evaluation focus

Incorporating inspiration and hope while refining awareness and reflection

In this cycle, the complete project scope of the timeline as stated in **C2.2: *Exhibition approach*** is addressed. In cycles 3 and 4, much was learned about awareness, engagement and self-reflection. In this cycle, this part of the timeline will be perfected, to fit the transformative learning experience. As promising results have been achieved on the first part of the timeline, this cycle will also include the two follow-up steps of the transformative experience timeline, inspiration and hope, in its design and evaluation.

Cycle 4.4: Evaluating the interaction led to actionable steps that will be further highlighted in this cycle. *C5.2: Diving deeper* starts by recapping the design goal, where after personal involvement is researched. These insights and further refinement sessions result in the final concept for the exhibit. The concept will be explained and evaluated in the remainder of the cycle.

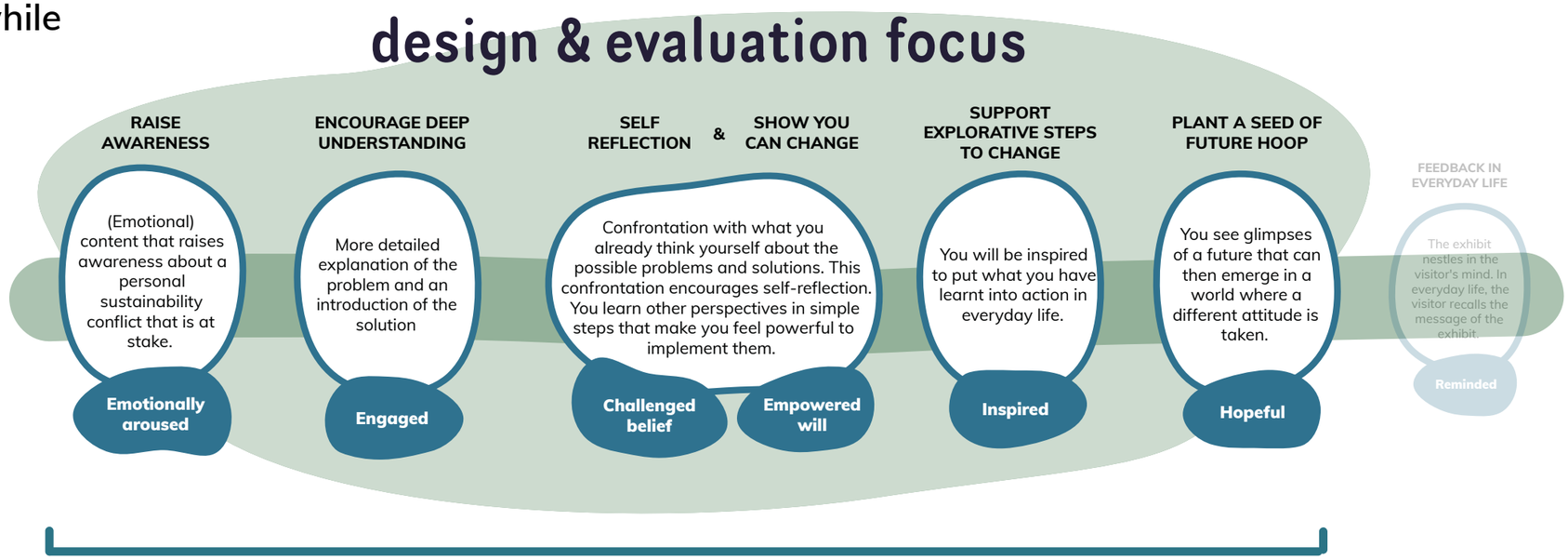


Figure 65: Cycle 5 design focus to incorporate inspiration and hope while refining awareness and reflection

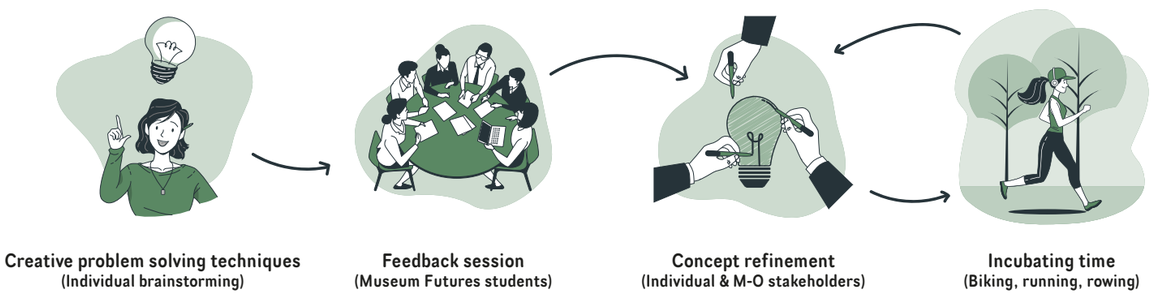


Figure 66: Design methods and techniques cycle 5

Methods

To generate ideas for the final iteration of the concept, a range of techniques (figure 66) were used. These creative techniques were mostly used to stimulate the improvement of the existing concept and take it to the next level. Notably, the regular input provided by Museon-Omniversum designers and technicians was valued more than ever in detailing the concept. Furthermore, the deliberate inclusion of regular 'incubating breaks' played a pivotal role in maturing the idea. As a result, a stand-alone concept that fits into the One Planet NOW! mobility area emerged.

C5.2 Diving deeper

Zooming out in order to discover

Recap on the design goal

In light of developments in *C4.2: Diving deeper* where the approach to the subject of cycling has been modified, it became apparent that these modifications are not adequately reflected in an updated design goal and storyline. Therefore, this sub-chapter presents a refined design goal and narrative for the exhibit.

In defining the goal and purpose of this exhibit within the zone, it was established that the exhibit should let visitors experience a behavioural change in terms of transport mode choice. Choosing the bicycle more often than choosing the car. Two approaches were tried to achieve this. First, an attempt was made to get people to cycle more by convincing them of the benefits of cycling. Thereafter, a futuristic utopian image of a city full of bicycles where the visitor is challenged to reflect on their mode of transport choice. This experience lets visitors discover that this choice has a lot of impact on the city and thus hopes to indirectly inspire people to take the bike more often. In *cycle 4: Prototyping to deepen the transformative experience*, it emerged that the latter seems a promising entry point for raising awareness of a new and original personal mobility conflict. Therefore, this cycle will work further on an improved concept via this angle. This realisation resulted in a refined design goal and story (figure 67).

