How can children make the ASC more fun?

Niels Kadijk

Supervisors University of Twente:

Robby van Delden, Eveline van Zeeland, Kasia Zalewska

Supervisor Norlandia:

Jorien Blesgraaf-Coops

UNIVERSITY
OF TWENTE.

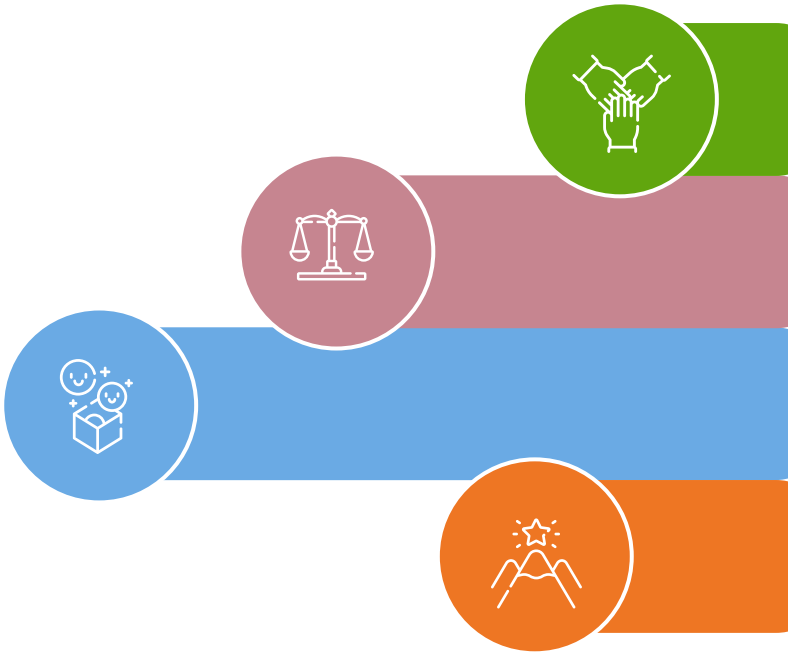


Table of Contents

Acknowledgements

First and foremost, I would like to thank all the children and staff at the different locations who helped me every week in making this research possible. The PMs were always enthusiastic even when I created more work for them by making a mess. I am going to miss the children the most and have many fond and funny memories of the ASC.

I would also like to thank Norlandia and in particular Jorien Blesgraaf-Coops for giving me the freedom to explore in my own way while still supporting me whenever it was needed. Next, I would like to thank my supervisors Eveline van Zeeland, Robby van Delden and Kasia Zalewska for providing feedback and for being enthusiastic and interested in the research. Lastly, I would like to thank my girlfriend, Lise Pieper, for helping validate my coding process and my father for a final read-through with valuable feedback.

Abstract

Many older children (7–12 years old) in the Netherlands go to after-school care (ASC) but find it boring, leading to dissatisfaction and even dropouts. Children dislike the ASC and do often not believe it can be fun. They want more variation, ownership and participation. Together with Norlandia (an ASC organization), this study explores how to make ASC more enjoyable by involving children directly in the design process. Using a co-design approach and principles like equity, fun, and empowerment, we worked with children over five months at multiple locations to gather their ideas and feedback.

To tackle this, we designed and tested a prototype that lets children participate in choosing and buying items for the ASC. This prototype consists of a payment system with which the children themselves can buy new toys and materials for the ASC. This approach gives them ownership and allows them to take their individual preferences into account. The idea showed great potential during the testing and the children all reported that it could make the ASC more fun. Furthermore, the organization is enthusiastic about developing the idea into a final product.

This paper also provides insight into the importance of context when co-designing and working with big groups of varying sizes. Additionally, we question some of the idealistic expectations of working with children and give a new perspective. Finally, it provides a framework of four key principles to guide the process of co-designing and evaluates this.

1 Introduction[1]

In the Netherlands, over half a million children go to after-school care when their parents are working (NJi, 2023). An after-school care (ASC), or buitenschoolse opvang in Dutch, is a place where children stay outside of school when their parents are working. The many hours spent at the ASC make it an important place for their development. According to the SZW (Ministry of Social Affairs and Employment, (2021), parents find it most important that their children have fun and enjoy themselves. Unfortunately, as children grow older, their dissatisfaction with the ASC increases. This growing discontent often leads them to leave the ASC, resulting in fewer friends remaining at the ASC which in turn, leads to more dissatisfaction, creating a cycle that only gets worse. Furthermore, SZW (2021) state that children find the ASC boring and that there is not enough to do.

Only limited research has been conducted about the ASC (Kenniscentrum Kinderopvang, n.d.; Partou, 2024) and even less focused solely on this age group. The research that is out there is mostly about quality control from the government and focused on gathering information and observations (Romijn et al., 2024; Slot et al., 2023). Furthermore, while the ASCs want to increase their quality this has not really happened over the last few years (Romijn et al., 2024; SZW, 2021). Therefore, we will explore how the ASC can be made more fun for older children. This research is being carried out together with Norlandia, a childcare organization that operates 47 locations across the Netherlands.

Instead of letting adults come up with solutions, what if we allow children to shape the ASC experience themselves? Right now, it is their lives that are influenced by the decisions of adults, but little is known how they would change the ASC themselves. If we let children at the ASC participate in the decisions they could feel more responsible and involved which can lead to more fun activities and a safer work environment (Rijnen & Schreuder, 2000). Not to mention, participating in these decisions is also an official right in accordance with the United Nations Law on Rights for Children in 1994 signed by the Netherlands (Kinderrechten.nl, n.d.). Therefore, we ask ourselves the following research question:

> *How can we make the ASC more fun for children (7-12 years old) by designing a solution together with children?*

[1] This chapter is based on the literature review done prior to this study

To answer this question, I first conducted a literature review to understand how to work together with children. This led me to choose co-design as the most suitable approach since it directly involves the children who are the most important stakeholders. Over five months, I visited two different Norlandia ASC locations once a week. We followed a design thinking approach which will be described in the next chapter. First, I describe the organization and the ASCs in more detail below.

1.1 The organization

Norlandia is a child-care organization which is part of the Norlandia Health & Care Group (NHC) originating from Norway. They established their foothold in the Netherlands by taking over several child-care organizations (Consultancy.nl, 2015). Now, they provide care to children in the Netherlands before, in between and after school for varying age categories (age 11 weeks to 12 years). This research is focused on the after-school-care branch of the organization consisting of 47 locations. This makes it the 19th largest ASC corporation in the Netherlands (Wijzer, 2024).

According to their vision and website, one of the key strengths of Norlandia is their Norse roots and their focus on outside play. However, it is unclear what these Norse roots mean, and numerous other ASC organizations also emphasize playing outside.

1.2 The ASCs

A total of four different Norlandia locations were visited during this setup. Two locations, one in the province of Utrecht and another in Noord-Brabant, were visited a combined total of 25 times (13 to Noord-Brabant and 12 to Utrecht). The location in Utrecht consisted of two locations that merged every week to take part in the activities.

The number of children that were present ranged from 19 to 25 in Noord-Brabant and 12 to 21 in Utrecht. To gain a broader understanding of Norlandia's operations, visits were also conducted at other locations in Zuid-Holland (36 children) and Noord-Brabant (10 children), each visited once. Further details regarding these locations and the specific number of children for each session are provided in Appendix A.

All the ASCs generally followed the same day-to-day structure. A detailed example of a typical day from the perspective of a child is provided in Appendix B. In general, the ASCs followed the same structure every day:

1. Retrieving the children from school (for ASCs not located within a school building).

2. Indoor free play (10–15 minutes).
3. Snack time (15–30 minutes).
4. Outdoor play, weather permitting (45–90 minutes).
5. Indoor free play (45–90 minutes).
6. Getting picked up to go home.

The next chapter explains the literature study that was conducted.

2 Literature review

To better understand how to collaborate with children, I conducted a literature review on co-design with children. This chapter will briefly summarize the methodology and findings.

2.1 Methodology

To find out more about co-designing with children I used a PRISMA analysis (Prisma, n.d.) with the following search query in Scopus, ACM and Web of Science.

"(co-design OR "participatory design*) AND (children OR kids OR tweens OR "pre-adolescent*" OR preteens OR pre-teens) AND (Tech*) AND limit to 2013 TO 2024"*

This resulted in 600 results which have been narrowed down following the approach in Figure 1. The results of the 31 studies are summarized next.

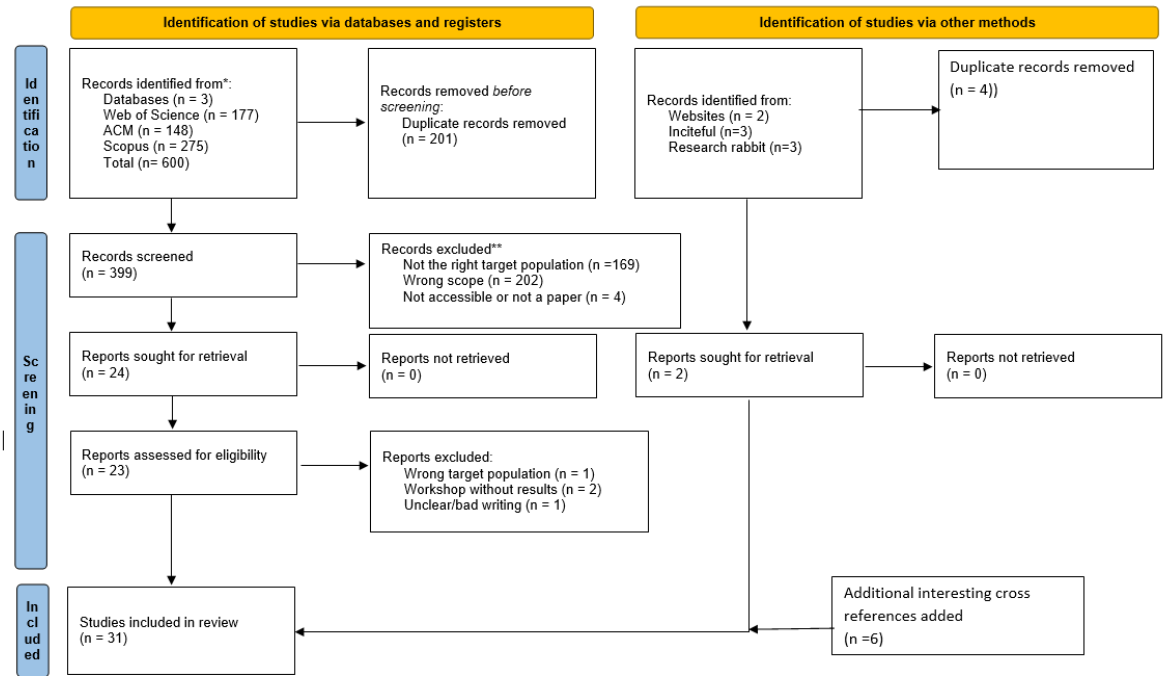


Figure 1, PRISMA flow diagram adapted from https://www.prisma-statement.org.

2.2 Roles of children in design

Technology is advancing rapidly, and children are more than just end users of these technological advancements and products (Druin, 2002; Iivari & Kinnula, 2018). Druin (2002) was one of the first to describe the different roles children can take in developing technologies. She explains the transformation from seeing children as end users to testers, informants and eventually design partners (see Figure 2). The role of children as design

partners, often referred to as co-design, has been researched and applied more and more in recent years (Alhatem et al., 2019; Korte, 2020).

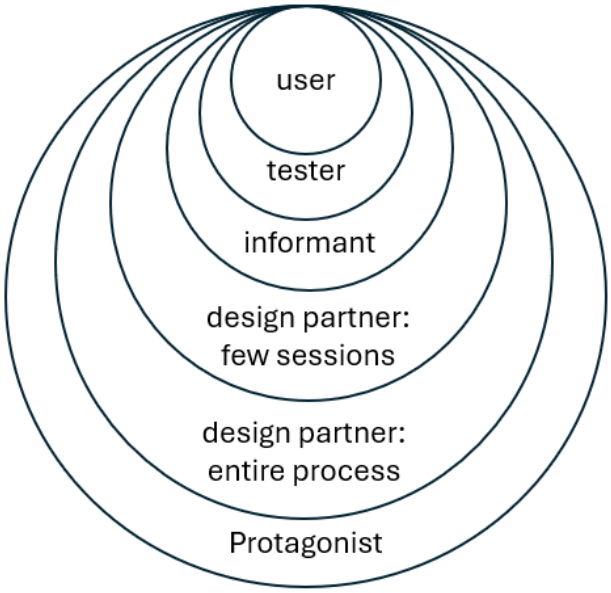


Figure 2, roles of children in designing technology adapted from Druin (2002)

The role of children as users is the oldest of the roles. In this role, children help by testing a technology while adults observe, make videos or test for skills. This testing is focused on testing existing technologies to get a better understanding to produce future technologies or improve learning strategies.

When the testing focuses on a prototype instead of existing technologies, children take the role of tester. While similar, the aim is to improve the technology before it is released.

As informants, children contribute during multiple stages of the design process. They can act as users testing existing technology or test prototypes. Additionally, they can take a look at sketches, judge ideas and test both lo-fi and hi-fi prototypes.

Finally, in the role of design partner, children are considered equal stakeholders in the process. Although this role is the most time-consuming, it provides the best understanding because of the frequent feedback and time spent together. Because of the time-consuming nature, some researchers chose to only involve children during a few sessions while others involved children in the entire design process.

Since it is recommended to involve (older) children directly in making decisions on the ASC this role as design partner seems the most suitable (Rijnen & Schreuder, 2000;

SZW, 2021). Moreover, children in the Netherlands have the right to equal participation and deserve a say in shaping the ASC (Kinderrechten.nl, n.d.).

Multiple studies (Druin, 1999; Jerry Alan et al., 2013; Schaper et al., 2023; Tare & Guha, 2023) agree on the benefits of involving children directly in the design process. They describe mainly three different types of benefits.

1. Empowerment and increased learning for the children.
2. Better and more unique designs due to a better understanding of the end-user, flexibility, honesty from the children and more original ideas.
3. Adults gain new perspectives and learn to become more flexible.

For these reasons, I chose to collaborate with children as design partners. The next chapter discusses more elaborately what it means to be a design partner and how I collaborated with the children through four main principles.

3 The four cornerstones

In the previous chapter, the role of the design partner was chosen as the best option for this research. However, several studies disagree on the best way to work together as design partners and what it means to be equals (Druin, 2002; Iversen & Brodersen, 2008; Korte, 2020; Large et al., 2006). Therefore, a framework of guiding principles was developed based on the literature review (Kadijk, 2024). This resulted in five cornerstones that were used to guide and evaluate this research:

1. Collaboration as design partners comes from both the researcher and the child.
2. The adult and child should work as equal design partners by using equitable practices, tools and techniques.
3. Working together as equals is a continuum where we will strive as much as possible for a balanced partnership.
4. The children should be empowered by the techniques used to gain new skills and knowledge.
5. The design activities should be fun and interesting and should not require long explanations.

Upon closer examination, equity and balance share a lot of commonalities and have been combined into one. This resulted in the four cornerstones seen below:

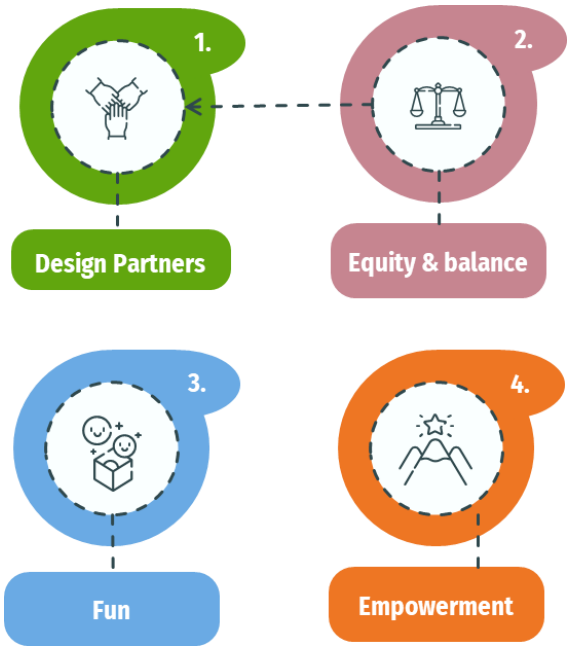


Figure 3, the four cornerstones

The first cornerstone, *design partners*, draws on Druin's (2002) work on children as design partners. The second cornerstone, *equity & balance*, explains what it means to be equal and balanced partners based on the work of Yip et al. (2017). Third, *fun* is discussed with the help of the work by Read et al. (2009). Last, the fourth cornerstone focuses on *empowering* children through design, drawing from Olsen's (2023) work.

A more detailed description of each cornerstone is given in the next sections together with questions to evaluate the extent to which they are fulfilled. Here, I adopt the perspective of Read et al. (2002) and Yip et al. (2017) in which the exact role of children is not static but a continuum that changes over time. For each cornerstone, multiple continuous dimensions are described which help in evaluating the extent to which they are met.

3.1 Design Partners

The first cornerstone states that *everyone collaborates as design partners*. However, there is no consensus on what it means for children to be design partners. One of the first and most influential persons to describe the role of children as design partners was Allison Druin who defines it as follows:

> ... with the role of design partner, children are considered to be equal stakeholders in the design of new technologies throughout the whole experience. As partners, children contribute to the process in ways that are appropriate for children in the process. (Druin, 2002, p. 3)

This description contains three separate parts. First, Druin implies that children should be equal stakeholders throughout the *whole process*. However, she also recognizes that it is important to remember that children cannot do everything that adults can. Therefore, the activities should be *appropriate*. Second, the PM (pedagogical staff) should also be included during the design steps since they are crucial to how the ASC runs.

Finally, children are *equal stakeholders*. This means that their contributions are just as important as that of the researcher or other adults. However, there is an ongoing discussion within the interaction design for children community about what it means for children to be design partners. This discussion mainly questions whether children can be seen as equals or

not (Iversen & Brodersen, 2008; Korte, 2020; Large et al., 2006). Therefore, the framework by Yip et al. (2017) was used in this research which talks about balanced design instead of equality. This concept of balanced design is discussed as a separate cornerstone in the next section. The final three dimensions are illustrated below.

Each dimension has an indicator in the middle (currently random), which will be used at the end to evaluate the overall experience. This will be determined by reviewing each phase (see Chapter Four) individually and taking the average of these results. Additionally, the children will be asked to reflect on this at the end. This approach is the same for all four cornerstones.

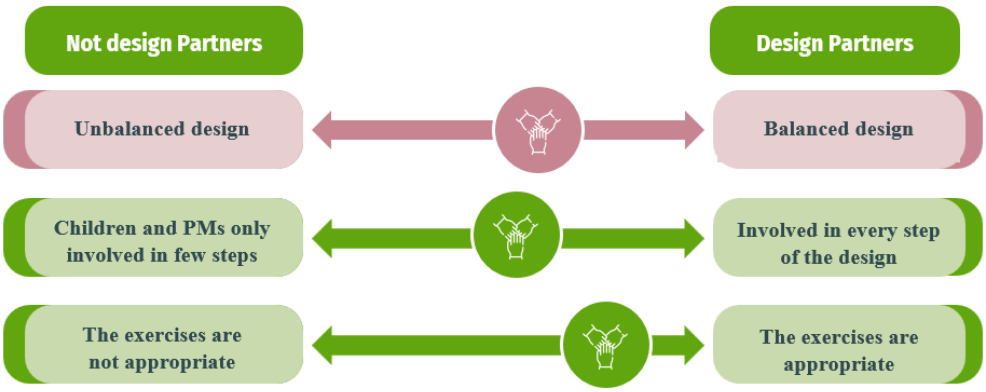


Figure 4, the three dimensions of being a design partner (Druin, 2002). The pink dimension depends on the cornerstone equity & balance. (indicators are random)

3.2 Equity & balance

As explained earlier, it is unclear what it means to be equal when working with children. Yip et al. (2017) provide a more nuanced view of equality making a distinction between equity and equality. Equity focuses on treating everyone according to their needs instead of providing the same for everyone.

Yip et al. make the following three statements explaining how equitable practice can take place (p. 5743):

1. Everyone's contribution (...) can be valued equally, but the engagements and interactions to make these contributions need to be equitable.
2. Participants' expertise is equally important (…), but tools and techniques that emphasize equitable design interactions are needed (…)

3. Children and adults can be equal members of a participatory design group, but we need equitable practices to support participants' investments in the co-design group.

Yip et al. (2017) translate these three concepts into the concept of balanced design for which they provide four dimensions to examine if a partnership is an equal and balanced one. These four dimensions regarding *equity & balance* are shown below.

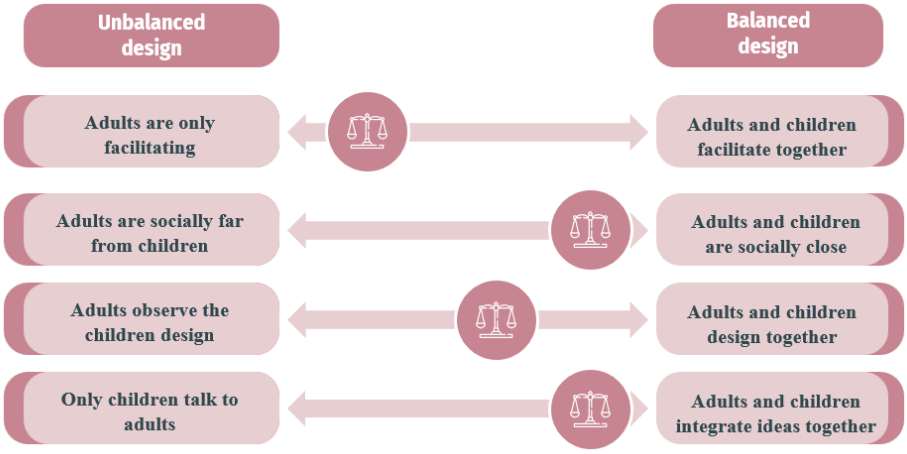


Figure 5, four dimensions of balanced design (Yip et al., 2017)

3.3 Fun

The activities at the ASC will take place after the children spent seven to nine hours at school already. Normally, they can play and do not have to participate in exercises for the rest of their day. Therefore, to keep children motivated the activities must be fun.

Read et al. (2009) categorize fun into three key dimensions: expectations, engagement and endurability. Expectations consist of predicted fun and reported fun. Predicted fun has been excluded from this research since there was only limited time before sessions and this was needed to explain the activities to the children.

Endurability can be assessed by whether the children are eager to repeat the activity and whether they retain memories of what we did. Together with reported fun and engagement, this resulted in four dimensions of fun illustrated in Figure 6. For each specific dimension tools are provided that measure these dimensions.

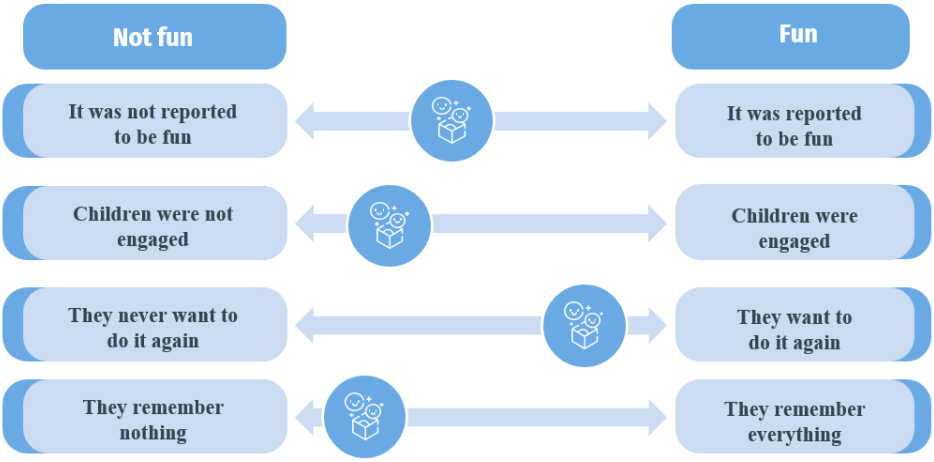


Figure 6, four dimensions of fun based on the work by (Read et al., 2009)

To measure fun efficiently and in a fun way, I designed a box based on the smileyometer with which the children could vote (see Figure8). This box incorporates the smileyometer and again-again table by Read et al. (2002). The smileyometer uses smileys to make it easy for children to express their feelings on an activity. The again-again table asks if children would want to do the activity again which gives insights to endurability. Additionally, the children were observed during sessions to see how engaged they were. Last, children will briefly be asked what they remembered from previous sessions at the beginning of each session.

Figure 8, adapted fun toolkit (Read et al. 2002). Translations top: How was it? Awful, not fun, fun, a lot of fun, amazing. Translation bottom left: Would you want to do it again? Translation bottom right: Tips or ideas?

3.4 Empowerment

The work of Iversen et al. (2017) and Iivari and Kinnula (2018) on the role of children as protagonists was the inspiration for the importance of empowering children. They emphasize that children should also benefit from the research. They both provide insights into empowering children and Iversen et al. (2017) even provide an overview of questions to test if children feel empowered. However, they lack a specific definition of what it means to feel empowered. Therefore, the framework by Olsen (2023) was used. They provide a more substantiated definition that makes a distinction between four different domains that are important for empowerment:

- **Information**: Children feel that they have the knowledge and perspective necessary to reflect, make informed choices and shape one's own views.
- **Autonomy**: Children feel able to freely express thoughts, reflections and opinions.
- **Recognition:** Children feel heard and taken seriously through support and acceptance from the adults.
- **Alliance:** Children feel like they had important contributions to the collaboration and work progress.

Olsen describes these dimensions as guidelines and they will be used to shape questions for the children to evaluate empowerment similar to the work by Iversen et al. (2017).

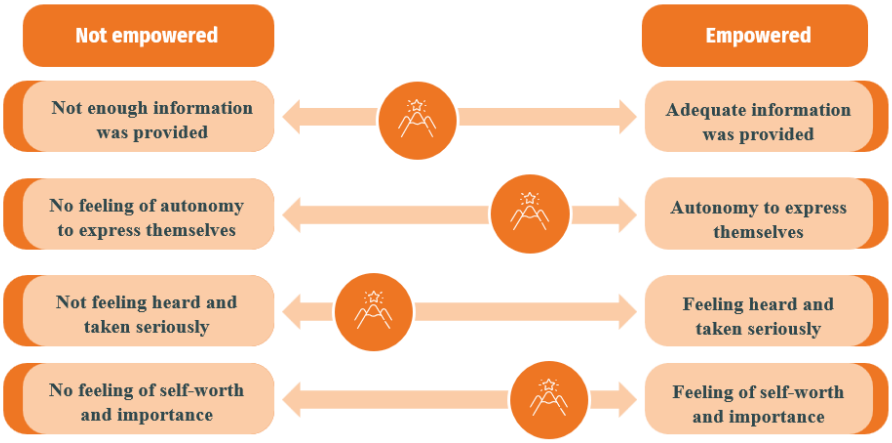


Figure 7, four dimensions for empowerment (Olsen, 2023)

3.5 Conclusion

Thus far, this chapter has explained the framework of four cornerstones with corresponding dimensions. Similar to the work of Yip et al. (2017), these dimensions are not meant to be objective measures to prove if the objectives of the cornerstones are met. Instead, they are meant for reflection and providing insights that can be used to continually improve the co-design process.

Throughout the whole co-design process, I will reflect on these both by myself and together with the children and PMs. This will be achieved through personal reflection, discussions with PMs and a survey combined with a discussion in the last week.

Together, the four cornerstones should provide both a valuable foundation and points for improvement throughout the whole process.

4 Design thinking[2]

Many different design methodologies can be used in a project such as this. Most co-design sessions with children followed a process of gathering information, creating ideas, prototyping these ideas, testing them and doing this in multiple iterations (Iversen et al., 2017; Jerry Alan et al., 2013; Korte et al., 2019). One design method that also follows this approach is design thinking. Design thinking is used in several big companies such as Google and Philips (McKinsey, 2017; van Zeeland, 2022) and during co-design sessions with children (Delft, n.d.; Van Mechelen et al., 2019).

Furthermore, design thinking allows people, or children in this case, to practice design without prior experience or training (Brown, 2008). By working in five distinct steps, it provides structure and clear intermediate goals that can be used during the co-design process. Furthermore, Norlandia's management was already familiar with design thinking through a set of workshops. Therefore, design thinking was selected as an appropriate method to structure this research.

Design Thinking consists of 5 steps (van Zeeland, 2022) :

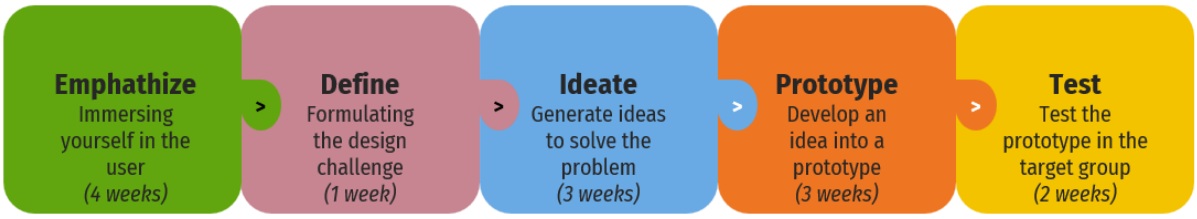


Figure 8, the different design thinking stages

During the literature review, I found many existing techniques that could be used during every stage. The complete overview of these activities, summaries and if they are suitable can be found in Appendix C. Every technique was judged on the following three criteria:

- Fit in with the cornerstones
- Practical requirements such as group size and researchers needed
- Fit with the design thinking approach

This resulted in the following activities briefly described in the table below. In addition to the three criteria mentioned above the table describes why the techniques were chosen. In the next chapters, these activities will be described in more detail.

[2] This chapter is based on the literature review done prior to this study

Table 1, overview of techniques

Technique	Design stage	Description	Reasons for final selection
KidReporter (Bekker et al., 2003)	Empathize	Make a newspaper together with the children.	This technique provided a fun and engaging way to explore the ASC for the first time.
Would you rather? (Simko et al., 2021)	Empathize	Have a line divide the room and have children go to different sides depending on the answer to a question.	This technique helped validate assumptions, spark discussions and raise awareness of differences in perspectives among children.
Sticky noting (Mona Leigh et al., 2013)	Empathize	Critique an existing technology or prototype together to provide feedback for future improvements.	This technique allowed the children to critique and look at existing ideas at the ASC so we could learn from them.
Empathic design challenge (Delft, n.d.)	Define	Use prior knowledge of the empathize phase to define a problem statement and criteria.	This technique helped define the design challenge by providing examples and a step-by-step approach.
Layered elaboration (Walsh et al., 2010)	Ideate	Elaborate on previous ideas without destroying others.	This technique helps think further since children build upon each other's ideas.
Bags of stuff (Mona Leigh et al., 2013)	Ideate	Bring stuff with interesting materials to prototype with.	This technique made coming up with ideas fun and allowed us to make lo-fi prototypes.
Lo-fi prototyping (Druin, 1999)	Prototype	Using basic materials to build a quick prototype that can be used for testing	This technique allowed for multiple iterations to be made and improved over time.
Fun toolkit (Read et al., 2009)	Test	Toolkit with different tools to measure the fun that children had.	This technique made it possible to measure how fun children found the final idea.

5 Empathize

What follows is a description of the first four weeks of the co-design sessions: the empathize phase. The goal of the empathize phase is to get a better understanding of the experiences, thoughts and feelings at the ASC and "*why they do the things they do*." (van Zeeland, 2022, p. 44). Furthermore, the context and other stakeholders are explored to get a better understanding of the current situation.

This chapter first describes how the empathize phase was conducted. Afterwards, I will reflect on these activities before discussing my findings in the analysis section.

5.1 Methodology

The section that follows provides an overview of the methods and techniques used during the empathize phase. Before the empathize phase, I got written permission from all the parents of the five locations, that their children could participate in the research if they wanted. The children themselves also agreed verbally with participating in this research. Additionally, the PMs also gave their written permission to be part of the research. When new children joined the group their parents were also asked if they could be included in the research.

I will now discuss the briefing and collaboration with the PMs followed by a description of the activities conducted by the children.

5.1.1 Preparation

During every visit to the ASCs, I briefed the PMs about the plan for that day and asked them to comment on it. Additionally, it was a moment to reflect if the activity was suitable for the children and whether there were no ethical problems. The first time, the full design cycle was explained together with the time frame and the work being conducted at different ASCs. In addition, the PMs received the following directions to ensure the right mindset.

- It is crucial that the PMs also participate actively in the activities and not just as facilitators. Whatever needs to be implemented will need to work for the PMs as well.
- The PMs do not have to act as the police. If a child has a great idea that diverges from the given task, let them explore it!

The first time a full hour was planned to get to know them better and ask questions regarding their work. Since the PMs are important stakeholders, they will need to be included in the context analysis. Whatever will be implemented will depend partly on the PMs. Therefore, this session began with three main questions, followed by additional questions depending on their answers.

- What do you like about your work?
- What do you not like about your work?
- What could be improved about your work?

Afterwards, the PMs and I carried out the regular preparations for the day. This involved preparing snacks, arranging chairs and getting the children from school. These moments provided an opportunity to engage in informal discussions about the ASC.

General structure

The plan for every session was to follow roughly the same timeline:

- Prior: Debriefing with PMs
- 15 min: Snack time
- 5 min: Reflection on the previous session
- 5 min: Explaining the activity
- 40 min: Time for the activities
- 5 min: Reflection
- Afterwards: Free play with the children

In the first session, the PMs formed three groups and extra time was planned to provide every group with different roles as suggested by Van Mechelen et al. (2014). After explaining how they worked, the following badges describing these different roles were handed out (see Figure 9).

- Praatbaas (Speech boss): Makes sure everyone follows the speaking rules.
- Spullen bewaker (material guard): Makes sure everyone shares and everything gets cleaned up.
- Tijd bewaker (Time guard): Makes sure everything gets finished on time.
- Sssst-sherrif: Makes sure everyone is silent when something is explained.

Figure 9, role badges for the children

The rules of "praatbaas" were discussed by the groups themselves or followed the rules already in place at the ASC. For example, using our *"indoor voice"* which means they should not be loud when we are indoors. The next chapter describes the activities that will be implemented during the empathize phase.

5.1.2 Activities

Week 1: Introduction

Before the different design activities, it is important to first introduce children to the concept of design and get to know them (Druin, 1999). To achieve this, each group designed a name and a logo. To motivate them, everyone got a personal design journal as suggested by Druin (1999). Each journal had their name, logo and team name engraved on it. The main goal was to get to know the children better and have them start to think as designers.

Week 2: Newspaper

As discussed earlier, the next activities focused on getting a better understanding of children at the ASC and the organization. Using the KidReporter technique (Bekker et al., 2003), all the groups created a newspaper on large A1 sheets. They received special role tags for this similar to those in Figure 9. The roles represented roles in a newspaper agency resulting in editor-in-chief, chief interviewer, chief illustrator and chief photographer who were in charge of their respective parts of the newspaper. Additionally, they could use a Polaroid to take pictures. The goal was to focus on what children liked, disliked and wanted differently. This activity took place at four ASCs to further explore differences between locations and get a better representation of the whole Netherlands.

Week 3: Ranking existing ideas (and a teambuilding activity)

The week after we investigated existing technologies and ideas to make the ASC more fun. To achieve this, a variation of *Sticky Noting* (Mona Leigh et al., 2013) was applied. First, I searched for existing ideas at different ASCs that were targeted at making it more fun (See Appendix D). Similar to the fun-sorter by Read et al. (2009), the children then sorted the ideas into the most fun and least fun. They then used sticky notes to explain what they liked and disliked and possible improvements for each idea. For comparison with the current situation, cooking and playing outside were included as well.

Additionally, to create better group dynamics we started the session with a short team-building exercise and energizer. The children had to make a tower with balloons and tape without talking to each other. To ensure they did not talk two children were chosen as

referees who would take balloons if a group talked. After five minutes the highest tower would win.

Week 4: Would You Rather

Last, we used the WYR (Would you rather?) method by Simko et al. (2021) to get more insight into what children preferred. For this method children got a would you rather have x or y question and then moved to the corresponding part of the room. For example, one of the questions was: "At the ASC, would you rather always play outdoors or always indoors?" (See Appendix E for all questions). They would then either run to the left side of a line indicating that they preferred always outdoors or to the right side indicating always indoors. After each question, I asked a few children to elaborate on their choices. Furthermore, this activity encouraged children to realise that different opinions needed to be taken into account which helped prepare for the define phase.

5.1.3 Data analysis

These different activities resulted in a huge quantity of unstructured data that needed to be analysed. In academic research this is often achieved with a focus on 'reducing bias', 'coding accuracy', 'reproducibility' and measuring 'inter-coder agreement' (Braun & Clarke, 2021). Braun and Clarke (2021) explain that this is often approached from a realist point of view where there is one universal truth that can be discovered. However, it quickly became clear that this did not fit for this research.

Following Braun and Clarke's more detailed book on thematic analysis, we considered whether a second coder, who had never interacted with the same children, could interpret the mood of the ASC and arrive at the same findings as I did. Furthermore, the quality of the data was limited by the absence of additional observers besides myself and the PMs. This limitation makes it more difficult to find one absolute truth since other researchers cannot see the data in context. Last, the pedagogical manager explained that one of the trickiest things in working with children is that every adult looks at children through the lens of their own childhood which is different for everyone. This led to the realization that the realist ontology of one reality did not fit with the setup of this research and my personal beliefs.

Instead of seeing this subjectivity as a weakness or a 'bias' it is the key to analyzing data through reflexive TA (thematic analysis) by Braun and Clarke (2021). Their six-phase approach allows the data to be analyzed from a *critical* realist ontology. Critical realists still

believe reality exists but that our understanding of it depends on the social context (Braun & Clarke, 2021, p.25). This aligns with a contextualism view where knowledge is seen as context-dependent and influenced by the interpretations of the researcher while still providing grounding for results. When creating codes and themes, I approached this from the same point of view. To increase the quality of the research my supervisor and a peer were also asked to take a look at the codes and the data. Defining my view as a critical realist helped create a common ground, allowing us to analyze the data with a shared understanding.