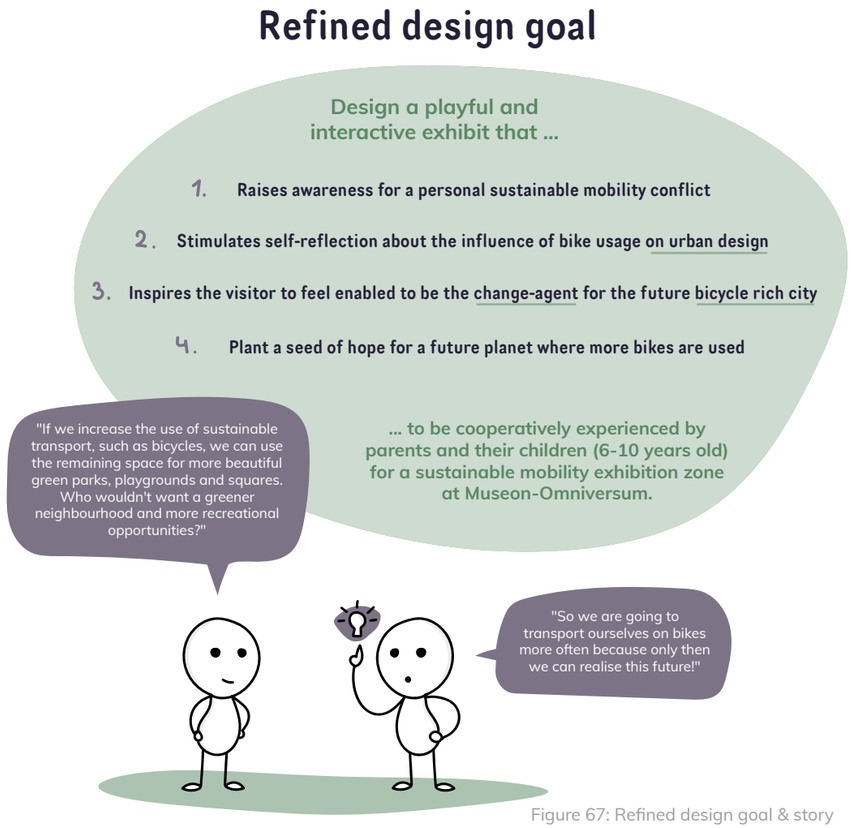


Figure 67: Refined design goal & story

Personal involvement

In *C4.4: evaluating the interaction*, it emerged that the concept led to personal conflict among some visitors. The utopian image of the city of bikes was seen as a beautiful and a hopeful future prospect. Who wouldn't want to live in such a beautiful green city full of space for people? But at the same time, there was also a moment of conflict among these visitors. Because yes, this vision of the future is beautiful, but there are also many things that will no longer be possible. For example, how will weekly groceries be brought home effectively? Those cannot be transported all in one go on a bike. Conflicting thresholds were discovered, especially by parents, which can be attributed to a personal conflict being present. The question that arises is: how can we design the exhibit such that these inhibitions can be turned into strength and inspiration for change? This can be done by putting the situation into perspective. For instance, there might still be room for delivery trucks from online supermarkets or there might be bicycle streets where cars are guests. These are some examples that could turn sceptical feelings into hope and empowerment.

In addition, more families could also be captured to think about their personal commitment to the city. Now about half of the families saw personal conflict, the other half were just observing what they saw. This could be done by thinking more about the reflective questions being asked. For example, to encourage more personal connection, one could ask: would you like to live in this city? This puts the visitor in the situation in a more direct way, ensuring personal involvement.

C5.3 The concept: ‘Pedalling towards sustainable urban mobility’

Introduction and explanation of the final concept

The interactive exhibition ‘Pedalling towards sustainable urban mobility’ (figure 68) is a hands-on experience that introduces visitors to a city where bikes are the main mode of transport. In the exhibit, visitors can magically discover a hopeful future vision of the city of bikes. The intersection in front of the museum has been transformed into a utopia without cars. Visitors are encouraged to explore what is going on in this world. Would they want to live in a city like this? The connecting part of the exhibition deals with the influence of means of transport on urban planning. Visitors will have the opportunity to reflect on how transportation choices affect the construction of a city. If cities become less dependent on cars, much more space will be left for beautiful green parks and squares.

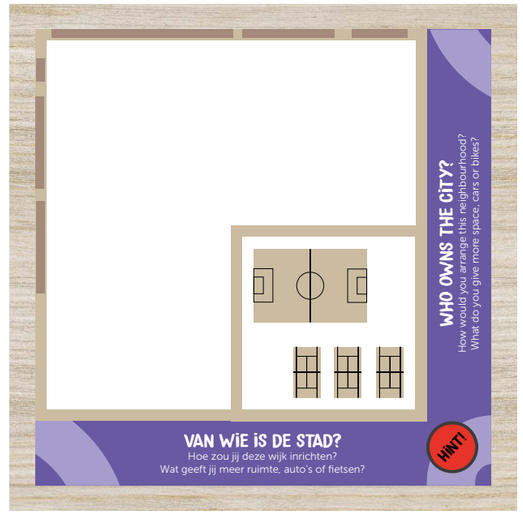
In two different exhibits, visitors are supported to explore and reflect on the influence of bicycle use on the spatial organisation in a city. A cycle path occupies significantly less space and facilities than automated vehicles. With positive approaches to cycling, the exhibition hopes to show visitors that they can make a difference. Visitors leave the exhibition feeling hopeful, the future bicycle city looks bright. Parents and children have learned from a new and original perspective why they should take the bike more often in the future.

Concept meaning

During the exhibition, parents and their children face a personal mobility conflict together. The vision of a green city, rich with spaces for bicycles and people, presents an appealing prospect for the future. However, this idealistic vision comes with significant practical challenges, as it requires a radical shift in transportation habits.

Top view

Cover the white puzzle area with 3D puzzle pieces



Who owns the city?

Discover the influence of transportation on the urban planning in a puzzle

Bicycle city

Magically discover a future vision of a city full of bikes

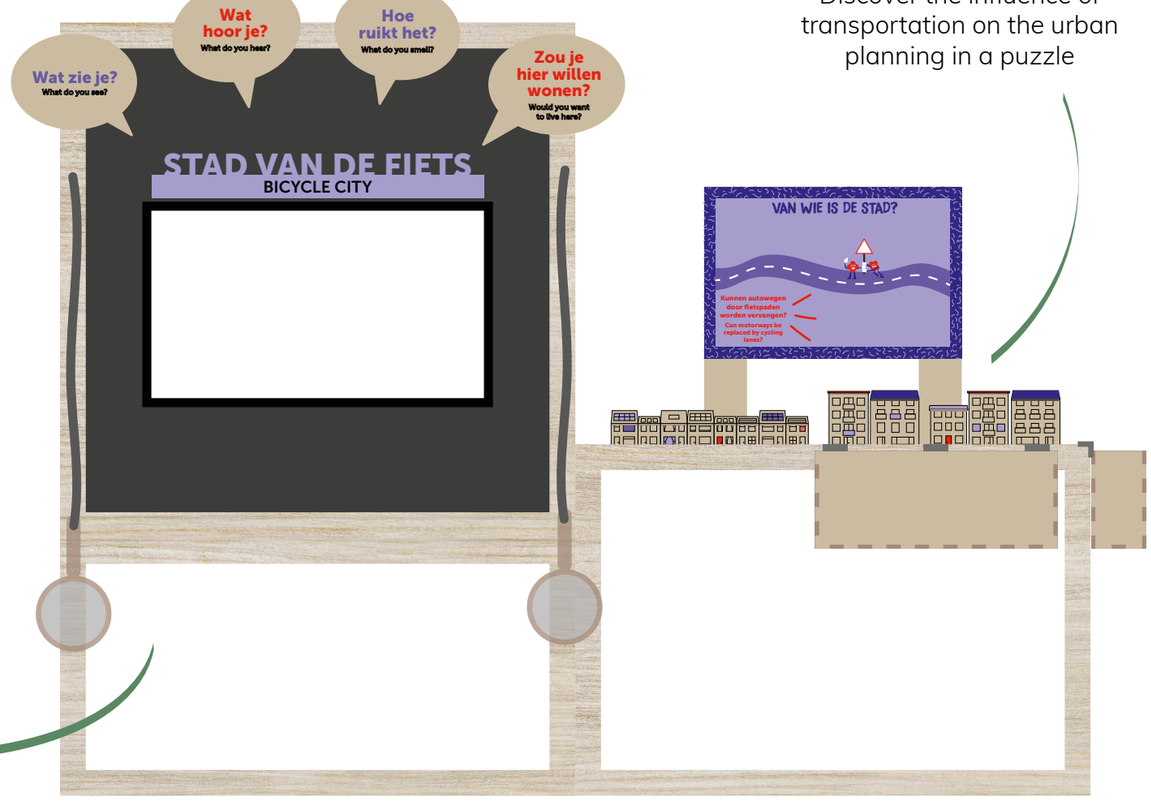


Figure 68: Concept visualisation ‘Pedalling towards sustainable urban mobility’

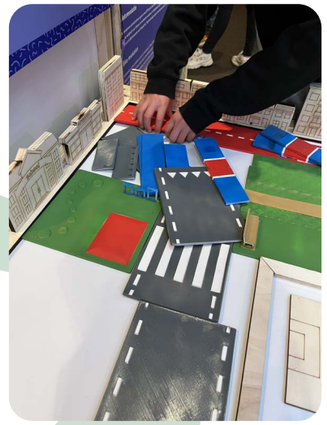
Figure 69: Overview of the designed exhibit | Figure 70: Close up of the hidden bicycle city

C5.3.1 Storyboard

The exhibit catches the visitors' attention. The visitor's attention is grasped by the screen. What could be seen on there?

With a special magnifying glass you can explore a utopian bicycle city

Together, you can discuss what this city entails. The supporting questions can help to do so.



Subsequently, you can start designing a city in the neighbourhood puzzle

Discussions are sparked about designing the neighbourhood. Together, you make trade-offs and build the future neighbourhood.

If you press the button, a hint will be provided.

The hint will magically appear on the box behind the puzzle table.

The familiy leaves the exhibit full of inspiration and proud of the result. They have built a neighbourhood that is cycling-friendly and hopeful.

C5.3.2 Key aspects of the concept

Emotional awareness about a personal sustainable mobility conflict

The search plate of the ‘Bicycle city’ (figure 71) shows a utopian image of a future city. Feelings of hope create an emotional attachment to the subject. At the same time, reality creates a sense of conflict with this utopia. Emotional awareness about this conflict emerges.

Emotional conflict **Awareness**

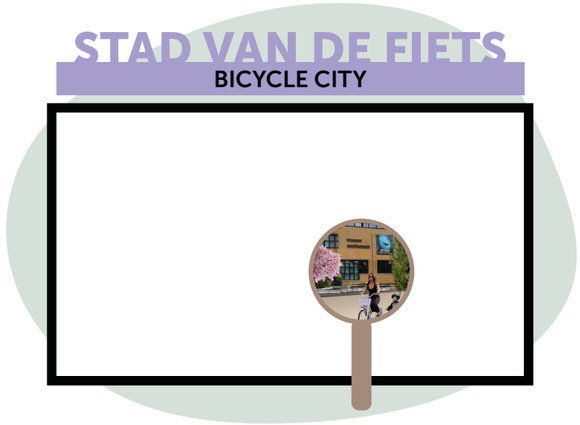


Figure 71: The search plate

Figure 72: Children and father marveling at the bicycle city

Magic interaction of wonder

The ‘Bicycle city’ offers a magical interaction to visitors. Together, you can marvel at things that cannot be seen with the naked eye (figure 72), but can be seen with a special lens. This wonder has an attraction and creates a social learning interaction between visitors. This social interaction is the starting point for exploring the exhibition together and reflecting on the topics covered.

Social interaction **Playful**

Support in understanding

The exhibition offers support (figure 73) to understand the topic and invite visitors to delve more deeply into it. By asking inquiring questions, visitors are invited to be part of the research themselves.

Understanding **Reflection**

Figure 73: Supportive questions on parent’s eye height

Figure 74: Hands-on city puzzle

Inspire by posing statements and asking questions

During the puzzle, visitors are supported in puzzling by various inspirational questions. With a push on the button, a random question is posed (figure 75). These questions help them reflect on the puzzle they have put together. Why have certain pieces been placed in one place, could they be placed otherwise?

Support

Figure 76: Overview of the installation in use, family is departing

Hands-on self-reflection

The city puzzle “Who Owns the City?” (figure 74) offers a hands-on way of reflecting on urban planning and transport mode choices. It is a physical way of discovering and learning what implications cycling can have for the design of a city.

Deep understanding **Self-reflection**

Figure 75: Box that poses inspirational and supportive questions

Future inspiration & hope

Visitors leave the installation feeling inspired and hopeful. They have learned in a new and surprising way why cycling can be a beneficial mode of transport. Visitors are inspired to get involved for a wider and greener city.

Inspiration **Hope**

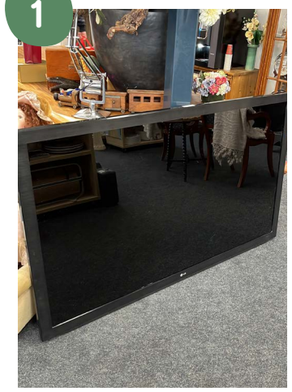
C5.3.3 Interactables

Polarised interactive screen [image 1-3]
The top polarising layer of the screen, which is incorporated in the cube, has been removed. As a result, the LED light emitted by the TV is no longer polarised, so the TV only emits white light. If you hold a polarising filter in front of it, you can see what kind of image the LCD screen is emitting.

Magnifying glasses [image 2,4]
The magnifying glasses hanging next to the TV contain a polarisation filter. The loops can be used to explore the screen. The glasses are attached to the cube with a sturdy wire, preventing them from being taken away and also preventing visitors from getting too far away from the picture, so searching the displayed image remains a real quest. The loops are 3 layers of 5mm laser cut wood, the middle layer embeds a 5mm circle plexiglass with the polarising filter attached to it.

Appendix K presents a the full proposal on how all parts are produced.