The master Interaction Technology which I followed emphasises the importance of context. Therefore, this 6-step approach provided a structured yet flexible framework to explore the complex data and the experiences of being a co-designer. The analysis chapter will discuss the actual steps and their implementation.

5.2 Reflection

After four months of literature review, interviews and planning, I was ready to start the co-design sessions together with the children. With structured week-by-week planning and some flexibility in the schedule, I started enthusiastically. While I did get useful information things turned out differently than expected. Or as Yip et al. (2016) put it:

"things will go wrong all the time in completely unpredictable ways!"

Instead of co-designing, I spent my first day during the KidReporter activity running around answering questions, solving arguments, and even consoling children. At the end of the day, I received a wish list with ideas like a slide, trampoline or swimming pool and a newspaper so covered in glitter that I could barely read what it said anymore (Figure 10). In other words, things went differently than planned.

Figure 10, one of the newspapers covered in glitter

After this first session, I made adjustments to prepare for the next session at another ASC. However, throughout the activities, adjustments needed to be made to prevent other issues. Therefore, this chapter will give an overview of my experience during the different activities and how they changed between sessions. This overview is provided since it is important to know the context in which I collected the data and to better understand how the themes in the next chapter were developed. Moreover, it already provides information and insights about the ASC which can be useful.

5.2.1 Introduction

The first week focused on connecting with the children, creating teams, a team name and a team logo. They did this for their personal booklets which they loved and for which everyone kept asking "*Can I take it home?".* Choosing their final team's name and logo was significantly harder since it caused a great deal of discussions between children. I thought the first session was too hectic because of all the noise and excitement. However, a PM in Noord-

Brabant said afterwards: "*That went really well, I have never seen them so focused"*. Therefore, this first week was important to get a feeling of how to deal with the children and what was considered "normal". The roles intended to help children feel more responsible did not help and often caused confusion instead. Additionally, they would cause conflict because everyone wanted a role badge. The only role that was carried out was that of the timekeeper who started to loudly count down the last few minutes (not always correctly).

While Druin (2002) suggests that it is important to not fall into the role of a teacher, the opposite happened. I also had to learn how to console children, solve fights and was asked to make sure the children followed the rules at the ASC. This was challenging since at the same time I also had to learn how to do co-design. While not planned, I got pushed into the role of PM as well. This happened both by the children and PMs and I never managed to get completely rid of this role later in the process.

On the other hand, the suggestion by Druin (2002) to give design journals to children turned out great. After the first session, three girls asked if they could take their journals outside and soon others followed. In the end, 12 children (mostly girls) spend an hour writing ideas for the ASC in their journals on the first day. During the next sessions, children would often take the journals out of the book and write down more ideas for the ASC. While they never wrote down their thoughts and struggles (as Druin suggests) this free time provided valuable insights. Especially when joining them and asking and answering questions. Although the children barely used the journals in Utrecht all the children were enthusiastic when all their logos and names were engraved with a laser cutter and kept asking if they could bring their booklets home (Figure 11).

Figure 11, six different design journals from children (blurred) and PMs

Last, the PMs in Noord-Brabant also suggested letting the children first go outside so they could lose some energy before starting the activity. For the next sessions, we first played outside whenever this was possible.

5.2.2 KidReporter

This activity of creating a newspaper was carried out at four different ASCs. It quickly became clear that children were not familiar with newspapers anymore. This is most evident in the following conversation with one of the groups:

Me: "*Who knows what a newspaper contains?"*

Child: "*YouTube videos?*"

Furthermore, when looking at their newspapers they had no columns and wrote in long lines from left to right. In this new age, many parents get their news online and newspapers are not that common anymore. As such, the KidReporter might not be as appropriate anymore.

During the first and second sessions, all the children were very eager to receive one of the role badges. However, these badges caused fights about who was the editor-in-chief which even led to tears in one group. Another group's editor-in-chief chose his best two friends as bodyguards and did not join in any activity because he was the "boss" and did not need to. A third group's head illustrator quit because he did not like his job anymore. In other words, the roles were unclear and children struggled to understand what they entailed. It was already difficult to keep the children's attention to explain the activity. Therefore, in subsequent sessions, I decided not to use these roles anymore to prevent confusion or misuse.

After the confusion of the first sessions, I provided guiding questions on A4 sheets that could be glued to the newspapers. These were questions like "What would you do if you were the boss of the ASC?" or "What do you like about the ASC?". On the first question, the children answered, "Demolish the ASC" and on the second "Nothing". This made it clear that children did not like the ASC but did not provide any insights into why. To make some questions (see appendix E for all questions) more specific I changed them to "What are 10 fun things about the ASC?" However, this resulted in them writing ten times *"Nothing".*

Responses like this were frequent in the newspapers. Additionally, because I explained that the goal of the research was to make the ASC more fun the children wrote down many ideas for new stuff or activities they wanted. Follow-up questions did not result in any more insights since children often had trouble explaining themselves or simply did not want to answer. Furthermore, the same child who said nothing was fun at the ASC mentioned that she cooked at the ASC a week ago and that it was super fun.

The Polaroid camera provided some new insights but again children often had trouble explaining why they took a certain picture except for “it is fun” or “it is stupid”.

To conclude, while making the newspaper was challenging it also provided valuable insights into both the ASC and the activity itself. However, these insights often needed latent reasoning. For example, if multiple children mentioned that they wanted a treehouse, hut or tent it was because they find it important to have their own private space. This and other themes are discussed in the analysis phase.

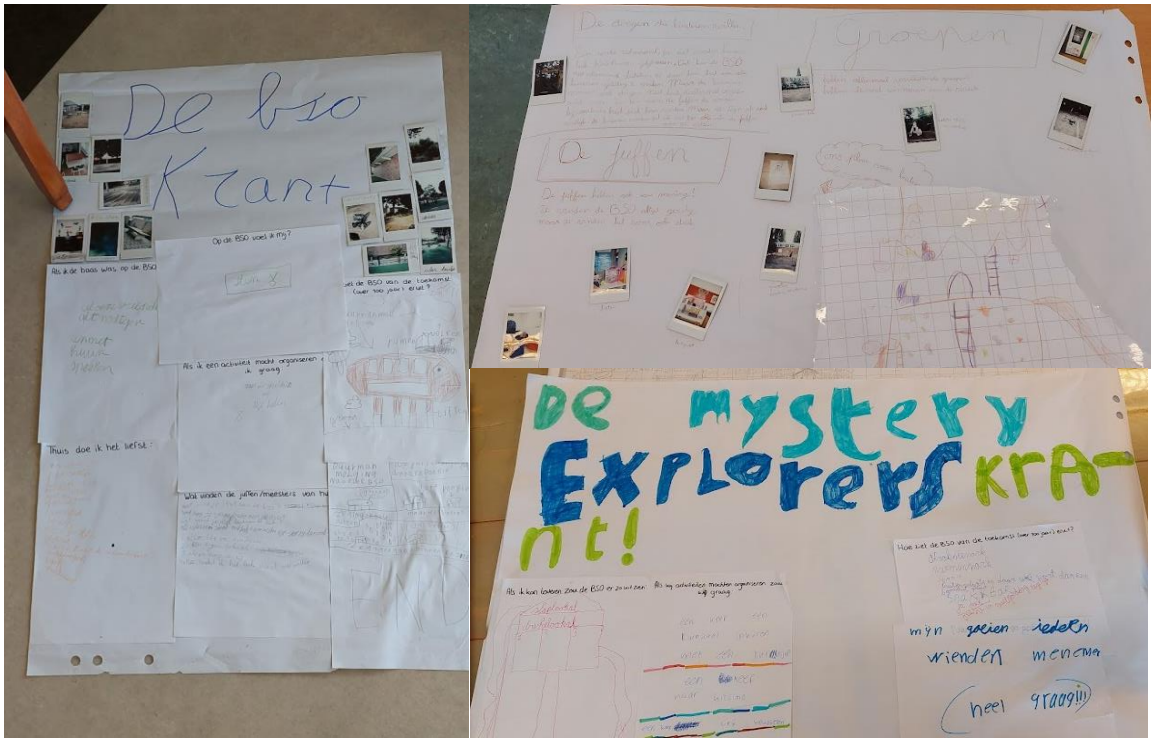


Figure 12, three newspapers made by the children

5.2.3 Ranking existing ideas (and team building)

After two sessions working together with the children, I noticed that the groups were not working well together. Therefore, we started with a teambuilding exercise this week. For the ASC in Noord-Brabant, I got them balloons and masking tape with which they had to build a tower in complete silence. Surprisingly, the children were completely silent and focused during the 10 minutes.

However, afterwards, we were in a small room filled with balloons. The situation quickly devolved into a state of chaos with children running around jumping on and popping balloons. Hence, for the session in Utrecht, this activity was done with straws and paper clips which worked just as well without any of the chaos. Although the challenge was a great

energizer and the children delighted in the experience, it did not notably affect team dynamics. A reason for this might be that the PMs made the groups, often dividing friends who might be noisy together. At sessions, they would often ask if we had to work in their groups again or if they could work with their friends. When they did not need to work in their group, but with friends they often expressed happiness. This remained the same during all activities and group dynamics never improved significantly.

After the teambuilding, the children had to rank different ideas for the ASC which worked well. Everyone expressed their opinion on how an idea should be ranked with some children taking the lead and being more vocal. On the contrary, the extra notes explaining why an idea was fun or not fun did not work since the children gave no useful answers. For example, for the question of why they like it, they would answer: “I like it” or simply “Yes”. This could mean that they did not really understand what was expected. However, when asking questions about why they liked it they would simply shrug their shoulder and turn away. This behaviour is something I encountered during multiple sessions. For some children, it seemed that they did not want to actively help or support the design process.

The first time there was some confusion on how the cards should be ranked so the second time a paper was provided to put the cards on which helped considerably (see Figure 13 to the right). Furthermore, because the exercise was clearer it avoided a lot of questions and allowed me to focus more on the content of the exercise instead of explaining it.

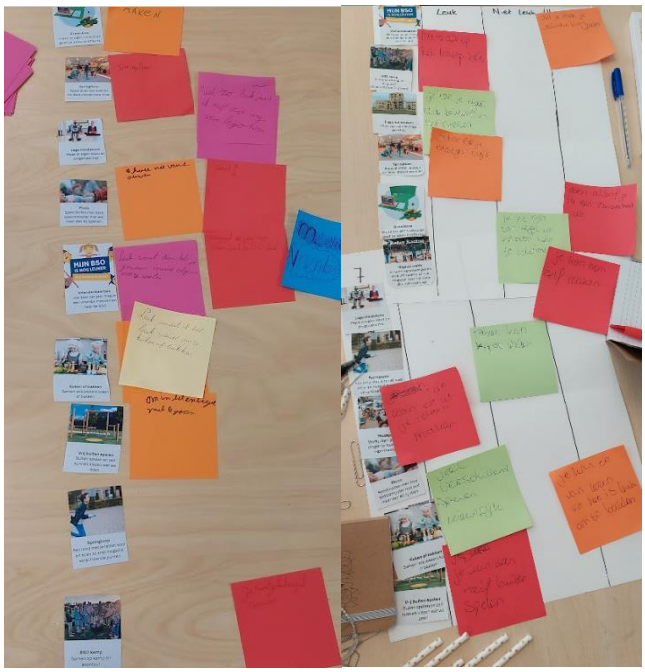


Figure 13, ranking existing ideas.

5.2.4 WYR (would you rather)

On the first day in Noord-Brabant I did this activity we went to the sports hall to have room for the activity and played there afterwards. The children had not been here for a while and had problems with listening to the PMs creating a tense atmosphere. This also resulted in difficulties with the activity. When I asked the first question, all the children ran in different directions and made so much noise I could not talk to them anymore. Therefore, the activity was cancelled that day.

In Utrecht, this activity went better but it was still hectic. The children did like the exercise but were also constantly talking and running around. What helped was one of the children pretending to be a news reporter so I asked her to help by interviewing people who wanted to explain their answers. It was an interesting but overstimulating experience in which I forgot to note down the exact number of children at each option. I only remembered questions with an obvious preference or interesting outcome. This activity could be great but to avoid these problems it should be done in a place with fewer distractions, clear rules and a second observer making notes as this was impossible to do while facilitating.

5.2.5 The PMs

The collaboration with the PM is also important during this research. During the first sessions, I specifically asked if the PMs wanted to join in the activities. Unfortunately, this did not happen in the way I expected. When they did join, they did so with varying levels of involvement. Sometimes they were involved a bit too much, leading their group but also deciding if an idea was good or bad and if it should be written down. Other times, they were less engaged and focused more on managing the children. Furthermore, PMs were often sick or on leave, so I had to work with replacements who knew less about the research or the children. For future research at the ASC, introducing and teaching PMs about co-design beforehand and giving clearer tasks might help them gain more confidence and make participation easier.

Another difficulty was the expectations of the PMs regarding my role. As mentioned earlier, I quickly fell into the role of a teacher which is not preferred (Druin, 2002). This role was often encouraged by the PMs. Either by asking if I could watch a group while they did something else or by not interfering when children were behaving unruly. Children quickly started calling me “meester”, the title used for male PMs, making it difficult to work together as equals.

It might have been better to address this issue, but I refrained from doing so because I wanted to help them. The PMs are already stressed, and I wanted to help instead of providing more work. What's more, the PM cannot oversee everything with 12 children per PM so I did not want to ignore problems as well.

For other research projects in the ASC, I would recommend two options. First, make it clear what you come to do during the research and that it is important to not have to actively supervise the behaviour of the children. However, this also makes you dependent on the varying skills of PMs who might not be able to keep the children listening. Alternatively, join the ASC for a few days in advance with the sole purpose of learning about the children, the group, habits and rules before starting design activities. This way you do not have to do this while designing allowing you to focus on the activity at hand.

5.2.6 Conclusion

Here we will discuss the overall experience at the ASC and reflect on the activities as a whole. The co-design activities did provide a great deal of insights and data, especially when analyzed further. However, making a newspaper might not be appropriate for this younger generation. Furthermore, the activities were difficult to facilitate with the group size and unstructured nature of the ASC. Unfortunately, the PMs only joined in the first few activities and never fully. This made facilitating a group of approximately 20 children challenging. Consequently, it was challenging to participate actively myself even though this is important for the cornerstone of *equality and balance*. Significant time was spent answering questions and keeping the children focused, which made participating challenging. Moreover, there were sometimes internal challenges at the ASC with replacements, staff switches, PMs leaving early or miscommunication. On those days the children noticed the restless atmosphere immediately and also became restless themselves. This together with the superficial answers given raised the question whether the ASC is the right environment for co-design with the philosophy described in chapter two. This will be explored further in chapter 11.

Regardless, the empathize phase did result in a wealth of information which will be discussed now. Later, in chapter 11 the co-design as a whole will be examined more carefully concerning the cornerstones.

5.3 Analysis

In this chapter, I will discuss the results of the different activities. The findings are discussed by developing different themes followed by a discussion of these nine different themes (Figure 14). The overarching theme, T*he ASC is stupid,* is introduced first followed by three themes focused on the PMs and five themes focused on the children. By presenting these nine themes through quotes, pictures and observations I aim to provide insights into the ASC for Norlandia and prepare for the next step: Ideation.

5.3.1 The analytic process

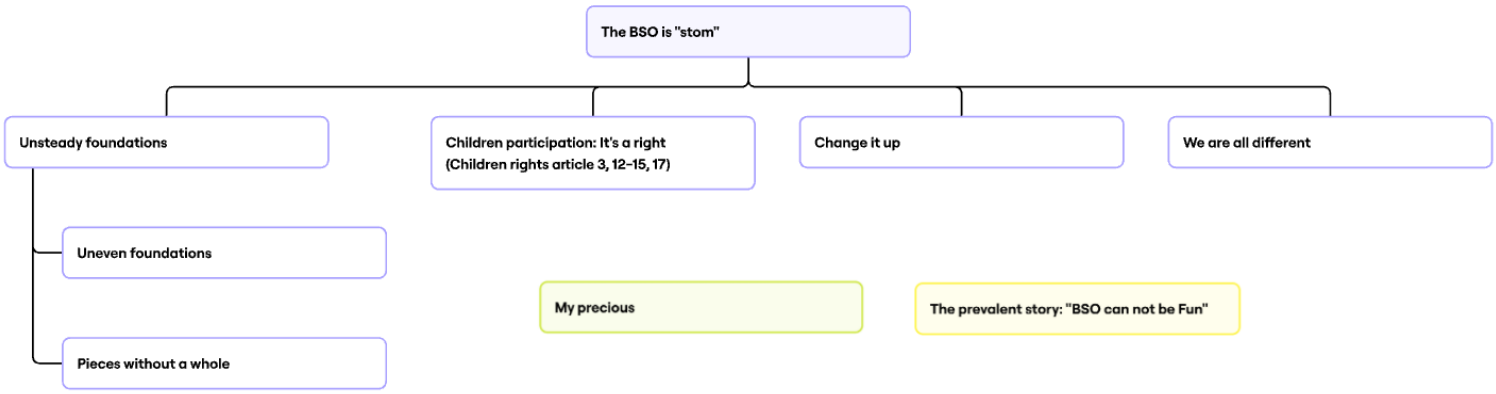


Figure 14, all themes and sub themes

As explained the analysis of the data was explored in a 6-step reflexive TA. Since reflexive TA sees the interpretation of the researcher as a key strength it is important to write down my personal and reflexive journey (Braun & Clarke, 2021) to better understand the position from which the data was analyzed.

The first step, data familiarization, came naturally because of the nature of co-design. Two days a week, at the ASC I was surrounded by the children and PMs familiarizing myself with the data. Additionally, while commuting to the ASC I would look through the artefacts we developed that day or read in the notebooks of the children. This quickly resulted in early thoughts about possible themes. However, as mentioned earlier quite some sessions went hectic due to several reasons resulting in feelings of frustration while interpreting the data.

Before the next step of coding all the data needed to be collected in one place. I felt overwhelmed by the huge amount of data spread across multiple sources, such as journals, notes and artefacts. To organize this Miro, a digital workspace, was created in which I organized the data in clusters. I clustered this data into separate categories like children or PMs.

From here the first round of coding started. I read all the data items one by one and grouped them into preliminary codes. Several data items contained insights that fit with the

preliminary codes and were copied to other codes. Additionally, the information about PMs and the children was split into two different sections.

From here on, the actual coding began which focused on developing latent codes. Going over the data gain, quite some data points were negative about the ASC which sometimes led to sadness or frustration about the situation while coding. Other times, I remembered fun moments with the children or read funny quotes leading to a happy feeling instead. I was aware of this colouring my analysis which reaffirmed my belief that a critical realist view fitted my view the best. Next, I rewrote the preliminary codes to be less superficial and more latent. Additionally, I went through all the data items once more to verify that they fit their code. Additionally, some got copied and included to support other codes. As suggested by Braun and Clarke (2021) another round of coding was carried out where I focused on naming and ensuring no codes were missed. This second round of coding was only for the codes about children since they are the main focus of this research.