1



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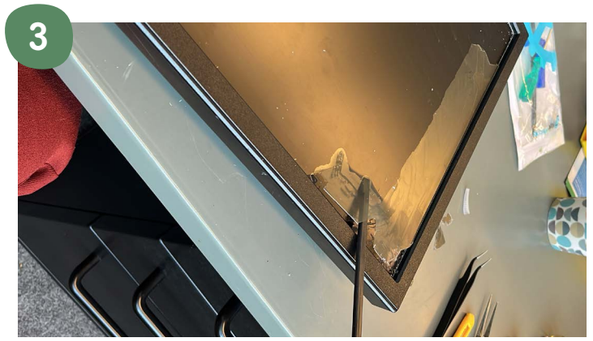

4

Note
The numbering of images in this sub-chapter is different from the rest of the document. After this chapter, the numbering continues as before.

Museon-Omniversum Utopian street [image 5]
The image that is hidden of the screen is a photoshopped utopian view of the intersection that lies before Museon-Omniversum. The normally busy car intersection has been transformed into a green oasis with cycle paths and space for people to walk and play. In the background, you can see the unchanged Museon-Omniversum museum building. For visitors, this must be a somewhat familiar intersection; they have passed it on their way to the museum. The image is made with Adobe Photoshop.

Speech clouds with research questions [image 6,7]
Above the screen are four speech clouds with research questions. These hang at about 1.60 metres, at adult eye level. These enquiry questions support parent and child during interaction with the exhibit. Through the questions, visitors are triggered to investigate the utopia.

5

6

7

Urban planning puzzle

On a large cube measuring 1 by 1 metre, visitors can design an imaginary neighbourhood, including infrastructure, greenery and other amenities.

- **The framework [image 8]**

Along two of the four sides, buildings have been placed. These are permanently installed and cannot be moved by the visitor. These include terraced houses and apartment buildings, as well as a school and a supermarket. In addition, in the other corner of the playing field, an area with sports fields has been created. This division provides a spatial purpose: the visitor feels tasked to ensure that all elements in the neighbourhood are accessible. These elements are laser cut from 14mm wood and engraved with details.

- **Puzzle area [image 9]**

The puzzle area is L-shaped and defined by boundaries, to it is clear where the puzzle pieces have to be placed.

- **Puzzle pieces [image 10,11]**

The puzzle pieces are three-dimensional and a simplified representation of elements you would encounter in a neighbourhood. The size of the puzzle pieces is roughly based on statistical figures on how much space certain facilities take up in urban planning. The parts are 3D printed and spray painted in representative colours.

8

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- **Storage containers [image 12,13]**

Storage bins are attached to the outside of the cube's frame. Puzzle pieces that are not used can be stored in these. The containers are made from 5mm laser-cut wood and are designed with enclosures for easy assembly.

- **Instructions [image 14]**

Space has been cleared on two sides of the puzzle area for instructions and support for the puzzle. The instructions have been foil printed at the museum facilities. Thereafter, they have been carefully stuck to the base plate of the cube.

12

13

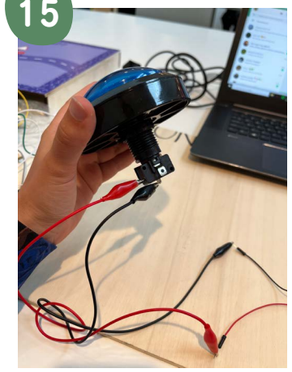
14

Hint button [image 15,16]
A large button can be found on the playfield. Visitors can consult this button if they need support while thinking about the puzzle. The button is wired to the Arduino grove connectors using alligator clips and is used as input for the Arduino program.

Supportive reflective questions [image 17,18]
A push of a button triggers a supportive reflective question to light up. This can be read on the board located directly behind the cube. The board attracts attention because the question is displayed with LED light. A total of 6 reflective questions are hidden on this board. With each press of the button, the next question in the sequence is displayed on this board.

The board is made with a 4-meter Arduino ws2812b led strip. This strip is attached to the back side of the box. Reflective tape ensures the distribution of the LED lights. A sheet of diffusing film ensures the light passes equally through the letters. On the top side of the box, the letters of the questions are laser cut out of a sheet of 5mm wood. On top of this wooden board is another foil-printed sticker so the letters are hidden if no LED light passes through.

15



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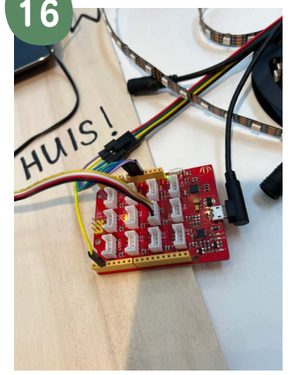

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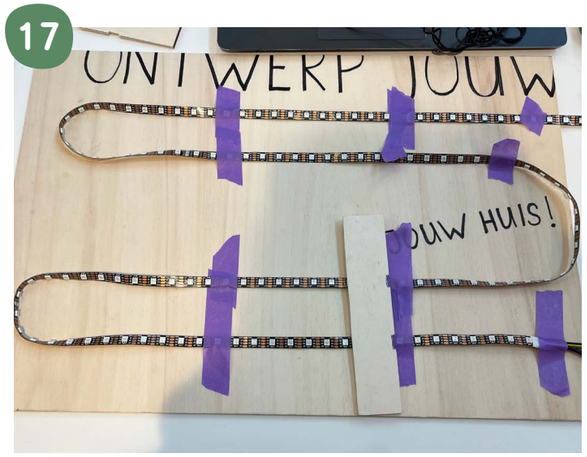

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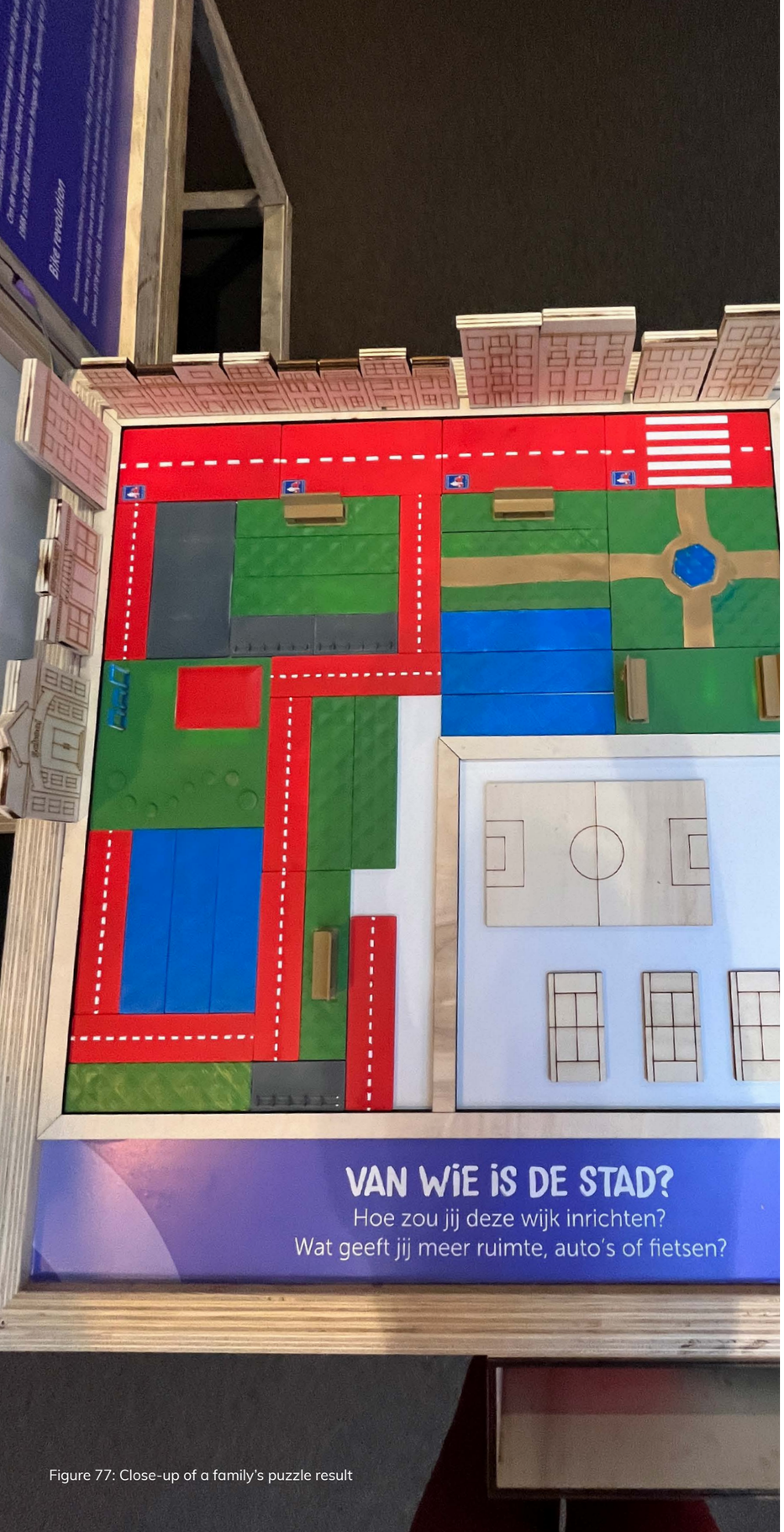

Figure 77: Close-up of a family's puzzle result

Figure 78: Overview of the exhibit

C5.4 Evaluating the interaction

Evaluating and validating the intended interaction

To be able to evaluate whether the final exhibit fulfils the design goal, a final evaluation test was conducted. During four days of the Ascension Day weekend, the prototype of the concept is tested in the mobility zone of Museon-Omniversum. The prototype will be placed in the finished mobility zone, alongside the 'bicycle island', which consists of non-interactive information about cycling and its implications. Table 4 presents a summary of the test, the full test plan can be found in Appendix L.

Set-up

Who **30 families** observation (children aged 6-14) of which **10 families** qualitative interview

What Evaluation test according to **research questions** and the **guide cards**

When **18 - 21 May** (Ascension Day weekend)

Where Mobility zone **One Planet NOW!**

Why To **evaluate** how the concept exhibit **fulfils** the **design goal**

Research questions

Experience
What kind of personal sustainable mobility conflict is experienced?
What kind of social interactions does the exhibit evoke?
To what extent does the visitor experience the exhibit as a hopeful future scenario?
To what extent is the exhibit perceived as interactive and playful?

Effect
To what extent are the visitors able to reflect on the content?
To what extent does the exhibit empower visitors with the will to change?
To what extent is there fruitful cooperation between parent and child?
To what extent are both parent and child enabled to learn?

Usability
To what extent are task and mission of the exhibit clear to the visitor?
To what extent do visitors feel free and confident to act?
In what kind of ways are visitors able to cooperate around the installation?

Reflection

On Thursday, testing was done with about **20 families**, the tests with the exhibit went practicalities-wise very well. The test plan could be **executed properly**, the adjustments from previous tests had been adequately taken to this cycle. On Friday, further testing was done with **10 families**. Content-wise, adjustments were madeduring testing where necessary. The most frequently used **approach routes** ended up on the puzzle part of the exhibit. As a result, the predetermined sequence of activities was not completed. Unfortunately, there was not much that could be done about this due to the available space. Families thus mostly **started puzzling first**.

Visitors mostly thought the **screen** was **out of order**. The magnifying glasses were not seen and the screen was walked past. An extra magnifying glass was stuck halfway against the screen so that a **'hint'** could be seen on the screen. This worked very well, the exhibit was tried by many visitors.

The assignment to the puzzle was very clear, the **button** was not. It often took several minutes for a family to realise what the button was for. Occasionally, therefore, the family was **intervened and support was offered** to visitors who had difficulty with the button.

A more extensive reflection on the test can be found in Appendix FIXME.