The next step was developing the initial themes which I did over multiple sessions. Miro helped in this by allowing all the data to be quickly dragged around. The different sessions helped me analyse the codes with a fresh mind and find different patterns leading to 16 different themes.

By now I had arrived at the fifth step of the process, theme generation and reviewing. The 16 different themes were fused whenever this was possible to lead to the final themes. While refining names should have been the last step the naming already took an important place during this process. By refining the names more initial themes could be combined into one overarching theme. When I got stuck on thinking of names I asked ChatGPT to help out and give 20 names based on the themes that fit together. This helped to find words that caught the right meaning and context better than the original one.

For the sixth step, I removed a few sub-themes that did not have enough added value to discuss separately. Having finished this, I went through the different codes and themes together with a peer and later a supervisor. They asked questions which often led to the realization codes were not clear enough. Presenting and explaining to them the different processes, the ontological and epistemological frameworks also helped me to get a better grasp of these concepts.

In the end, this resulted in six main themes and three sub-themes (see Figure 14). A more detailed account of these themes is given below. This whole analysis process took more time than expected and was finished when already in the ideate phase.

5.3.2 The ASC is stupid

As mentioned earlier, the children were negative about their time at the ASC. Almost every response from children was that the ASC was stupid. In this case stupid can refer to several negative feelings such as boring, annoying, awful, bad or something similar depending on context and tone. When you ask the group if they think the ASC can be *stupid* they all raise their hand without hesitation.

The reasons for this opinion are supported by the other themes which is why the ASC being stupid was used as an overarching theme. Besides the other themes that support this, there are more reasons why children dislike the ASC at the moment.

One major factor is how Norlandia currently deals with going outside. It is a clear focus point "because the parents find it important" (management team), and therefore children go outside almost every day. For the PMs, going outside is also often preferred since it significantly reduces noise and the children play more independently. Unfortunately, there are no activities organized outside. PMs usually stand more on the side and talk to each other. This is not necessarily a problem since children also want the freedom to play themselves. However, the place children play rarely changes and there is no material to play with outside (sometimes a football).

Admittedly, children often enjoy themselves outside, but it becomes repetitive and boring when it happens every day and in the same place. This was also evident with the WYR activity where I asked if children rather *always go outside* or *always indoors*. Here 15 of the 17 children immediately ran towards the option *always indoors*. When asked why one child explained that indoors there was more to do and play with. Another child said she did not like to play outside when it was raining. Nevertheless, I have observed children being very bored and not knowing what to do. Last, almost every newspaper created contained the wish of children to choose themselves if they play inside or outside. Again, this indicates that they do not always enjoy going outside.

For some children, it is more difficult to entertain themselves since they do not have any friends at the ASC or their friends got picked up early that day. During the ranking exercise, some children went on their knees begging for friend cards to be implemented. This existing idea allows children to invite friends over to the ASC with whom they can play.

Last for some children the environment is overstimulating and stressful. Having separate huts or tents for busy and quiet children was an often-mentioned idea. Another child wanted a smaller group size or a larger space. On a noisy and energetic day, one of the

children even said: “I get a headache from all this commotion and noise”. The PMs often try to tell children to be quieter, but this is often difficult.

On all these factors, the PM and organization are instrumental. In the next section, I will discuss the themes that I found from the organizational perspective before continuing with themes focused on children.

5.3.3 Unsteady foundations

This theme consists of the two sub-themes *irregular foundations* and *pieces without a whole*. As the name already suggests, right now, it is not possible to build on the organization and PMs. One significant issue is a lack of motivation to get things done. Let’s consider the next example:

Since it was the last day of one of the PMs and the children frequently requested it I wanted to play lasertag with them in the sports hall. They already had some unused laser tag pistols lying around and I asked if we could use them. The PMs explained this was unfortunately not possible since all the batteries were empty. I had some time so offered to get batteries at the local supermarket. Again, this was not possible since it used special batteries that were not available there. Nevertheless, she went to have one last look to see what was possible. After five minutes she told me the laser tag guns could be charged but that there were only 8 guns and we were with 23 children that day. Therefore, she and the other PM explained that it would be too difficult to organize. As an alternative we still went to the sports hall which the children also liked.

While the PMs do want to try, they often get held back because they see possible obstacles. This is likely due to high work pressure and a hectic working environment.
This struggle with taking initiative was also frequently mentioned as a problem by location managers or managers at the organization. This makes it hard for any concept or idea to be implemented if it is completely dependent on the PM.

Another issue is that the PMs sometimes think they know best what children like. When a child explained the idea of having ASC money for the children so they could buy their own things a PM said the following (with some indignation):

“I think we know quite well what you like”

Of course, the PMs know a lot about children, but it is interesting that many children still don’t enjoy their time at the ASC.

Finally, the older children at the ASC are less prioritized. Toys are often targeted at younger children. Furthermore, while PMs play with the younger children, they do not do this as much with the older children anymore. One time, when we discussed why activities were not planned for just the older children but for the whole ASC a PM answered: "*Then parents with multiple children complain if their youngest child cannot participate and become jealous"*. In other words, because the younger children do not like something the older children cannot do it anymore. Similar reasons were given more often and showed a priority for the younger children.

The unsteady foundations are partly due to the theme **irregular foundations**. There are a lot of differences between locations. At one location PMs have nothing negative to say while at others the PMs face more challenges sometimes leading to frustration. Some locations are based in their own building while others are part of a school with a playground in front of them. One ASC can be small with eight children while another has 140. In the end, the quality also differs considerably making it harder to implement a solution that works for everyone.

Last, there is the sub-theme of **parts without a whole**. While there is a common vision it is not always followed to the same extent at each ASC. For example, having daily activities (which are often weekly) which they can choose to participate in (they are often more mandatory). A reason for the difficulty of implementing this vision, might also be the miscommunication happening between the different levels of the organization. An example of this miscommunication can be seen in the following example:

1. The children are very enthusiastic about friend cards (being able to invite friends to the ASC a couple of days per year at the ASC).
2. The PM tells me she also had this idea and thought it would be great.
3. I informed the management and they told me it actually was the best idea of Norlandia (brainstorm competition) last year but that it has not been implemented yet.
4. I talked to the location manager about it and she says there is already a system in place and that it is already possible.

To conclude, because of these challenges that still need to be solved, *unsteady foundations* was developed. All these issues, and more, make it challenging to implement a concept that depends on the PMs. This was an important realization for the define and ideate phase since it significantly limits the options for what is possible. Last, these issues that the

organization and the PMs are having have a significant influence on the children resulting in children finding the ASC stupid.

*5.3.4 **Children's participation: It's a right** (Children rights article 3, 12-15, 17)*

In the Netherlands, every child has the right to participate in decision-making. They have the right to be heard and their opinions matter (Kinderrechten.nl, n.d.). As mentioned earlier, almost all children wanted to choose if they could play outside or inside. In practice, the question of where they wanted to play was never asked unless I suggested it. There are limitations to a choice like this since it is impossible to split up the group for practical reasons as a PM needs to be present. However, this does not mean the question could not be asked.

When I asked the children if they would rather have an activity every day that was mandatory or no activities ever during the WYR everyone preferred no activities anymore. They explained that they were concerned the activity would be stupid and that they were forced to participate. The SZW (2021) also discovered that especially older children find autonomy and choice important.

Before children can have a say, a shift in mentality is also necessary from the PMs. PMs are trained not to use the words *have* to but to use imperative language instead. For example: "*We are going outside*" or "*We are going to do an activity*". Officially the children had the choice if they wanted to participate in my activities or not and I planned to tell them that the activity was completely optional to join or not. However, this was discouraged by one of the PMs explaining that every child should at least try it.

After the empathy phase, I explained more explicitly that all the activities were completely optional. Some children loved being able to do their own thing and were surprised that they did not have to join. Unfortunately, sometimes PMs did make activities mandatory, even when the children indicated they wanted to do something else.

The right to choose is also an important theme because PMs do not always know what the children like. The one time we did ask the children if they wanted to play inside or outside the PM was surprised the children all chose inside. Another example can be seen below in Figure 15. Instead of joining an activity, two girls spent the next three sessions that I was there connecting dots on a huge carton box that I brought. Together with help from other children, they spend hours just drawing lines. They even refused to go home when their parents came to pick them up. I think this is another example that shows that children know best what they like. As an adult, I would never have thought they would spend more than 10 minutes on this but it turned into hours.

Figure 15, carton box coloured in (this took them approximately five hours)

To conclude, children's participation is a right the children should have which is currently not supported in the ASC. Children know best what they like and should have the right to participate in making decisions. Especially at the ASC where the goal for the children is to have fun.

5.3.5 Change it up

Although children do not want mandatory activities they do want to do new things. In the newspaper and their booklets, children mentioned over 100 new toys, activities and special days for the ASC. That they like novelty also became clear when we merged two ASCs in Utrecht. When we went from one location to the other location children did not like it at first. When we arrived, they immediately ran around exploring all the different rooms and spent time playing with all the new toys.

Another way to change things is by organizing activities. Sadly, as mentioned earlier, activities could be organized more often. When there is an activity, it is only given on one or two days in the week and there is never a choice between different activities. The exception is the holidays in which more activities are planned. Instead, as mentioned children go outside every day to the same playground with no new material or toys. This routine quickly becomes repetitive and boring. More activities should be planned, and materials should rotate or be bought to keep things interesting.

Last, children also had various ideas for days that might make the ASC more fun such as a yes-day (teachers can only say yes), weird hair day, bring your friends day, pyjama day,

pet day, plant day and more. Again, these ideas show that children would like to change things up by adding new events throughout the year.

5.3.6 We are all different

For the newspaper, children could take pictures of their favourite and least favourite things on the playground or within the ASC. Multiple times one child would take a picture of something as their favorite thing and later another child took a picture of the same thing saying it should go away. The same happened with ideas or complaints written in their booklets. A child would complain that some posts on the square should go away because they were the most annoying things and in the way of playing football. Other children used these same posts as obstacles for their own games.

Last, the different opinions were also clear while ranking ideas. Only a few ideas (for example building a hut) were consistently put roughly in the same place by children. For other ideas, one group might rank it first and another last. All these examples clearly show that there are huge differences that should be taken into account for the final concept. This is further supported by the sub-theme of *irregular foundations* which talked about the differences at the ASC.

5.3.7 My precious

One of the questions that I was frequently asked was: "*Can I take this home?"*. This could be about their booklets, craft projects, design artefacts or role badges. The theme of *my precious* is about this strong desire for children to have something for themselves. Ownership is not only important for materials but also about creating something themselves and having their own space. The one universally liked idea during the ranking activity was a den building set. Besides dens, children wanted a treehouse, or a tent or suggested dividing up their space into many tiny rooms. This last one was also confirmed by children during WYR where they preferred having one room split up into many instead of a room that was twice as big.

They loved creating things with open-ended material but did not always want to collaborate or share their ideas because it was their own which will be discussed during the prototype phase. To summarize, ownership is valued enormously by the children.

5.3.8 The prevalent story: "The ASC can not be fun"

Van Mechelen et al. (2014) describe groupthink as one of the challenging group dynamics encountered in co-design with children. In their case, groupthink emerged as

children wanting to be nice to each other but in this research, it emerged differently. Mainly in the belief that *the ASC can not be fun*. One of the first indications of this was a question newspaper activity: What are 10 fun things about the ASC? Every child wrote down "nothing". However, when I asked one of the girls what they did last week she told me she did cooking and that it was a lot of fun. While the main theme is that the *ASC is stupid* it does not mean it is never fun. I have observed the children often enough when they have fun and they even report having fun themselves. However, during activities, they could not mention anything fun about the ASC.

For example, a boy would say something he liked or get enthusiastic but then one of the other boys would say: "No that is *stupid*!" Immediately, the whole group would agree, and any further discussion was shut down. Even employees at Norlandia commented that "*maybe the ASC cannot be fun"*.

This story that is being told is often hindering since some children do not even try to come up with ideas to make the ASC fun since this is simply not possible. For the children, it is not considered "cool" to express that you like anything about the ASC. Moreover, the story creates an excuse to not even try to have fun. Furthermore, the main theme is *the ASC is stupid,* but this does not mean that it is impossible to ever have fun or change this.

5.4 Interlude

During this empathize phase, some ideas were easy to implement immediately. While they did not always solve a huge problem I still tried to see if I could implement any of these ideas. By making small changes during the process, I hoped I could show that this project could directly impact their lives and that they might feel empowered. Therefore, when children complained that they had no privacy on the toilet I quickly sat down with two of them to figure out why. Because the locks are removed for the safety of the younger children anyone can come in at any time. Therefore, we quickly designed signs to indicate that some toilets would only be for older children with a traffic light sign to indicate if they were occupied. With a laser cutter, I made their design and brought it the next week so they could hang it on the toilet (see Figure 16). The children who participated in this activity also indicated that they were important to the process during the interviews in the testing phase. Therefore, I would recommend implementing small and visible changes whenever time and resources allow this.

The same was tried at the ASC in Noord-Brabant since everyone wanted to play laser tag. However, as described earlier this never took place.

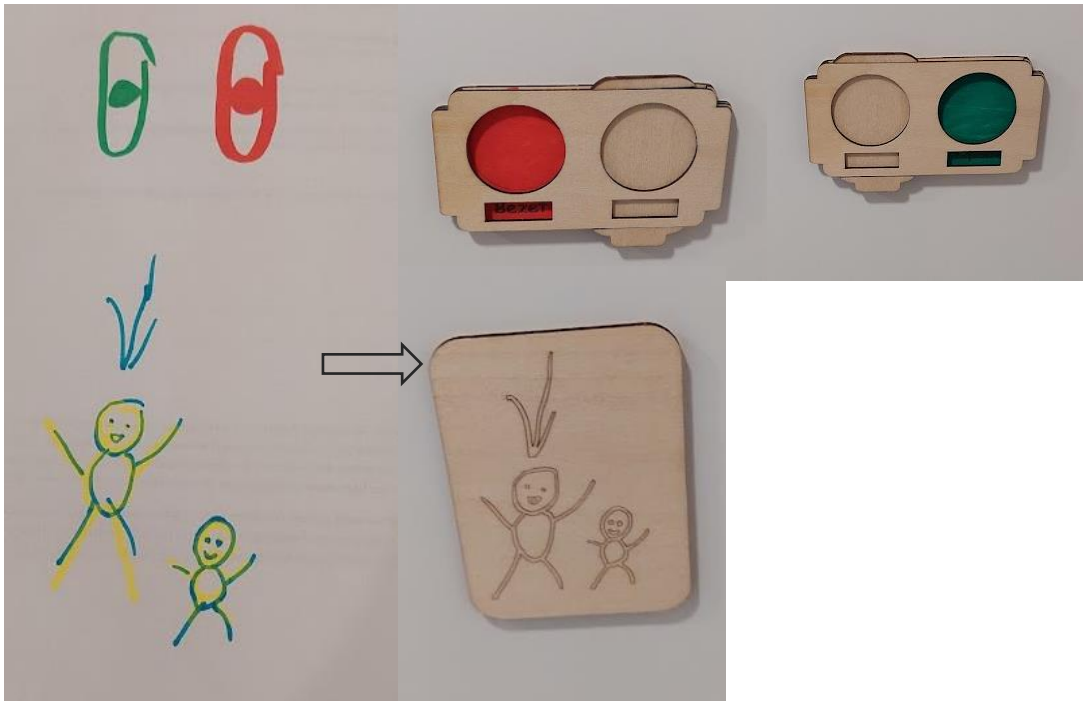


Figure 16, the toilet is for older children and occupied/free sign.

5.5 Conclusion

The empathize phase provided valuable insights into why children might dislike the ASC. While the activities were not always a success, and things went wrong they still provided valuable insights. In the next chapter, the developed themes will be used to define and frame a problem statement.

6 Define

After diverging and gathering as much information as possible in the empathize phase, the next step is to converge and formulate a design challenge. The goal of this phase is to create a concise statement that establishes a common ground for the ideate phase. Furthermore, the requirements defined in this phase will help guide the ideate phase to a better idea.

6.1 Methodology

To create a design challenge the empathic design challenge toolkit by Delft (n.d.) was used. Creating such a challenge can be difficult (van Zeeland, 2022) and this tool aims to make it easier by relating it to a story. A story was read to the group followed by what an ideal situation would look like. Then the design question was formulated together with the criteria the idea needs to fulfill. An example story made by Delft was first read out aloud to give an example of what it might look like. The story that was provided to the children focused mainly on the feeling that the theme *the ASC is stupid*.

Liam is 10 years old and goes to after-school care three times a week. He's not in the mood for it today, especially because all his friends are going home. Sometimes there's a fun activity at after-school care, but today everyone went outside to play, so Liam had to go along. He would have preferred to stay inside and chill. At 5 o'clock, Liam's parents come to pick him up, and he's happy about that. But the next day, he has to go to after-school care again...

I told the PMs this exercise might be difficult and asked if they could help with writing down and answering questions from the children. After giving the example and reading the story, the children spent 15 minutes on the worksheets.

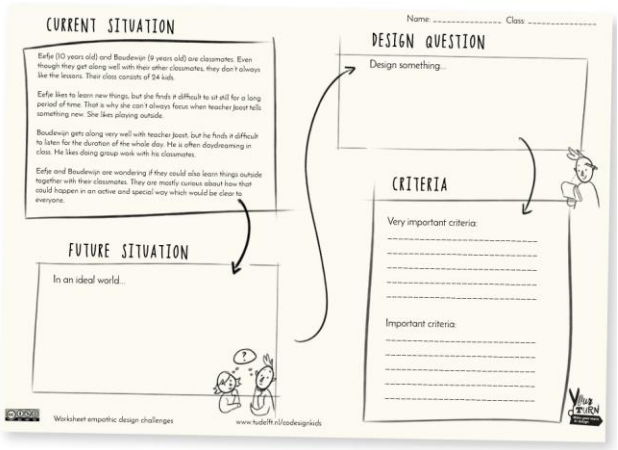


Figure 17, empathic design challenge example

6.2 Reflection on activity

After handing out the papers at the ASC in Noord-Brabant it quickly became evident that this activity was not effective. Half the children were doing something else, and the others all had their hands raised since they did not understand what they needed to do. The PMs did not help either and also kept asking me if I could explain it again. Most children would write nothing down or things that were off-topic like writing "PlayStation 5" at every open field. Some children did think out of the box in answering that there would not be a problem if Liam was picked up by his parents and did not visit the ASC anymore.

After answering questions for ten minutes the PM asked if we could go outside since "*it was not really working*". We tried for a minute more but afterwards the children were sent outside. I collected the different sheets, but they did not contain any useful information.

Since the exercise failed, the activity was not repeated at the ASC in Utrecht. Instead, I asked if children were interested in helping with the research. Three girls wanted to help, and we sat down in a more quiet place. Instead of letting them fill the worksheets in themselves, we discussed them together. By taking the time with a small group of children I had the time to answer questions properly and ask follow-up questions. The results of the session are described next.

6.3 Analysis

Since the story confused some children in the previous session, it was omitted during this one. Instead, we discussed some findings from the research so far focusing on the ASC being stupid. After they agreed I asked them what they would think the ideal situation would be. Here, one of the children said the ASC should be a bit like a holiday and that after the research all the children should say "Yes! I can finally go to the ASC again!". This resonated with me, and I asked the other children if they agreed as well. Therefore, our design challenge became:

How might we ensure that children say:
"Yes! I can finally go to the ASC again!"