Table 4: Test plan summary

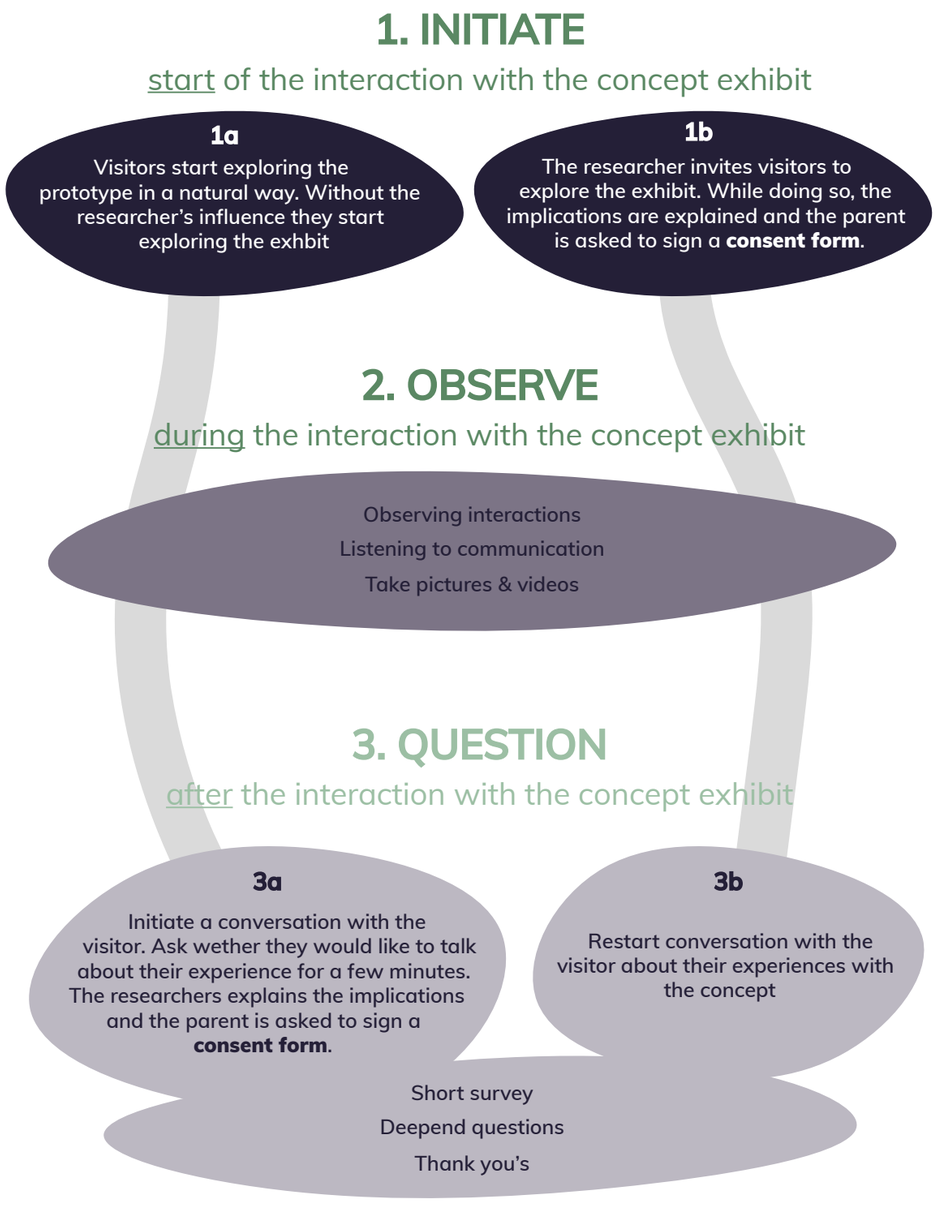

Figure 79: The setup of the flow of the test

Course of the test

The evaluation test consists of three phases, using different methods (figure 79). First, the test with a family is initiated, by either the natural flow of their museum visit or upon invitation of the researcher. During their interaction with the exhibit, the visitors are observed. Afterwards, families are invited to talk about their experiences. Appendices L and M presents a more detailed version of the process, which includes the observation plan that will be employed and the interview questions that will be asked.

C5.4.1 Key findings

The final evaluation shows that the exhibit is a promising concept in evoking sustainable understanding, enabling self-reflection and inspiring change. This chapter presents the key findings from the evaluation test, providing evidence to support this claim. Initially, general points are addressed, followed by a focused examination of the key findings for each element derived from the various stages of the experience journey.

General

The designed exhibition offers visitors a playful and interactive experience around the theme of cycling in the city. Families can marvel at a city that is pedalling towards sustainable urban mobility. Spatially and content-wise, the exhibit fits into the space and zone and is a valuable connection to the other displayed elements in the zone.

Physical cooperation

However, its current placement ensures that the approach routes most in use end up at the puzzle (figure 80). As a result, the puzzle is most of the time done first resulting in the beginning of the transformative message getting a bit fragmented. This certainly does not affect the enjoyment and interactivity for the visitor. In addition, the utopian image can also be a hopeful 'after-effect'. However, the real awareness of a real personal conflict is missing, when the puzzle is done first.

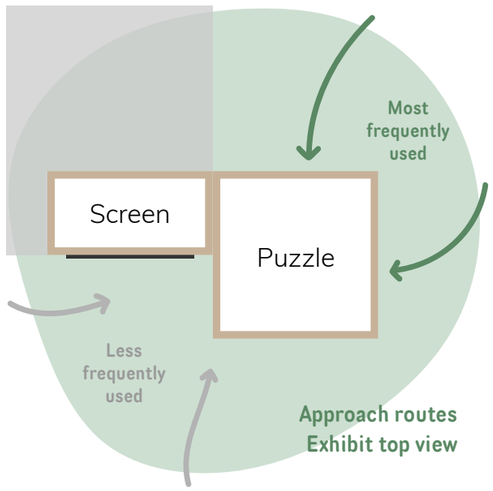

Figure 80: Observed approach routes

Bicycle city

Personal conflict

In the 'Bicycle City' exhibit, half of the visitors encounter a personal mobility conflict. The source of this conflict typically arises from the parent's perspective, while the child's involvement is less frequent. Occasionally, it was found in the interview that conflicts emerged from the parent's perspective, but they chose to not communicate this issue to their child. Interestingly, two families further discussed the conflict during the puzzle exhibit.

The conflicts that arise all fall roughly into the same category. **Such a city is very beautiful, but....** Several things are then mentioned that could be a 'but':

- but, how do I do the shopping then
- but, I can't walk/cycle that far
- but, then I won't get anywhere as quickly
- but, we are far from here

Engagement & reflection

During interactions in the museum, a parent is not always present with a child. However, when a parent is present during the interaction with the screen, the questions prove beneficial for the family in engaging them with the subject. The family members begin to collectively observe and reflect (figure 81) on the events depicted in the picture. In particular the questions "What do you see?" and "Would you want to live here?" effectively facilitate this process. The other questions occasionally lead to slight confusion as they are interpreted too literally, nothing is literally heard or smelled by the visitors.

Figure 81: Familiy relfecting on what they have seen

"I would like to live there though! I see so much space to play outside."

translated, personal communication, 18 May 2023

Usability

The task and objective of the exhibit are not entirely clear to all visitors. For about a quarter of the visitors, the intended purpose was clear, while the remaining 75% found it unclear. Both visitors and museum staff initially believed that the screen was malfunctioning or out of order. The magnifying glasses did not attract enough attention, and the use cues were missing. Displaying a hint on the screen with an extra magnifying glass already led to improvement. Visitors became aware that something was concealed on the screen.

As a result, uncertainty about what to do on the screen prevailed. This uncertainty was particularly evident among parents, leading to hesitancy and a tendency to refrain from active engagement. The interaction lacked a feeling of freedom and confidence to experiment. Children dared to experiment more and were often the first to find out how the exhibit worked. Subsequently, they were the ones to involve their parents in the interaction, encouraging their participation.

"This screen is broken I think, come on let's move on"

translated, personal communication, 18 May 2023

Social interactions

Lastly, several types of social interactions emerge among families. These interactions facilitate a greater level of learning compared to situations where such social contact is absent. Social contact deepens the overall experience by fostering deliberation, collaboration, and discussion among visitors.

Figure 82: Parent & child having social interactions

Who owns the city?

Social interactions

The social interaction is carried through in the “Who owns the city?” exhibit. The urban planning puzzle is an activity that is almost always done together and rarely alone. People consult each other, work together and discuss to reach a result (figure 83). Occasionally, heated arguments arise regarding the placement of puzzle pieces, which can be attributed to conflicts of interest or, more likely, sibling disagreements.

Figure 83: Parent asking child what he thinks

Self-reflection

The spatial puzzle proves to be an effective hands-on tool to design the city. The task is straightforward and comprehended by about 90% of the visitors. Families actively incorporate their needs and desires into the puzzle. For instance, for almost every family, the supermarket should remain accessible by car. So it can be concluded that self-reflection occurs here.

Initially, the majority of families do not understand the function of the button the first time they press it. The button attracts attention and is often the first thing people press when they arrive at the set-up. For half of the people, the function of the button eventually becomes clear after a prolonged interaction or observation. Seriously engaged families use 3 to 4 questions to extend their interaction with the puzzle, while other families are content with addressing 1 to 2 questions.

Three of the six questions work well to increase self-reflection on the subject and the outcome. After addressing the puzzle pieces are moved, added or removed. The remaining three questions are either often skipped or only briefly considered and a short verbal answer is formulated.

Questions that increase self-reflection:

- Are there enough parking spaces available?
- When do you need a car?
- Where can you go by bike?

Learn & cooperation

Children learn how a neighbourhood could also be classified. Investigating and trying out, they learn what is possible in a neighbourhood and that there are differences between car and bicycle facilities. For parents, this is less present; they need more depth to learn. They can get that depth in other parts of the cycling zone, but it requires more reading, which is often not done. What many parents did learn is other perspectives from their children that they may not have known before. For them, it is valuable to discover what their children care about.

> “Actually, children should just be given the reigns of the city, they should have a say, it concerns them the most.”
>
> translated, personal communication, 18 May 2023

Inspiration & hopefulness

Drawing a definitive conclusion regarding whether visitors experience a greater sense of empowerment afterwards is challenging. While hints can be detected of visitors expressing intentions to bike more often and take action, it remains uncertain whether this empowerment is a long-term effect or simply a response prompted by the research inquiries. To form a definitive conclusion, more incubation time, repeated incentives and further conversations with participants are needed.

Nevertheless, various actions do indicate a notable sense of pride associated with interactions at the exhibits. Many visitors take photos of the result, and families depart feeling enthusiastic and proud. Moreover, children in particular speak out about the hopefulness the exhibit offers them. They see no inhibitions yet, this is what they want for the future of their city. In contrast, parents tend to have a more realistic stance, acknowledging that we still have a long way to go. Although the occasional parent dares to dream about this hopeful future, the majority remains hesitant to fully embrace it.

> “When you’re done I’ll take a picture of it hey, you can come and work with mum later”
>
> translated, personal communication, 18 May 2023

Figure 84: Overview of the exhibit in use

C5.4.2 Reflection on the design goal

Design a playful and interactive exhibit that ...

1. Raises awareness for a personal sustainable mobility conflict
2. Stimulates self-reflection about the influence of bike usage on urban design
3. Inspires the visitor to feel enabled to be the change-agent for the future bicycle rich city
4. Plant a seed of hope for a future planet where more bikes are used

... to be cooperatively experienced by parents and their children (6-10 years old) for a sustainable mobility exhibition zone at Museon-Omniversum.

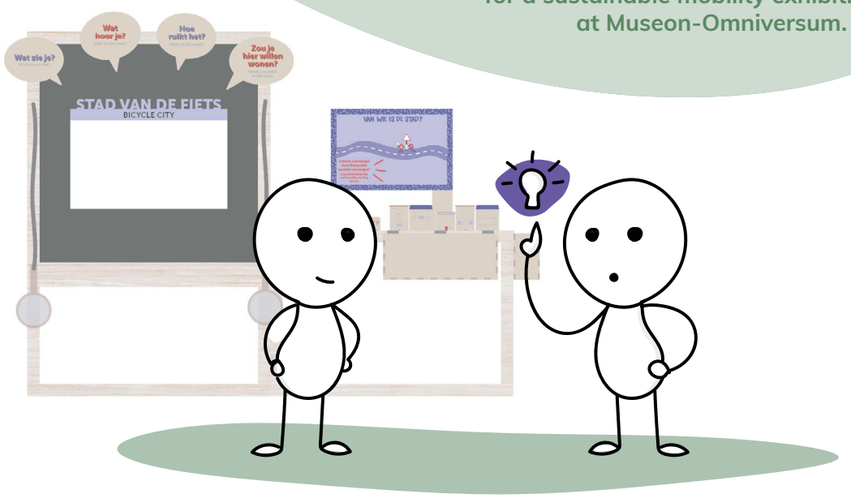

Figure 85: The design goal

This sub-chapter presents a reflection on the design goal (figure 85). Each part of the statement is dissected and answered to get a picture of how the design scores on the various aspects.

A playful and interactive exhibit

'Pedalling towards sustainable urban mobility' is a playful exhibition that appeals to young and old. Both exhibits offer interactive experiences that facilitate engagement and the exchange of knowledge. Nevertheless, there is room for improvement in terms of providing clearer directions to convey the purpose of the 'bicycle city' exhibit.

That raises awareness for a personal sustainable mobility conflict

Immersing visitors in a sustainable future scenario through personal questions is a key feature of the exhibit. The exhibit provides a unique opportunity for individuals to learn and explore the intricacies of this world. By experiencing the exhibit, visitors develop an enhanced awareness of the sustainable future and gain insights into the contrasting aspects. Notably, some adult visitors become aware of a personal mobility conflict within this envisioned world. Children often see this future not as a conflict, but as an opportunity. Research can be done on how to bring these two experiences closer together and involve more visitors in a personal conflict.

That stimulates self-reflection about the influence of bike usage on urban design

Families reflect on the personal and collective needs of a neighbourhood. Through this lens, they contemplate strategies to promote cycling as a preferred mode of transportation in the locality. Soon the impact becomes clear: a neighbourhood becomes much more spacious and colourful.

While experimenting, families reflect on different components and interpretations of the puzzle. However, there is potential for further enhancement of the supportive questions, to facilitate even deeper reflections.

That inspires the visitor to feel enabled to be the change-agent for the future bicycle rich city

Visitors experience a sense of empowerment and a heightened enthusiasm towards adopting cycling as their preferred mode of transportation. Whether this is a result of the experience or rather influences by the test setting is unclear. Further research is needed on whether this experience contributes to a long-term change in attitude and behaviour.

That plants a seed of hope for a planet where more bikes are used

Visitors leave the exhibition feeling proud and hopeful. Proud of the neighbourhood that has been created and hopeful about the future scenario they have discovered.

For parents and their children in a sustainable mobility exhibition zone at Museon-Omniversum

The exhibits fit in well with Museon-Omniversum. The activities create interaction between family members and spark conversations. Parents and children see it as a valuable addition to their museum visit.

C5.4.3 Points of improvement

From the test insights, various parts of the concept can be identified that can be improved. These parts are highlighted in figure 86. In addition, an effort will also have to be made to make the prototype museum-proof. Appendix N presents a complete and in-depth overview of the specific parts that can be improved. This document is also presented to Museon-Omniversum after the evaluation tests.