Following this, the discussion moved to identifying requirements. Here, we sidetracked and the children started thinking about different ideas already. After 10 minutes, I redirected them to the right topic by asking them what would be important for this idea to be a success. This was still difficult, so I started asking questions based on the empathize phase

and assessed their responses. For example, “Is it important that you can choose to participate or not?”. It did help to discuss this with the children to get input but the children were more involved as informants giving feedback (Druin, 2002) than as design partners. Their feedback was valuable and helped to refine and reject requirements. For example, the children were very clear that to remain interesting an idea should change or be new every month. After discussing this for 30-40 minutes we arrived at three requirements we all agreed were crucial:

- **For everyone**: Everyone should be able to participate and it is fun!
- **Free**: You can choose if you want to participate or not!
- **Different**: Every month we do something different.

Finally, due to budget constraints from the organization and to keep the ideas within reason during the ideate phase, I added the requirement:

- **Cheap:** It does not cost too much.

The design goal and requirements were also written out on a sheet and hung on the wall. This was intended to stimulate the children to think about the topic when I was not there and allow me to reference it during the ideate activities (see Figure 18). With this goal and requirements in mind, we could start the ideate phase.

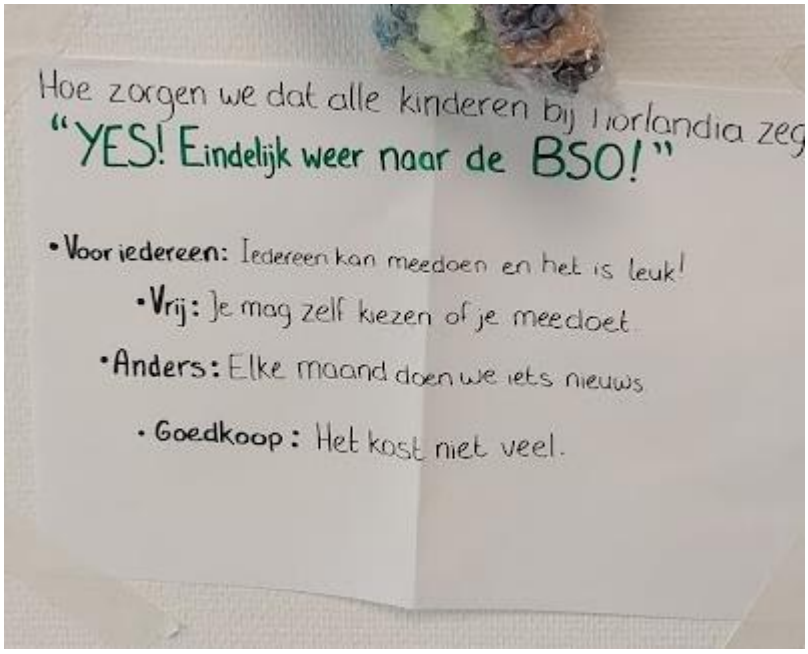


Figure 18, design goals and requirements hung on the wall at the ASC.

7 Ideate

The next goal is to come up with ideas that might make children at Norlandia say:

"YES! We can go to the ASC again".

7.1 Methodology

The ideate phase took a total of three weeks. In the first two weeks, we did two different activities. Bags of stuff and a variation on sticky noting. Finally, during the last week, we used bags of stuff again.

7.1.1 Bags of stuff

The first technique used during the ideate phase is *bags of stuff* by Mona Leigh et al. (2013). In this technique, lo-fi prototypes are made with a variety of open-ended materials. These materials were collected in two ways. First, I collected carton boxes, laser-cut leftovers, other household items and extra materials such as LEDs, cups, paperclips and more (see Figure 19). Second, during a discussion about the ASC, someone recommended the website https://www.scrap-shop.nl/. This company collects industrial trash and residual material and sells it in big moving boxes. The materials are selected so they are appropriate for the age group and contain a wide variety of stuff. For example, CDs, LPs, foldable carton boxes, plastic pieces, fabric, stickers and much more. Two of these boxes were ordered and contained significantly more than my own collection. Additionally, in Utrecht, I saw an electronics shop near the ASC with huge carton boxes. After talking to the owner, I could take these and many more boxes and he told us the ASC would always be allowed to grab any boxes out of the bin in the back. These boxes were also included as possible materials. Unfortunately, no such place could be found near the ASC in Noord-Brabant, so they worked with smaller boxes.

When the activity was presented three things were made clear:

- No hoarding of materials
- No fights about materials, if there is a fight no one gets it
- Everyone helps cleaning in the end

With these rules laid out, children could start crafting ideas to reach our design goal. At the end of the session, each child shared their ideas with the group.

Figure 19, bags of stuff

7.1.2 Sticky noting

After two sessions of bags of stuff, there were not many useful ideas Additionally, children had difficulty thinking about using technology for their ideas. To solve this, various existing techniques were combined into one activity to try to diverge more:

- Word brainstorming by Delft (n.d.).
- A variation of layered elaboration by Mona Leigh et al. (2013)
- Sticky noting by Mona Leigh et al. (2013)

The children who wanted to participate were split up into three groups with two to four children per group. This time they could make groups themselves since last time caused a lot of annoyance when friends were not placed together. The first group would write down ideas to make the ASC more fun and reach our design goal. In case they found it hard to think further, they had a basket describing some specific different problems in the ASC. For example, one problem stated that playing outside every day gets boring. The idea behind this was to have children more focused on solving problems at the ASC instead of focusing on something they personally wanted.

The second group would receive the ideas from the first group and try to improve on the ideas. For inspiration, they could use cards with random words to combine with the previous idea. This step was inspired by layered elaboration where children build upon the ideas of each other.

Then, the third group received the sticky notes from the second group and tried to see how they could improve the idea with technology. To assist, I provided cards with different sensors and actuators that might interest them.

Last, we put the sticky notes with the ideas on the wall and everyone voted for their favorites with stickers. Following this activity, the children used bags of stuff to develop the selected ideas further.

7.2 Reflection on activities

During the empathize phase I told children more explicitly that the activity was optional to participate in. As a result, half the children (approximately 10) did something else which made the group easier to deal with since it was smaller. The following sections reflect on the activities during the ideate phase.

7.2.1 Open materials

The first thing that became clear was that most of the children loved the open-ended materials of bags of stuff. Especially the Scrapbox was popular and children would push each other in their urge to see what was in it. They loved it so much that it distracted them from the design activity. Once they saw the box they did not listen anymore and just wanted to know what was inside.

While not everyone was making something for the ASC everyone seemed to love crafting things with the materials. Usually, the only crafting materials they have are coloured paper pieces and tape. Now that they could use a hot glue gun and more interesting materials they loved it. One striking example involved a boy who normally hates the ASC. I even asked him if he thought the ASC could *ever* be fun the previous week and he answered with a firm no. He is normally allowed to go home by himself after his mother calls but now asked the PM if he could stay longer. In the end, he stayed almost an hour longer, focused on his craft project.

7.2.2 Limited ideas

All the children loved crafting, but this did not mean all the results were useful. Especially in the first session most of the ideas were on the surface level and were difficult to implement or did not fit with the requirements from the define phase. These ideas were interesting but could not be implemented at other ASCs or were not feasible. For example, a treehouse, playground layout or pet house for their ASC dog (see Figure 20). There are elements in these ideas that could be pursued further but there we arrive at our next issue that will be discussed in the next section.

Figure 20, ideas from children made with bags of stuff. There is a pet house (left), playground layout (top right) and a treehouse (bottom right)

To try to get more interesting ideas the sticky noting activity was done. While the activity only took 20 minutes it did result in a more interesting idea. This time I prepared my ideas in advance, so I did not need to facilitate the session and brainstorm at the same time. The first group that had problems with inspiration did not completely understand the assignment and wrote down the problems on sticky notes. Then only the second group started writing down ideas. Nevertheless, this still resulted in interesting ideas. Adding the technology part resulted in fewer interesting ideas than expected. Most ideas got an LED strip added since it looked cool. However, some of the children added buttons to an idea for voting, a secret code to solve a mystery or motors to their car so it could drive.

Figure 21, sticky notes with ideas from children

Unfortunately, in Utrecht, the PMs needed to ask questions to the children which interrupted the process a couple of times. This made the children impatient and difficult to keep focused. To conclude, the adapted sticky noting activity did help with getting more interesting and new ideas.

7.2.3 No interest

Since many of the ideas were on a surface level, I attempted to ask questions which might lead to improvements for the idea. However, it was clear that children were not in favour of this approach. Most questions were met with an “I don’t know” or shrug off their shoulders. What's more, when I came up with suggestions, they did not want to work further on this. For example, one child made a car out of cardboard. I suggested organizing a soapbox race where children build their cars out of wood. He loved the idea but when I asked if he wanted to help me think it out further, he said no and ‘drove off’ in his carton car. This also happened when a few children made a voting box for which children could submit ideas on pieces of paper. This idea was interesting, so I wanted to look at some of the pieces of paper. However, I was told sternly that this was not allowed since it was their idea. Next session it was allowed (see Figure 22). I explained that I needed to have a look so I could see if we could implement it at other ASCs. However, they liked this even less and stated that this was their idea, and they did not want to share it before walking away.

Figure 22, a voting box with ideas

After working out more ideas and voting on them I expected children to be motivated to work on these ideas. Especially the children that wrote down the ideas or contributed to them. However, when I asked who wanted to help work on some of the most voted ideas everyone remained quiet. One of the children asked if they *had to* and when I told them nothing was mandatory and they could also work on their own thing they all ran off towards

the scrap box. There was no interest in working on the ideas, even when I asked the children personally if they wanted to help or what they thought. This made me realize that the co-design I had envisioned and described in Chapter Three was not possible. Most children simply did not feel motivated to work on the entire design process. Next, I will discuss how these suggestions and this insight resulted in the selection of the final idea.

7.3 Analysis

As discussed above, the envisioned philosophy of co-design was not working. This was frustrating for me and took some time to accept. As a result, I needed to choose which idea to pursue further. Additionally, the ideate phase revealed another insight. Most of the ideas such as the voting board depended on the PMs for implementation and organization. Since a clear theme from the empathize phase was the *unsteady foundations* this was not desirable. Some PMs might implement ideas successfully while others fail to even get started. As such, I added another requirement to the design goal:

- The idea should *not* depend on the PM.

This requirement, together with the ones already mentioned in the define phase, made it difficult to find an idea that showed potential. Many of the ideas from the children focused on a single activity like solving a code or having an interactive dancing game. However, these ideas might become boring since they do not fulfil the requirement that the idea should be different every month.

Another interesting idea was that children could suggest and vote on activities. This aligned well with the theme of *children's participation* and *change it up*. However, the PM must fulfil an important role in organizing the activities and ideas of children. When tested a visit to a trampoline park was revealed and it immediately led to discussions about budget, logistics and transportation.

In the end, I chose an idea based on a conversation I had with one of the PMs. A PM was ordering toys and materials for their group and the following conversation took place:

Me: *"Why do you not ask the children to help you?"*
Her: *"I prefer to do it myself"*
Me: *"I think the children would really like it"*
Her: *"I will see"*

In the end, it never happened. I felt this was a missed opportunity for children's participation and thought of the idea of the children saving their own money at the ASC which they can spend themselves on toys and materials. I had been mulling over this thought for a while and it seemed promising. As such I added ASC money as one of my ideas during sticky noting and it received four votes and children expressed that they liked it when going over the ideas.

When no one wanted to work on this or any other ideas after the sticky note activity, I felt frustrated. I visited different children asking what they worked on, but nobody worked on any of the ideas we discussed. When I walked by one girl, she was making a key cord with a small box in which she could collect things. When she explained it to me, I got enthusiastic and explained that we could combine it with the idea of ASC money. Each child would receive a personal tag on which they could collect points. She also started getting enthusiastic and together we brainstormed further on the idea. To ensure that the things were owned by the children and could be taken outside I offered the idea of a cart in which children could save their belongings. When I got the technology cards, she suggested adding an LED light indicating how far you got with collecting points and buttons to pay with. To make the cart more fun, sticks were added to the side where we could build a hut. Additionally, she added a wheel of fortune with activities in case children were bored. The final result can be seen below in Figure 23.

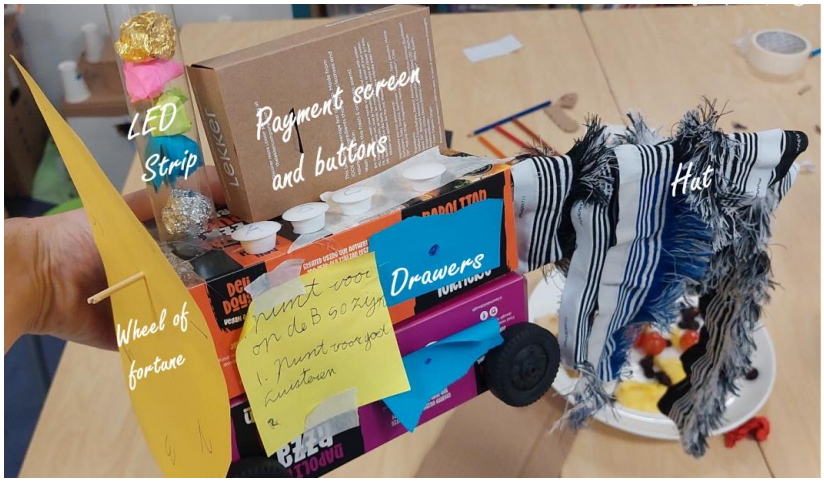


Figure 23, the idea with an ASC cart and point system

The children would get points for visiting the ASC. She also suggested getting extra points if you listened well. We discussed this further during the prototype sessions in the next chapter. To spend the points, we made a booklet with different items you could buy (see the figure below).

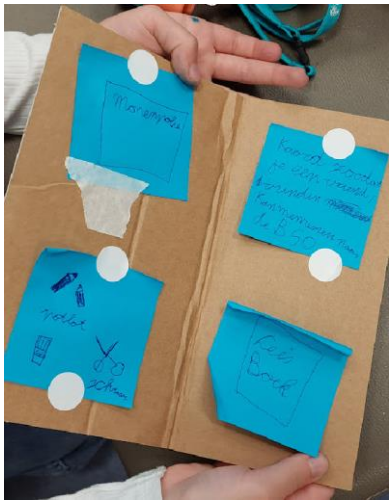


Figure 24, the ASC shop book

7.4 Conclusion

There were a lot of potentially interesting ideas. However, many of them did not fulfil the requirements and it was difficult to talk with children on improving their ideas. The final idea consists of two parts.

- Points with which they can buy things for the ASC.
- A cart in which they can store these things.

These points are earned by visiting the ASC and collected on their personal payment card or tags. With these points, they can save for new toys for the ASC together with other children. They can see the progress they make towards a goal and when they reach it, they will receive something new for the ASC. All this is done through a payment machine that can show their names, and their points, receive payments and show their progress. This they can then store in their cart which they can bring outside as well.

While not solving the problem completely the idea of ASC money does fit all the requirements of the define phase.

- **For everyone**: Everyone can participate together or even alone.
- **Free**: It is completely optional.
- **Different**: It allows children to have different toys. Additionally, the item list can be changed every month.
- **Cheap**: The idea can use part of the budget of the PMs to ensure it does not cost more money.

- **The idea should *not* depend on the PM**: The idea requires someone at the organization to both make a list of items and order a list of items, but these are straightforward tasks.

For all these reasons, and because one of the children wants to participate, I have decided to move forward with this idea. Together with the children, we developed it further and created a prototype which is discussed in the next chapter.

8 Prototyping

The next step is to get the idea from the ideation phase into a prototype for testing.

8.1 Methodology

The prototyping phase happened in three iterations over three weeks in which I visited each ASC location twice. Since the concept included a cart, I managed to acquire a second-hand cart in Noord-Brabant (see Figure 25). Unfortunately, I did not manage to get one for the ASC in Utrecht on time, so we focused more on the payment system. Since there were still materials left over from *bags of stuff* no extra materials were needed. First, a lo-fi prototype was created without any technology. To help them choose which technology we would use the technology cards from the ideate session again.

Figure 25, second-hand cart

In the second iteration, I brought the first version of a scanner. This version included RFID tags, a scanner, buttons, a numpad, an LED strip and an LED matrix. This allowed children to interact with the technology and test it out. Based on this session, we designed the final prototype. During both sessions, children could freely join in with designing the prototype. Last, I spent a week focusing on finishing a functional prototype based on the two sessions.

8.2 Reflection of activities

In Noord-Brabant, half the group decided to play outside, while the other half stayed indoors to craft. This time, the children got enthusiastic about the cart and got more involved. In the end, six children actively participated in working on the prototype. However, they were all girls since most of the boys went out to play. One boy did stay indoors and occasionally joined the discussion and other boys would occasionally ask questions or provide feedback as well. It would have been beneficial if more boys were actively involved in the prototyping. The children who did participate were enthusiastic and everyone quickly focused on something they wanted to work on. During this session, children were most involved as design partners. They actively discussed ideas among themselves and added these to the cart. The first few times they would ask me permission, but I made it clear they could do whatever they thought was best and once this idea landed they managed to work more independently.

I missed one week in Utrecht due to illness and only had one week to work there on the prototype. When I brought some of the electronics children got interested but never

engaged to the same extent as in Noord-Brabant. This is interesting since previous sessions in Noord-Brabant were usually more challenging. Likely, the cart helped the children to get enthusiastic and have something more tangible to work on. The following section discusses how these activities led to a final prototype.

8.3 Analysis

8.3.1 First session

Once I explained the idea and why I brought the cart the participating children quickly got to work. We started with more utilitarian parts of the card. To store their belongings, it needed to be rainproof. Luckily, it already included a system for this which we adapted so you could still look and easily access the cart. After this, everyone split up focusing on different elements of the cart. I collaborated on the payment system together with one of the other children. Together with the technology cards from the ideate session, we determined how we would use the technology. With the children working on other parts, it resulted in the prototype that can be seen below in Figure 26.

The payment section showed your name, your points, the item you wanted to buy and the points you needed. Additionally, we clarified the rules for earning points. Instead of getting points when you would behave well you would get them every week. This decision was made so the points do not depend on the PM but also to give all children an equal say. Interestingly, children did not want the points to be awarded every session. According to them, it was fairer to get the same amount of points every week since it would be unfair to children who visited only once a week. Additionally, since cleaning is not fun and always causes friction at the end of the day, we thought children could earn bonus points when cleaning up within five minutes. To speed this up a cleaning boss would be appointed among the children to make sure everyone cleaned up.

Children liked the idea of earning points for certain activities or competitions which could be explored further in the future. Additionally, this then depended more on PMs again which I wanted to avoid for now. Last, since one point was declared insufficient, every child would receive ten points every week.

Another child made a booklet which contained all the things children could buy. Since the exact budget was unknown, items were colour-coded as cheap, normal and expensive. To pay for these items you could type a corresponding number with the numpad. Other children added a basket to keep their tags in and a mail slot in which children could add ideas. Last,

below the payment system there was storage space to store personal belongings. With all this in mind, it was time to start working on an electronic version as well.

Figure 26, Billie the cart

8.3.2 Second session

For the second week, I introduced some electronics and got all the basic functions working. Children could scan their tags and see their names and points on a LED matrix. Additionally, they could see and pay for some items. The progress they made would be shown on an LED strip which would display colourful patterns when all the points were spent on that category. The full interaction is described later but for now, this was used as a first test to see how children would interact with the system and what it should look like. This was conducted at both locations.

First, all the children were eager to take a look at what was going on and what was happening. Second, many of the children were eager and impatient to get their tags and get points. In this version, there was one mode that gave points every time children scanned their tags. This resulted in children just standing there for 20 minutes collecting as many points as possible. Even though the points were still useless at this point.

The children interacting with the system helped by providing useful insights into the interaction. For example, since there was no confirmation option children often accidentally

paid for the wrong option. Additionally, the LED strip only displayed the progress after it displayed the text. This meant that many children did not understand how the LED strip was related to the system. Despite this, children quickly understood all the functions of the system and would explain it to others.

In Noord-Brabant, the cart was further developed by adding a foldable table and a curtain. In Utrecht, it was the first time showing the idea. At this location, only one child was interested in actively participating in designing the system further and testing it out. However, other children often got involved in the discussion. When I explained the idea, they became enthusiastic about the payment system. However, they did not see the need for the cart. Instead, they claimed a cupboard was good enough. Consequently, we shifted our focus completely to the payment system. The cart can be interesting for future research but due to time constraints, the focus was on the payment system.

When the children saw the electronics, we determined that one LED matrix would be sufficient to show all the information instead of the original plan of four screens (see Figure 26). As a result, the children designed a new display which can be seen below in Figure 27. In addition to an LED matrix (the blue screen) and a numpad, it also consists of two buttons that could be used for confirming to pay.

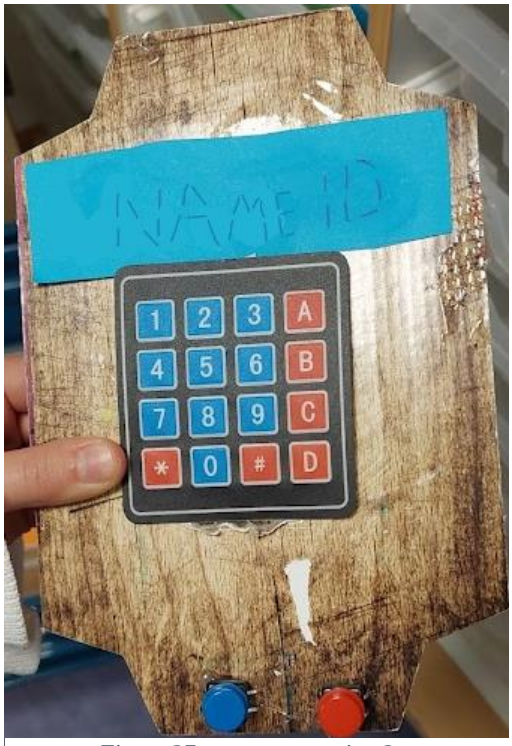


Figure 27, prototype version 2

Figure 28, box to hide the electronics and scanner

Some other children came up with the idea that all the wires and the scanner could easily be hidden inside a box. They suggested combining Figure 28 with Figure 27 for the final concept. With these lo-fi prototypes, I continued to make the final prototype for testing.

8.3.3 Final prototype

After these two sessions, I concentrated on developing a functional prototype suitable for testing. The prototype uses the * and # buttons on the keypad instead of the buttons in the lo-fi prototype. Additionally, the prototype has a place where you can scan your card, the LED strip and a short description (see the image below). I made the box using a laser cutter and the Arduino Mega controlled all the electronics. ChatGPT was used for most of the initial coding which I finalized and put together.

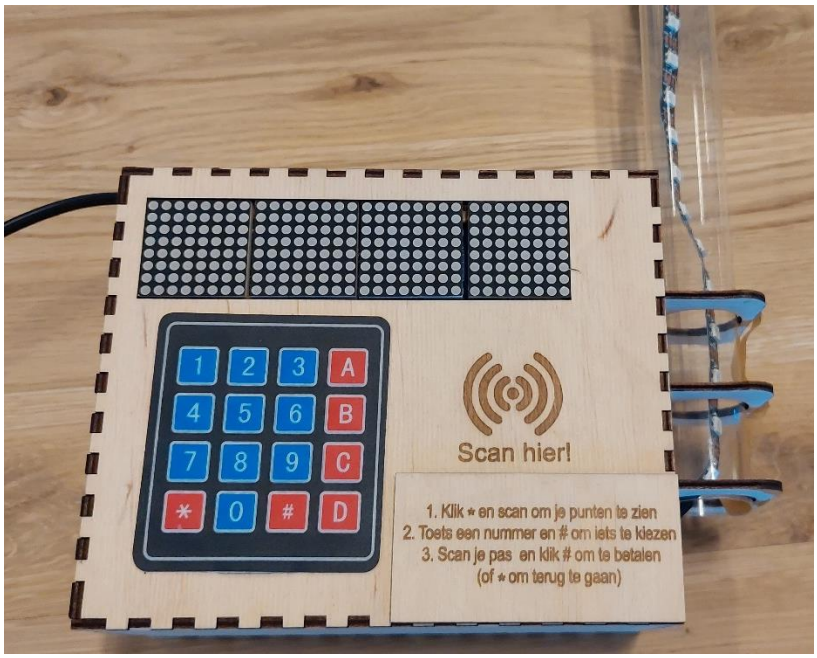


Figure 29, the final prototype used for testing

The flowchart below in Figure 30 describes the most important interactions with the system. The complete code can be found in Appendix H. Next, a few of the key functions of the system are discussed in more depth.

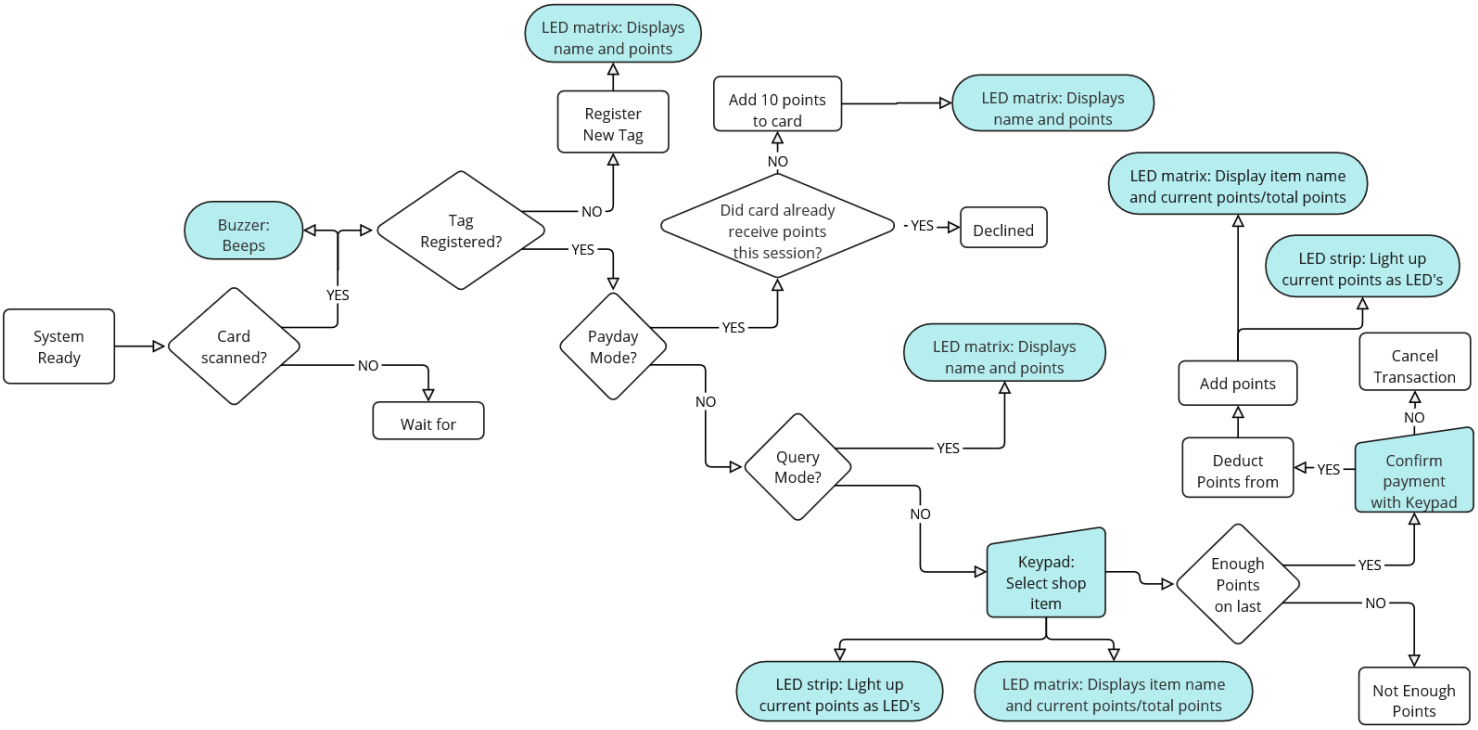


Figure 30, flowchart of the interaction with the prototype (partially made with Miro AI)

Payday mode

The Arduino could be put in different modes by sending certain keywords through serial communication to the Arduino. One of those modes was payday which was activated at the beginning of a session. If children scanned their card in payday mode, they would receive ten additional points as long as they did not receive points during that session. In the final design, payday mode will become redundant since children should only get paid once a week. However, now I wanted to be flexible in case of mistakes so the payday could be initiated multiple times and the amount of points given could be adjusted.

Cleanup mode

Next to the normal payday mode, there was also a special one for cleaning up. This was initiated when the ‘cleaning boss’ would enter a ‘secret’ code on the keypad. Following this, a red LED would flash indicating the start. Then children would earn five points if they were finished on time and the cleaning was sufficient according to the cleaning boss and the PM.

Query mode

By pressing the '*' button the system was put in query mode which allowed the children to see how many points they had. When a number was typed in the system would leave query mode so children could pay for the shop items that they selected.

EEPROM

Normally, an Arduino does not save any of the data from session to session. Since it was crucial to remember how many points the children had and what they invested in the data needed to be stored locally. To achieve this, I used EEPROM which stands for erasable programmable read-only memory. For the tags, the name of the person and their points were saved here. Additionally, the Arduino also saved the current points of the different shop items. Points for Utrecht and Noord-Brabant were differentiated by changing modes during the setup.

Tags

RFID tags were given to all the children (see Figure 31). These were their personal tags and many of them decorated them or added key chains. Some were even put into little boxes when they found out they could be scanned through the material.

Figure 31, different tags decorated by the children

8.3.4 Shopping with points

For this idea to work it is important to know how many points the children get and what they are worth for the testing phase. The points should be worth enough to ensure that children do not need to wait for years before buying something. Therefore, the initial idea was to make every ten points worth two euros. However, when talking this through with the financial department it quickly became evident that this was not possible. In the end, the

maximum possible amount was 0,75 cents per week. This was roughly two-thirds of the current budget of PMs leaving them some money to also buy things with.

With these 0,75 cents in mind an ASC shop booklet was created with varying items they could buy. These items were all under 40 euros to ensure that the children could get them within a short time. I tried to select a diverse list of items which included items that were interesting for everyone. Additionally, some items were inspired by complaints or wishes from children. For example, a tent, football goals and more crafting materials. The complete booklet can be found in Appendix E.

8.4 Conclusion

With all these systems in place, the prototype has all the functions it needs for the testing phase. Besides the payday mode and adding names it can run independently and without supervision. The next chapter discusses how this prototype was tested.

9 Testing

This chapter discusses how the prototype was tested and discusses the results.

9.1 Methodology

The testing of the prototype took place over three weeks (three days at the ASC). The first two weeks focused on getting points and spending them. Then after the Christmas holidays, I brought the things that they managed to collect. Normally, children would achieve a maximum of 15 points per week (5 points for cleaning quickly). To ensure that they got enough points within two weeks additional points were given:

- 30 points when registering their tag
- 10 points at the start of both sessions
- 5 points for cleaning up quickly
- 30 points for participating in an interview

This allowed children to earn a maximum of 90 points which would normally take at least six weeks. By giving them enough points I could also test how they would react when succeeding in their goal and receiving their items. However, future research is needed to see how they deal with the system over time with fewer points.

The interview questions were a mix of open and closed and focused on assessing the overall co-design sessions and the idea with the help of the cornerstones. The questions can be found in Appendix I.

During these sessions, we followed the plan of the PM again since no activities were organized. Therefore, the interviews took place in varying locations from outside on a tree trunk to indoors in a hallway. In total 17 children were interviewed. Some children wanted to be interviewed together so this resulted in two groups of three and one of two.

9.2 Reflection of activities

I initially planned to conduct a pilot test but due to a mistake in wiring the Arduino got fried the morning before the pilot test. Despite this setback, the system worked well and continuously. Rewarding children with 30 points to do the interview also helped to involve the children who normally did not participate in the activities. This allowed me to get a better-represented group for this interview. Since the interview ended up being 15 minutes, they often got impatient and without the points as a reward, it would have been possible to finish some interviews.

Some children wanted to be interviewed together and to speed up the process I agreed. I also hoped that this might encourage discussion between them. Unfortunately, it often meant the opposite since children quickly agreed with each other and got more easily distracted. The children did provide useful insights but similar to the empathize activities often had trouble explaining their reasoning or going more in-depth. Nevertheless, they were motivated to try this because of the points they would get for the interview. In the empathize phase they were more likely to give up quickly after encountering a difficult question.

Last, some children were quickly impatient and for them, fewer follow-up questions were asked to speed up the process. Furthermore, due to frequent interruptions by other children, a change of location or even a child that needed consoling some questions or follow-up questions were skipped by accident.

9.3 Analysis

This section will discuss the findings regarding the prototype and the idea. The findings regarding the overall process will be discussed in the discussion chapter. Here I will first discuss the idea concerning both the cornerstones and the themes from the ideate phase. The cornerstones were originally made to evaluate the design process. However, since the idea is focused on children's participation, they fit well to also evaluate the idea.

9.3.1 Design partners

By using this idea, children help as design partners when it comes to ordering things for the ASC. The children participate in every step of the purchasing for the ASC. They can come up with ideas for items and have the final say in what gets bought. To ensure that they are involved in every step, children should also be included in the final item selection for the booklet.

Figure 32, design partners prototype

The idea seems appropriate for their age and the children found so as well. A few said it might be a little bit childish but could not explain why. Most of them found it appropriate and even explained that it would help them learn:

"Yes, because, for example, you learn math with money so you can learn how to deal with that."

9.3.2 Equity and balance

The idea makes buying things more balanced. It forces adults and children to facilitate together. They ask the PMs for help to save for a particular item but also help each other. After some children succeeded in collecting enough points for a walkie-talkie, they said the following:

Child 1: *"I still have ten points left"*

Child 2: *"You should give it to the microscope. That is kind"*

Since the adults are also given a tag, they might be more likely to play together with children if they buy something together but this remains to be seen. Children come up with ideas for the ASC shop and PMs will need to implement these. This collaboration facilitates designing together and integrating ideas.

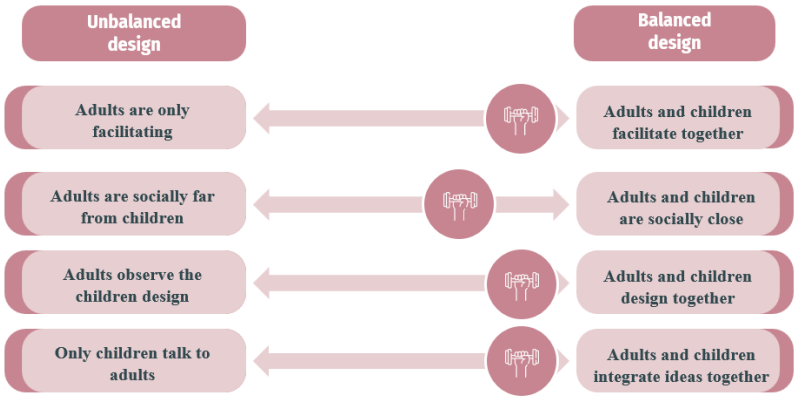


Figure 33, balanced design prototype

9.3.3 Fun

All the children reported the idea to be fun, really fun or even amazing. The PMs also reported that they were disappointed when they could not use the system in between sessions. This could also be seen in how engaged they were. The children would cluster around the prototype to scan their tags. When they got points every time, they scanned it resulted in children standing there for 20 minutes trying to get as many points as possible.

Furthermore, when an item had enough points children would turn around and announce this loudly. Alternatively, they would first gather everyone around and when the light would do a rainbow pattern they would dance around the prototype.

When asked if they thought it would remain interesting and if they would keep using it most children responded positively. One child initially said no but changed his mind under the condition that the booklet with shop items kept being updated to keep it interesting.

Last, children remembered the system well. Even when I did not visit the ASC for two weeks they remembered accurately how many points they had on their tag and even which numbers responded with their favourite item in the shop.

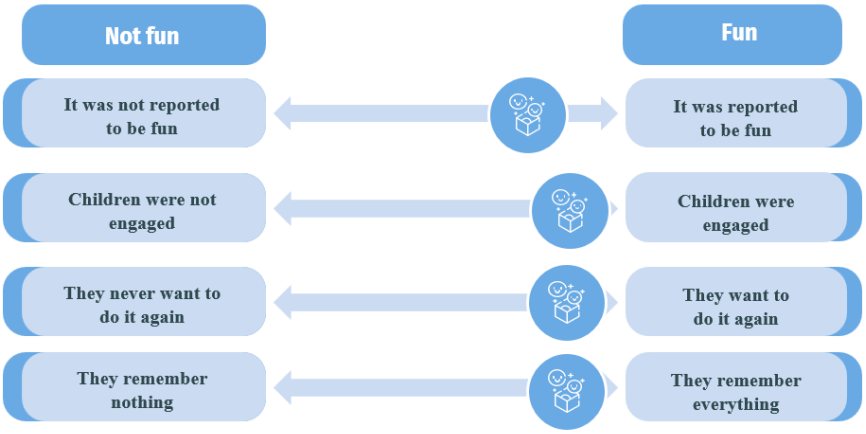


Figure 34, fun prototype

9.3.4 Empowerment

All the children reported that they had sufficient information to understand the system. However, currently, it is unclear how children can submit ideas or understand how they are selected. Some children explained that they loved the idea because they could save for a PlayStation over three years. However, a PlayStation would likely not be accepted by Norlandia since it does not fit well within their vision and the ASC already has a Nintendo Switch. Therefore, Norlandia should provide clear requirements and involve the children in making the booklets.

Many children indicated that they loved the system because it allowed them to do their own thing and vote on their favourites. This indicates that it provides a sense of autonomy to express themselves. One of the younger children explained it as follows:

"Yeah, well sometimes I am the smallest who does not quickly do stuff.
And now I do."

While some children answered that they would feel taken more seriously with this idea others disagreed. So, while it might not help for some children it might for others.