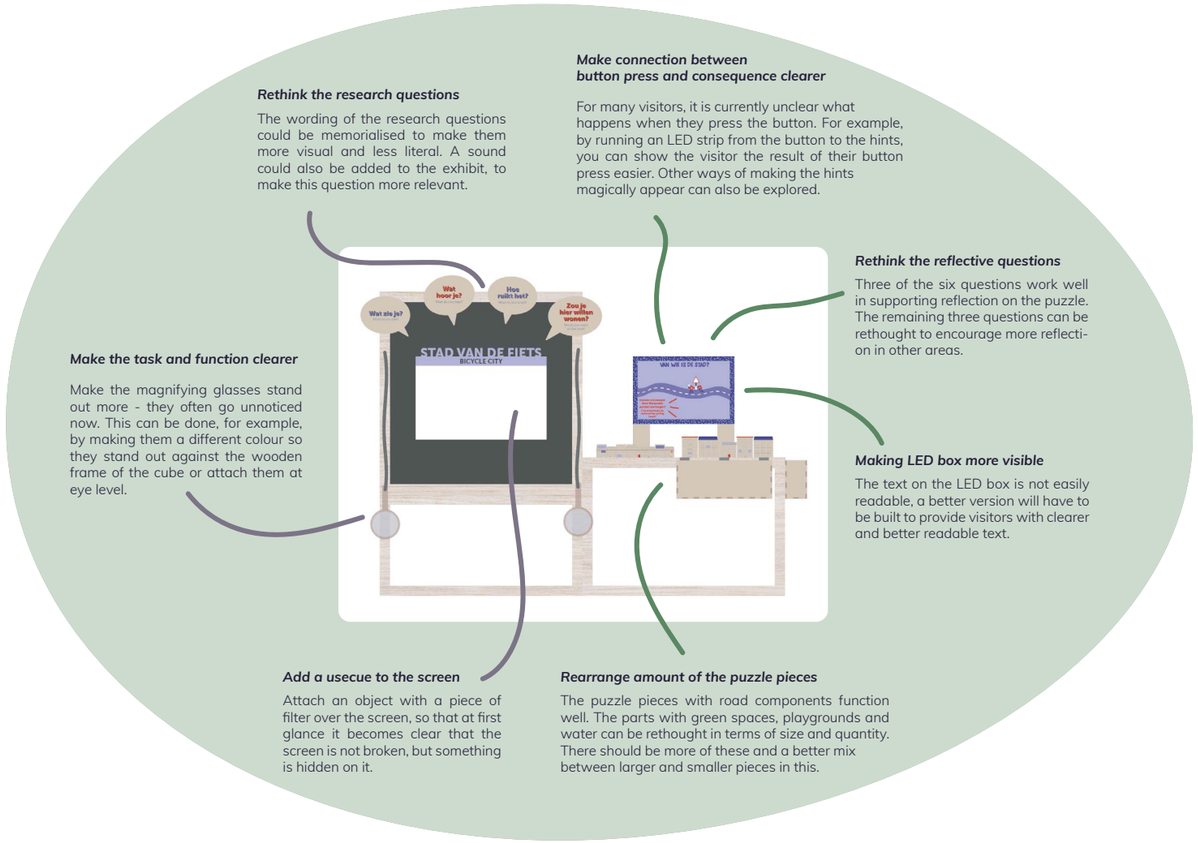

Figure 86: Summary of short term recommendations (full set of recommendations are noted in Appendix P)

Figure 87: Friends interacting with the city puzzle

C5.5 The future of the exhibit

Concluding this thesis with some final recommendations

All in all, it is difficult to say whether the exhibition triggered a tranformation. More long-term testing and evaluations with visitors would be needed to give a conclusion on this. However, the design does score well on the components of awareness and reflection, which were defined early on as the main focus of this project. The evaluation results show that the concept is a promising and hopeful solution to possibly trigger a sustainable mobility transformation.

In addition to the points of improvement from section 5.4.5, which would result in a museum-proof concept on a short-term, several long-term recommendations can be made to Museon-Omniversum.

1.
During this project, the incorporation of the polarised lenses was an early and deliberate choice for creating the interaction. From the initial stages, this component played a pivotal role in the design. During the design cycles, it was chosen to keep this component stable and not experiment with other approaches for this interaction. However, for Museon-Omniversum it is worth exploring alternative approaches that can evoke a similar sense of magic and interactivity while effectively highlighting mobility conflicts. An initial draft of this exploration has been developed, showcasing potential directions. Further details and visual references of this exploration are presented in Appendix O.

2.
Research should be conducted into the long-term effects of inspiring and empowering visitors to change their behaviour. Observations, insights and discoveries from these explorations can be fed back into future designs for the museum.

3.
The new design is not yet fully museum and tamper-proof. Due to limitations in time and available resources, thorough research on production techniques and design methods was not possible within the scope of this project. As a recommendation, it is suggested that further development in these areas be pursued, leveraging the existing expertise available within the museum itself.

Figure 88: Action quote by TOMTOM

Epilogue

This chapter describes my personal reflection on this thesis. About six months ago, as I embarked on this project, I carried with me personal goals and aspirations, unsure of what lay ahead. It was a daunting task, as this thesis represents the culmination of my studies—a significant milestone in my academic career. Having previously completed a challenging bachelor's final project amidst the ongoing turmoil of the COVID-19 pandemic, I lacked confidence in my ability to accomplish this master's graduation project all on my own.

Currently, at the end of my graduation project, I can happily say that all those feelings are gone. Reflecting on the past months, my experience of the project has been entirely different from what I had anticipated. From the very beginning, the support and guidance of my colleagues at the museum and the supervisory team from the TU Delft propelled me into an immensely rewarding and captivating adventure. It was during this project that I truly discovered my drive as a designer.

Drawing upon the knowledge acquired throughout my academic journey, I was eager to establish an iterative process that would allow me to learn and evolve through prototyping and testing, rather than merely striving for a single concept at the end of the process. Although it required some hard work, I can take pride in saying that I succeeded! The three planned iterations resulted in the creation of three prototypes, each accompanied by valuable testing and learning experiences. The final outcome of this project would not have been as comprehensive and well-considered if I had not pursued the development of prototypes and conducted tests based on the initial two iterations of the concept.

Throughout the process, many aspects went smoothly, yet there are always lessons to be learned and improvements to be made. I would like to share a few of these lessons:

1.
As a designer, it is easy to become carried away by the enthusiasm generated from a particular discovery. In my case, I stumbled upon a magical interaction quite early in the design process, receiving overwhelmingly positive reactions from those around me. While there was no evidence that this technique was not suitable, it was challenging to remain critical and consider whether there may be other interactive techniques that are even more enchanting and effective. I only had this realisation late in the process, when it was already too late to make significant explorations and changes to the design.

2.
Stepping out of one's comfort zone is crucial
When entering a completely new environment, I initially found it intimidating to delve into physical exploration instead of relying solely on literature. However, during my first evaluation test, circumstances compelled me to dive into the context of a bustling museum environment, and I discovered that the insights gained from direct experiences far surpassed what the literature alone could provide. Dare to venture into uncharted territories!

3.
The museum granted me immense freedom, trust, and control over this project. Sure, this is exciting, but all the more valuable if you seize it with both hands. The provided confidence in my capabilities gave me an immense boost to deliver valuable results. On the flip side, it also gave me immense pressure to perform. I was working hard. As a designer working for a client, I have learned that it is equally important to have the ability to take a step back when necessary. If things are not progressing as desired, I have found that taking a brief break, even if it disrupts the planned schedule, can be incredibly valuable. Returning to challenges with fresh eyes often yields superior results. Go cycling or running sometime to clear the mind and incubate all your thoughts!

As I conclude this final epilogue, my chapter as a student ends, and a new one as a designer starts. I have discovered a profound passion in designing interactive experiences for public places and am excited to see what the future holds for me.

Thank you for accompanying me on this journey,

Zola

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Pedalling towards sustainable urban mobility: design of an interactive exhibit to inspire visitor's attitude transformation

Master thesis

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