Last, children reported that they could influence the ASC somewhat but only regarding toys. One child suggested to also include decoration options in the booklets so they had more to say about how the ASC would look like. With extra options like this, children would have even more to say at the ASC. Another child was very proud since he asked other children to help him save points and kept proclaiming *"I started a campaign!"*. Moments like this indicated a feeling of self-worth and empowerment.

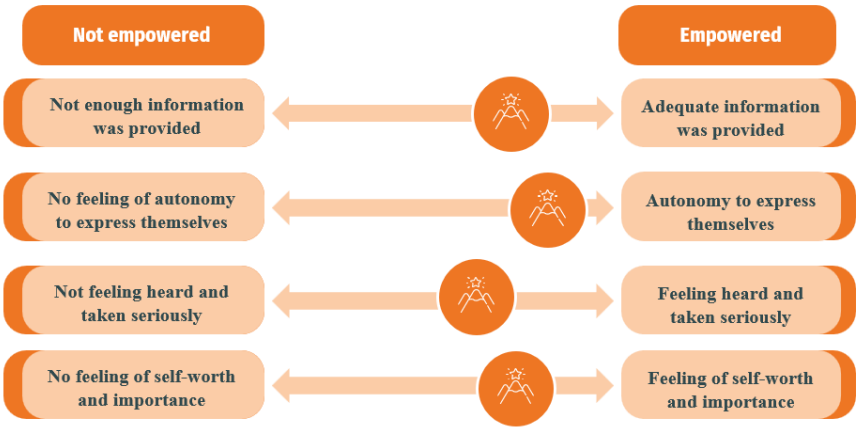


Figure 35, empowerment prototype

9.3.5 Does it make the ASC more fun?

The cornerstones indicate that the idea could help with making the ASC more fun. However, does it address the problems identified in the Ideate phase? I started to code the data from the interviews in a similar approach to the empathize phase. I quickly realized that most codes aligned closely with some of the themes identified earlier. These themes are described below together with findings from the testing phase.

***Children's participation: It's a right* (Children rights article 3, 12-15, 17)**

The first theme that fits well with this idea is children's participation. The cornerstones already confirm this, and multiple children confirmed this when I asked if it made the ASC more fun. For example, in these three answers:

"A little bit, because we bought it. Then we tell it so and we have something to say."

"Yes, just because we choose more ourselves"

"Super, because most stuff gets bought by the ASC and now you can also buy something"

These all show that children appreciate that they can choose and vote for themselves. The idea encourages the PMs to actively involve the children. As mentioned before this also comes back to the idea that PMs or adults think they know what children like. When I explained the idea to one of the PMs, she initially got indignant and said:

"I think I know very well what children like"

This clearly shows a potentially limiting mindset. When I made the booklet, I was sure some ideas would be popular. For example, football goals since the children often complained that they did not have goals. However, no points were ever given to this item. Hopefully, this idea will help PMs and Norlandia involve children more actively and realize the necessity of this.

Change it up

Children also explained that it would make the ASC more fun just because there would be new items. This is not necessarily true since the budget is reallocated from the PMs' budget, but it might make them appreciate the new things more. Getting new stuff was even better than an ASC dog:

"Because we can have new stuff instead of a puppy because if the puppy dies you do not have it anymore."

Additionally, children also believe that this will allow them to do more new activities:

"At least we can do something. You always do the same. Or you go craft or something."

And

"Because it is already fun that you can do more. We used to always do the same and that was not that fun. Always go outside. Because you have more options. And with walkie-talkies can you can do jachtseizoen (Dutch game show)*."*

In short, with new toys, they think that they have a more exciting and less repetitive time at the ASC.

My precious

The first thing the children started asking when I told them I was going to leave soon was whether they could keep the tags. Even when I explained to them the tags would be useless without the prototype they did not mind. They all love the idea of having their

personal tags and their own points. Furthermore, they appreciate the idea of owning the things they buy:

"Yes, well, the stuff is real money, and usually they just do a score somewhere. Now you can really just have it."

The children's excitement about keeping and even decorating their tags shows how much they value having their personal tags with points.

We are all different

Another benefit of this idea is that it allows children to follow their individual interests. This was also discussed by two of the children:

Child 1: "It is more fun because PM X can not choose what we like"

Child 2: "She can also not really buy something for everyone because everyone wants something different"

These quotes illustrate that children recognize that it is difficult to find something that fits everyone's preferences. The idea helps to ensure decisions are made based on individual preferences instead of what the PM or the majority thinks is fun.

9.3.6 Social aspect

Originally, I was worried that children would argue with each other about ideas and try to claim things for themselves or exclude children. However, the opposite happened. New groups were formed of children who would normally not play together but were interested in the same thing. What's more, children believed the idea could lead to new friendships:

Child: *"Yes, there will be more to do, and you get friends and you will feel less lonely"*

Researcher: *"Why do you get more friends?"*

Child: *"For example, sharing the hammock so you can go nice together. Sharing together makes it fun."*

As mentioned earlier, children also help each other achieve their goals simply because *"that is kind"*. Therefore, while there is potential for striving there is also a lot of potential for children to develop socially and make new friends.

9.3.7 Technical aspects

During the testing and observations, there were no significant issues with the system itself. At some point, the children started typing in random numbers causing the system to crash if they typed 13 but this was the only significant error. Children quickly grasped the

concept and how it worked and frequently explained the process to their friends. Some children attempted to pay without noticing they needed to confirm their payment. These issues were quickly resolved when other children or I explained how it worked.

The biggest flaw of the current prototype was that it took too long. Since the screen was not big enough to show a lot of names it used a scroll animation. Since this was programmed on Arduino it was locked in this animation loop. Together with other similar cases like the LED strip lighting up, children often had to wait for quite some time before they could pay all their points. Reducing waiting time or allowing the system to be overwritten when a card is scanned would improve usability.

However, this was also more of a problem because of the large number of points children had. When having fewer points every week this issue might not be significant. Last, children could currently only pay ten points so when they got five points for cleaning, they were unusable until the next session. Multiple children were frustrated by this and asked that they could just always deposit points.

In conclusion, there are no major technical hurdles to solve, and the interface was easily understood by the children and the PMs.

9.3.8 Getting presents

A few weeks after the test I returned to the ASC with toys that they ordered. The children did not always achieve to collect enough points, but this was ignored since they only had limited time. In the end, I brought the children the following dived over the two ASCs:

- Walkie talkies (both ASCs)
- Microscope
- Crafts box
- Emergency tent
- Propellor to make your paper airplane fly
- A hammock
- A LED strip
- A game

Of course, all the children were happy to receive these gifts. Sometimes they did cause arguments about who was allowed to use what. Usually, I or a PM managed to quickly solve these. I initially expected the children who bought a toy would want to claim it for themselves but most of the toys got shared by everyone quickly. The children were engaged

with their new toys until the end of the day and asked me to store them in a safe space in the end. In conclusion, spending points did not cause additional friction over ownership and children appreciate and share their new toys.

9.4 Conclusion

From testing the prototype, it quickly became clear that children enjoyed the concept. Furthermore, it relates directly to the themes found in the empathize phase. I also asked the children if they thought it would make the ASC more fun. Everyone responded positively, with answers that ranged from "*Yes a lot*" to "*Yes, but not amazing"*. Since everyone is different, I think it might significantly improve the ASC for some while only slightly enhancing it for others. As such this idea will likely not completely fulfil the design challenge that we originally stated:

How might we ensure that children say:
"Yes! I can finally go to the ASC again!"

Nevertheless, it will likely make the ASC (a bit) more fun for some children and partially meet our design challenge for a few. For example, one child who said the following:

"I look forward to going to the ASC again because then I get points again"

This is exactly what we hoped for with this research. Next, it would be important to test this over multiple months to see if it remains interesting enough over a longer period.

10 Discussion

In this chapter, I will discuss how the research went and look back on the different activities. For this, both my observations and reflections will be used in combination with the questions asked during the testing phase.

10.1 Cornerstones

Here, I will evaluate the cornerstones and how they evolved during the whole process.

10.1.1 Design partners

Overall, I did not always collaborate with the children as full design partners. We did not always work together as equals as described in the next section. Furthermore, children were not always involved in decision-making. While they were involved in every activity some key decisions were made without them. For example, selecting a final idea and how to test it. Furthermore, the testing was done with the children, but the children were not involved as a partner but as testers. While I wanted to involve the children more, they preferred to do something else or would rather not think too much on difficult questions or topics.

On the other hand, every step in the process was done together with the children and during the empathize, define and prototype phase we collaborated more as design partners. Especially making the prototype in Noord-Brabant worked well with children and me integrating ideas and making decisions together.

Most children found the activities appropriate, but some found them too childish or boring. Especially the newspaper activity was often seen as childish and boring. Since children also do not know what a newspaper is anymore this exercise seems inappropriate and should be replaced by a more exciting and modern version, for example, making a vlog.

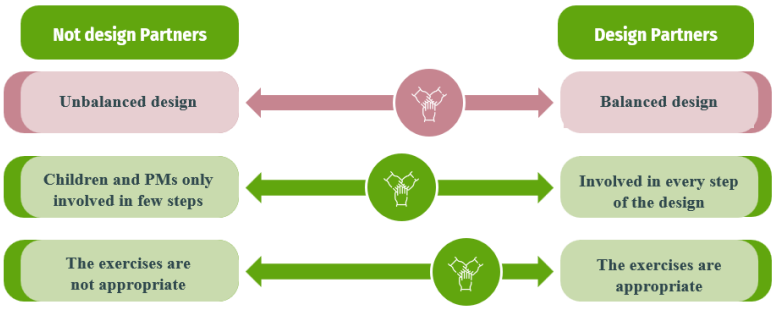


Figure 36, design partner cornerstone results over the whole design process.

Besides working with the children as design partners I also wanted to involve the PMs since they are important stakeholders. However, they rarely participated directly in the

activities. I could have made this clearer, but this was challenging. Especially since I often worked with different PMs. Additionally, the PMs were often busy doing other tasks which made me decide to quit focusing on the PMs. In the end, this might have been beneficial since different opinions from the PMs could have influenced the ideate stage negatively. Now, the focus could be fully on what the children wanted.

10.1.2 Balanced partnership

In the beginning, I tried to include children in facilitating the session by assigning them specific roles. As explained earlier, after this was unsuccessful it was mostly abandoned. To make the roles more clear Van Mechelen (2016) suggested starting with a class discussion on what the roles mean and what the etiquette should be. After two sessions, I realized that it would be impossible to have any classical discussion. The combination of a long day at school, a large group of children, a small room, PMs not intervening and difficult group dynamics made it hard for the children to remain focused. Therefore I focused on activity instructions which were already challenging to convey. In the end, this meant that I mostly facilitated and children only helped in some specific cases. For example by being a referee during a teambuilding exercise. The children who did help in this way stated that they helped and helped facilitate the sessions.

I was socially close to the children and tried to improve this by ensuring I engaged with them during the breaks (if they wanted this). For example, by joining football, hide and seek or tag activities. During the activities I planned to be more involved but in reality, I spent more time explaining the activity again and distributing the right materials.

I still involved myself as much as possible but was often interrupted by questions. In the end, we did design together and most children also stated this during the interview. However, this did not always happen as much as I previously planned.

Because of all the questions I got, I assumed all the children were mostly discussing their ideas with me. However, when I asked them during the interview everyone stated that they also discussed and integrated ideas with other children.

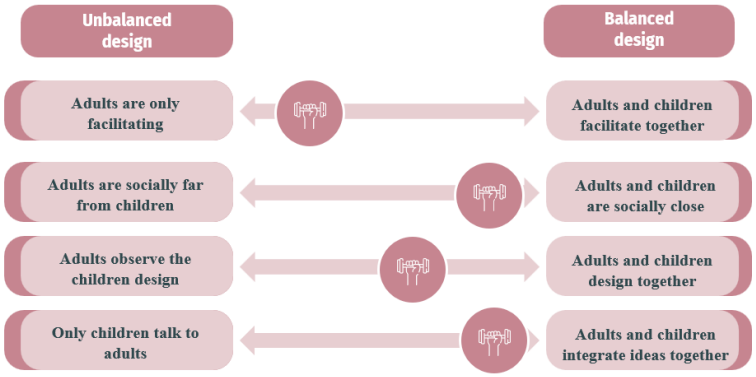
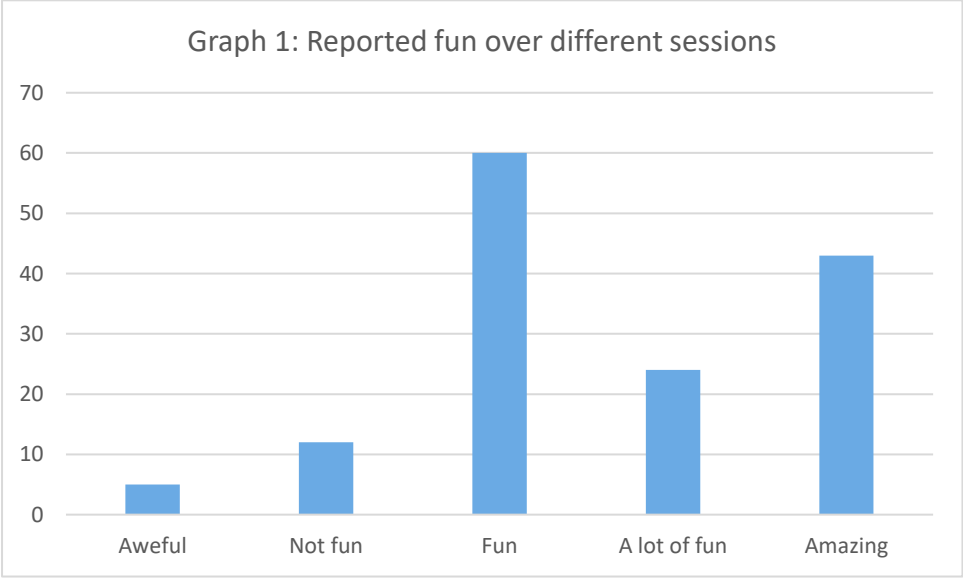


Figure 37, balanced design cornerstone results over the whole design process.

10.1.3 Fun

In general, children mostly reported enjoying the activities as shown in graph 1. Negative feedback, like awful or not fun only happened during the empathize phase. After the teambuilding and when we started crafting children started being more positive. Of course, this was also because children who did not want to participate did not do so. Interestingly, when asked if they wanted to do an activity again half usually said yes, half said maybe but no was only voted three times.

When looking at the research as a whole, all interviewees liked it. Eight found it fun, three a lot of fun and 6 found it amazing. Ten would like to do it again and seven maybe. They all remembered some of the activities and were engaged during most of them. To conclude, the children seemed to mostly have fun or even found it amazing.



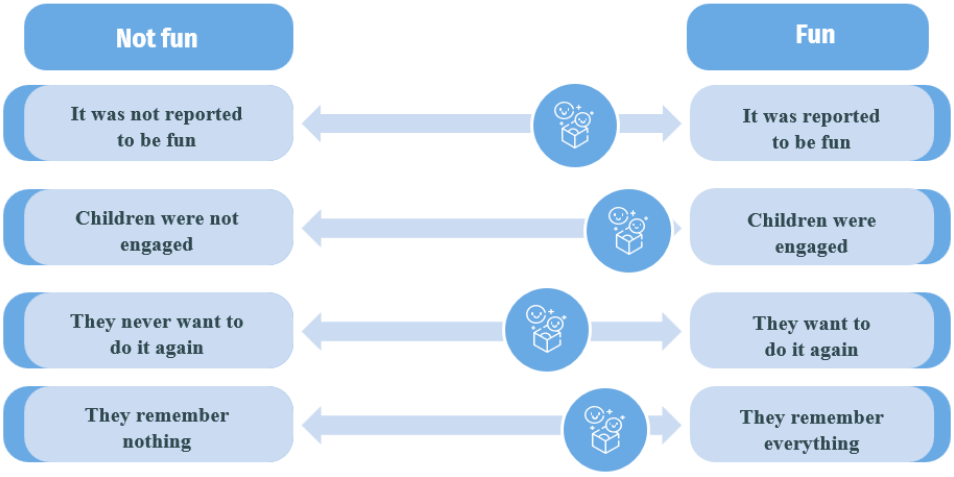


Figure 38, fun cornerstone over the whole design process

10.1.4 Empowerment

To improve empowerment, I tried to provide adequate information. However, as mentioned earlier, this was often difficult since it was challenging to keep everyone focused. Nevertheless, all the children did remember and knew the purpose of the research. Other more complex information was difficult to share. For example, the outcome of the ideate phase.

Nearly all the interviewees had the feeling that they could express themselves and felt heard and taken seriously during the process. The feeling of self-worth and importance varied more between children. Some that directly helped during the prototype phase felt more important. Similarly, one of the children specifically mentioned their contribution to the sign we made on the toilet. However, others felt that they did not contribute to the research.

In conclusion, some children did feel empowered by the research but others did not share this feeling. It remains to be seen if this feeling of empowerment stays and changes how they act at the ASC. Measuring empowerment remains vague, and further research is needed to define what empowerment with children truly entails.

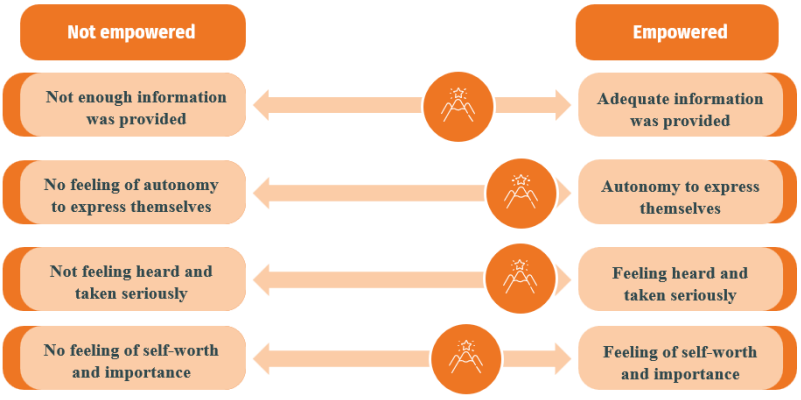


Figure 39, empowerment cornerstone results over the whole design process.

10.2 Contributions co-design

In this section, the contributions concerning co-design with children are discussed.

10.2.1 Context

Most co-design research takes place in a school context and the influence of the context is not always consistently reported and described (Tsvyatkova & Storni, 2019). This research provides a more detailed description of how the context and the location influenced each activity and its outcomes. Doing co-design at the ASC was crucial in researching the context but it also resulted in multiple difficulties. While this was their natural environment this was not always positive since the children found the ASC stupid. Some other important practical limitations are:

- Children can be tired after their school day
- The location is often small with limited space and a lot of children
- There are often substitutes replacing regular PMs
- The children are not always used to doing activities
- The group size can vary between sessions
- You are competing with free playtime
- You are quickly put in the role of a PM

Despite these practical limitations, the research did reach a rich understanding of the context. Therefore, it can still be interesting to co-design at the ASC. Future researchers can use this report to better prepare themselves in this case. Furthermore, it shows the importance of considering the context when doing co-design with children.

10.2.2 Big (varying) group size

Typically, co-design with children is done with a few small groups of one to three children and multiple researchers (Korte, 2020). When research is done with bigger groups and one researcher, the researcher usually takes a more facilitative approach (Van Mechelen et al., 2019). Instead of only facilitating, I tried to actively join as a design partner. The evaluation of the cornerstones shows varying degrees of success. Sometimes the children worked as design partners but at other times I took decisions without the children.

What worked well was working with a smaller group for activities that required more explanation or discussion. For example, during the define or prototype phase. Then, during activities with all children, like bags of stuff, it was possible to actively participate myself since less facilitation was needed. While a varying group size can be challenging, this

research shows that it is possible and has its benefits. By working with many children on the empathize phase we got a better understanding of the ASC and by working in smaller groups we were able to have more meaningful discussions. In the beginning, I often tried to include everyone as much as possible but once I started being more flexible in the group size I could progress past certain hurdles. For example, coming up with a design challenge.

To conclude, a big group can be difficult but occasionally working in smaller groups can help overcome some hurdles. A smaller group of children is recommended but this is not always possible. This research should provide more insight into working with a bigger group of children while taking a more active role in the design process.

10.2.3 Can every child be a design partner?

Druin (2002) claims that every child can be a design partner and contribute equally to the design process if they are willing. After my research, I do not fully agree with this view. I think the context plays a crucial role in this. For example, during my research group dynamics played an important role in how children interacted. This is also supported by Van Mechelen et al. (2014). Some children would not take the exercises seriously and others did not dare to always express their opinion. This might be avoided with more time, expertise, a different setting or smaller groups but this is not always possible. Therefore, which child effectively joins a co-design session is context-dependent.

Additionally, every child is different. Some children only focused on their friends and wanted a new gaming setup while other children specifically discussed the wants of children they did not hang out with. With more support and a different context, both groups might show equal contributions but time is often limited and some children can contribute quicker than others. I do believe that every child can make meaningful contributions but not always on the same level or as a balanced design partner.

To conclude, the context influences the capabilities of children, and you cannot expect them all to collaborate on the same level.

10.2.4 Free to choose

It was never mandatory for children to participate in activities. However, in the beginning, they were often encouraged to participate. The PMs and I would start the day by explaining what activity we were going to do and everyone participated. Similar to a normal day at the ASC, we encouraged children to participate and never explicitly gave them an option. However, how could we be design partners if children had the idea that it was

mandatory to participate? Then you do not operate as equals but from a position of power (Iivari et al., 2015).

This was a scary thing to do since children might not be interested in participating at all. Nevertheless, this research shows that it can be done. The children who volunteered were more motivated, listened better and asked more questions. Even children who did not actively participate could still be involved by asking them specific questions or by testing out the prototype. Unfortunately, most children who volunteered were girls which raises the question if common co-design activities favour girls more.

Making it voluntary also made it necessary that the children liked the activity. Even when they liked it, they might suddenly opt to not participate. One girl who was super motivated one session and rated every day as amazing would suddenly decide that she rather draw on her own that day. Since most co-design with children happens with consisting group size (Korte, 2020) I wonder if children do get the explicit choice to participate or not. Furthermore, a real choice can only be offered when the alternative is interesting as well. If the children were not participating, they could play games, play outside or do other things they wanted. Furthermore, they could also join part of the activity and change later if they wanted to. Interestingly, children often expressed surprise and even asked “Really?” when I told them they could choose.

This experience shows that children want to work voluntarily. However, more work is needed to better understand how to motivate children to join activities and how to create activities that are interesting enough for both boys and girls to join.

10.2.5 Ideas of children

In the beginning, I expected that I would be able to make every decision together with children. However, as the cornerstones show, this did not always happen. Especially, during the ideate phase children had difficulty coming up with ideas that would solve the issue. Mona Leigh et al. (2013) claim that children have fantastic ideas like a rocket ship to see their friends. They explain that this should be translated by adults into an idea focusing on mobile technology used to communicate with your friends. This part led me to the expectation that children would come up with many amazing and interesting ideas. However, children often had more basic ideas focused on getting a new PlayStation or a dog at the ASC. Other times they were simply not motivated or interested. Of course, this is partly due to the context as mentioned before but working together with children might also be described too positively.

In the end, I came up with an idea based on frustrations that the children were not included in ordering new toys for the ASC. Later, this idea was owned more and more by the children as they started getting involved in the prototype phase. However, the decision to pursue this idea was made by me. Therefore, I question if ideas by children are always creative and usable. In addition, if a fantastic idea needs to be translated into something practical by adults, is it still the idea of a child? Iivari et al. (2015) also explain that we need to consider the difference between *"practicality and beautiful visions about children's participation"* (p. 30). In this case, the idea that children would come up with amazing ideas might have been a beautiful vision but not a reality. These beautiful visions are good to strive towards but researchers should not be aware that these are not always feasible depending on the context.

This report shows that for practical reasons it can also be necessary and beneficial for the researcher to make decisions or follow their own ideas. In the end, the children still helped develop the prototype and took ownership of the idea. This is also where the cornerstones helped since they allowed for the flexibility to take a practical approach but also to move back towards children as co-designers afterwards.

10.2.6 Cornerstones

The cornerstones used in this research can provide a guideline for future research with children. First, the design partner cornerstone provides a useful reminder to involve children in as many decisions as possible. Second, the balanced design cornerstone helps shape daily interactions. Third, the fun element helps to ensure that the children like the activities and provides a better understanding of what children like. Fourth, by making empowering children a goal and not a byproduct you ensure that it gets priority.

In the end, they could not only be used to evaluate the design process but also the final idea. Since all the cornerstones are a continuum, it helps in striving for the best result as much as possible while still allowing to adapt when things do not go as expected.

10.2.7 Fun voting

Another contribution is the adaption of the fun toolkit by Read et al. (2009) into a voting system. Children always loved to vote, and it made it easier for me to gather responses. However, it is important to be present or appoint a child to collect votes since some children like to vote multiple times.

Additionally, measuring fun also helped in getting a better understanding of how children liked each activity. Observations can be difficult and some children that seemed to dislike an activity could suddenly find it amazing.

Figure 40, adapted fun toolkit (Read et al. 2002). Translations top: How was it? Awful, not fun, fun, a lot of fun, amazing. Translation bottom left: Would you want to do it again? Translation bottom right: Tips or ideas?

10.2.8 Outdated

The KidReporter activity in this research shows that this activity is getting outdated. Children of this generation do not know what a newspaper looks like making the activity less suitable. Since every generation is different, other activities might also be getting outdated and new activities might be needed that fit well with the children of this time.

10.2.9 Practical findings

The table below summarizes other practical recommendations for co-designing with big groups and in the setting of the ASC.

Table 2, practical tips

Practical findings	**Reasoning**
Play (outside) before any activity.	By letting the children play first they can lose some energy before starting an activity that requires more focus. This is especially important for big groups or after a long day at school.
Learn names quickly	Using first names helps establish friendships and collaboration (Druin, 2002) but for big groups, using their name is also crucial to interact with

	the group and individual children. For example, asking one of them their opinion or to pay attention for a moment.
Let them make groups themselves.	When the children could work with whoever they wanted they often had more ideas and were more motivated. The forced groups where friends were split up often caused a lot of friction.
Give (personalized) notebooks.	Druin (2002) suggested giving notebooks and this worked great during the empathize phase.
Voice recording did not work.	Initially, I planned on using a voice recorder to make notes but never got the opportunity to use it and instead used a notebook. There was too much noise and I was too busy to find the time to use it.
Be careful with interesting open-ended material.	Children loved working with the open-ended material. However, since the materials were so interesting, some of them easily got distracted and only focused on the materials instead of solving the problem.
Do the exercise yourself at home.	During activities, it is sometimes difficult to participate in activities because you need to facilitate. By preparing at home, you can still contribute as a design partner as well. For example, prepare ideas on post-its for a brainstorming activity.

10.3 The prototype

The prototype showed a lot of promise while testing. It helped that the prototype could do anything the final idea was supposed to do. Both children, staff and the organization are positive. The organization is also investigating how they can roll out a version of the prototype to every ASC. As explained in the testing phase it fulfills every requirement from the define phase and can make an impact at Norlandia.

For other researchers, it shows that elements which improve co-design can also improve a final concept. For example, children want to participate in the decision-making process and this idea allows them to do so. Furthermore, it shows the importance of ownership. Since every child owns their part of the prototype, the tag, they are more enthusiastic. Even children in front of the PlayStation stopped so they could get their personal tags registered.

Children also mentioned that to remain interesting, the booklet needed regular updates with new ideas. By using regular updates we can keep the children engaged and interested (Zhao et al., 2017). Furthermore, it is interesting that all children reported to like the prototype and believed it could (somewhat) help. This means that even though there were

obstacles and practical limitations in working with a big group at the ASC the result was promising.

To conclude, the idea is more than just the system. The payment system is a tool to achieve the actual goal, of increasing children-participation and a feeling of ownership at the ASC. By implementing it, Norlandia can integrate children's participation in the way they work and make it easy for the PMs and fun for the children.

11 Conclusion

This research set out to explore how children can make the ASC more fun since children often dislike their time there. Through co-design, we conducted many different activities that provided insights on how to answer our research question. Despite hurdles, we got a better understanding of the current situation at the ASC. This resulted in the overarching theme *the ASC is stupid*. This is supported by several themes discussed in the table below.

Table 3, overview of themes.

Theme	**Description**
Change it up	Children want more variety in both activities and toys at the ASC. Especially going outside can get boring if it is in the same place every day without any activities.
Children participation: It's a right	Children want to decide for themselves what they do. They know best what they like and don't want to be treated as little children.
We are all different	Every child has different interests and wants different things.
The prevalent story: "The ASC can not be fun"	Children and many adults are convinced that the ASC cannot be fun causing a negative and passive mindset.
My precious	Children love to have ownership over their things.
Unsteady foundations	The PM and Norlandia are currently not providing a solid foundation on which to build new ideas. This is supported by the next two themes.
Irregular foundations	Every location and PM is different making the implementation of an idea more difficult.
Pieces without a whole	Many parts of the organization have good ideas, but it is difficult to implement them.

These themes provide valuable insights for Norlandia giving them a better understanding of the current situation. Furthermore, it might help other ASCs in the Netherlands to deal with this same issue as well. Based on these themes the following design challenge was established:

How might we ensure that children say:
"Yes! I can finally go to the ASC again!"

To solve this, we came up with the idea of an ASC shop that could make a positive difference at the ASC. It allows children to actively participate in the decision-making and all children indicated that this could make the ASC (a bit) more fun. While it will not address all the problems, it can partially solve some of them. More work is already being done by Norlandia to solve some of these problems with a focus on the organization and the PMs. A prototype of this idea was made and tested. Testing yielded promising results, and children believe it can make the ASC more fun. Furthermore, it fits well within several themes from the ideate stage. However, due to the complex situation at the ASC, it will not suddenly make the ASC fun for everyone. Nevertheless, for some children, it could make the ASC amazing and for others, it might help a bit.

To conclude, *how can children make the ASC more fun?*

The current situation at the ASC is complex and contains multiple issues. To make the ASC more fun, the children need more variety, a belief the ASC can be fun, ownership and the ability to participate. One way to partially achieve this is by implementing an ASC shop. Children can use their personal tags with points to select which new toys and materials the ASC buys. This gives children more opportunities to participate, creates ownership and takes everyone's personal preferences into account.

11.1 Next steps

The results of testing the prototype seem promising but require testing over a longer time. It should be investigated if the idea remains interesting over time and if the points are sufficient. Children already mentioned that the booklets should be updated. This requires ideas to be collected by children and PMs. Norlandia should provide clear guidelines so children and PMs know which ideas can be accepted.

Later, the idea could potentially be extended further. For example, by including the children in making decisions about furniture for the ASC. Or as one child suggested, being

able to choose decorations and furniture to influence how the ASC looks. Potentially, activities could also be offered through the shop, but this should be approached carefully due to challenges if children do not want to participate. Last, children also had the idea that they could earn extra points through competitions or an ASC market where parents could buy things. These options could add variety to the ASC throughout the year keeping it engaging and fun.

11.2 Future research

Doing the research at the ASC had a significant impact on the design process. Due to a large group size some activities failed, and some needed to be adapted. Further research is necessary to see how location and group size influence the co-design process. Smaller groups allowed more in-depth discussions and better communication but little more research is done on how and when to adapt the group size.

Co-design activities are often done in a school environment (Korte, 2020). A manager of an after-school program in the United States explained it as follows (Uchidiuno et al., 2023):

"You know, like when you're in school, if they make a game out of learning, that's exciting. If you go to the club and they make a game out of learning it's like whoa, whoa, what is this? Oh, we don't want to do this."

In other words, activities that might work in a school setting might fail in other contexts. Therefore more research should be done on what activities are suitable for which contexts.

Researchers should consider settings in which it is clear that the activities are completely optional. More work is needed on how to then motivate children and keep them interested. Especially boys were less interested in joining and more work is needed to understand if current activities favor girls and how to make things interesting for children. Finally, future research could investigate whether activities, such as KidReporter, might not be suitable for the current generation.

12 AI disclosure

Two different AI tools have been used while writing this thesis. The first is Grammarly used for finding grammatical mistakes. The second is ChatGPT which has been used in four ways:

- Help with the naming of themes.
    - Example prompt: Can you come up with 20 theme names based on these codes?
- Help with rephrasing specific sentences I was struggling with.
    - Example prompt: How would you rephrase this sentence so it is more formal and in active voice?
- Providing feedback on the text.
    - Example prompt: Based on this document with tips on academic writing please highlight parts of the text that can be improved. Explain in between brackets what is wrong with the sentence in two to three words.
- Getting formal synonyms.
    - Example prompt: What is a more formal way to say “a lot”?
- The Flowchart was initially made with the AI integrated within Miro based on my code and then adapted by me.

All the suggestions of AI have been carefully examined and usually adapted to fit my writing style. Rarely, an improved version of one of my sentences was copied completely but never more than one sentence.

13 Bibliography

Alhatem, M., Kamaruddin, A. B., Ali, N. M., & Ghani, A. A. A. (2019). Children involvement in participatory design process: A background review [Article]. *International Journal of Advanced Trends in Computer Science and Engineering*, *8*(1.4S1), 474-483. https://doi.org/10.30534/ijatcse/2019/7581.42019

Alvarado, D., & Díaz, P. (2015). Involving children in design activities using the ChiCo exploratory co-design technique. *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *9083*, 198-203. https://doi.org/10.1007/978-3-319-18425-8_16

Bekker, T., Beusmans, J., Keyson, D., & Lloyd, P. (2003). KidReporter: A user requirements gathering technique for designing with children. *Interacting with Computers*, *15*, 187-202. https://doi.org/10.1016/S0953-5438(03)00007-9

Braun, V., & Clarke, V. (2021). *Thematic Analysis: A practical Guide*. Sage Publications Ltd.

Brown, T. (2008). Design Thinking. *Harvard business review*, *86*, 84-92, 141.

Consultancy.nl. (2015). *Scandinaviers nemen Wassenaarse kinderopvang over*. https://www.consultancy.nl/nieuws/11282/scandinaviers-nemen-wassenaarse-kinderopvang-over

Delft. (n.d.). *Co-design with Children* https://studiolab.ide.tudelft.nl/studiolab/codesignwithkids/

Dindler, C., Eriksson, E., Iversen, O., Spaces, I., Katrinebjerg, I., Lykke-Olesen, A., & Ludvigsen, M. (2005). Mission from Mars: a method for exploring user requirements for children in a narrative space. https://doi.org/10.1145/1109540.1109546

Druin, A. (1999). Cooperative inquiry: developing new technologies for children with children. https://doi.org/10.1145/302979.303166

Druin, A. (2002). The role of children in the design of new technology. *Behaviour & Information Technology*. https://doi.org/10.1080/01449290110108659

Guha, M., Druin, A., Chipman, G., Fails, J., Simms, S., & Farber, A. (2004). Mixing ideas: A new technique for working with young children as design partners. *Proc. IDC 2004*, 35-42. https://doi.org/10.1145/1017833.1017838

Iivari, N., & Kinnula, M. (2018). Empowering children through design and making: towards protagonist role adoption. *Proceedings of the 15th Participatory Design Conference: Full Papers - Volume 1*, 1-12. https://doi.org/10.1145/3210586.3210600

Iivari, N., Kinnula, M., & Kuure, L. (2015). With best intentions. *Information Technology & People*, *28*(2), 246-280. https://doi.org/10.1108/ITP-12-2013-0223

Iversen, O. S., & Brodersen, C. (2008). Building a BRIDGE between children and users: a socio-cultural approach to child–computer interaction. *Cognition, Technology & Work*, *10*(2), 83-93. https://doi.org/10.1007/s10111-007-0064-1

Iversen, O. S., Smith, R. C., Dindler, C., & Acm. (2017). Child as Protagonist: Expanding the Role of Children in Participatory Design. *16th International ACM Conference on Interaction Design and Children (IDC)*, 27-37. https://doi.org/10.1145/3078072.3079725

Jerry Alan, F., Mona Leigh, G., & Allison, D. (2013). Methods and Techniques for Involving Children in the Design of New Technology for Children. 1. https://doi.org/10.1561/1100000018

Kadijk, N. (2024). *How can children make the BSO more fun?* University of Twente.

Kenniscentrum Kinderopvang. (n.d.). *Kansen voor de BSO*. https://expertisecentrumkinderopvang.nl/onderwerpen/bso

Kinderrechten.nl. (n.d.). *Thema: Participatie*. https://www.kinderrechten.nl/professionals/participatie-van-het-kind/

Korte, J. (2020). Patterns and themes in designing with children. *Foundations and Trends in Human-Computer Interaction*, *13*(2), 70-164. https://doi.org/10.1561/1100000079_app

Korte, J., Constantin, A., Alexandru, C. A., Fails, J. A., Eriksson, E., Good, J., Pain, H., Hourcade, J. P., Garzotto, F., & Waller, A. (2019). Pushing the Boundaries of Participatory Design. *17th IFIP*

TC13 International Conference on Human-Computer Interaction (INTERACT), *11749*, 747-753. https://doi.org/10.1007/978-3-030-29390-1_74

Large, A., Nesset, V., Beheshti, J., & Bowler, L. (2006). "Bonded design": A novel approach to intergenerational information technology design. *Library & Information Science Research*, *28*(1), 64-82. https://doi.org/https://doi.org/10.1016/j.lisr.2005.11.014

McKinsey. (2017). *How digital reinventors are pulling away from the pack*. https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/how-digital-reinventors-are-pulling-away-from-the-pack

Mona Leigh, G., Allison, D., & Jerry Alan, F. (2013). Cooperative Inquiry Revisited: Reflections of the Past and Guidelines for the Future of Intergenerational Co-Design. *International Journal of Child-Computer Interaction*. https://doi.org/10.1016/j.ijcci.2012.08.003

Moraveji, N., Li, J., Ding, J., O'Kelley, P., & Woolf, S. (2007). *Comicboarding: using comics as proxies for participatory design with children* Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, San Jose, California, USA. https://doi.org/10.1145/1240624.1240832

NJi. (2023). *Cijfers over buitenschoolse opvang* https://www.nji.nl/cijfers/buitenschoolse-opvang-bso

Olsen, R. K. (2023). Key factors for child participation - an empowerment model for active inclusion in participatory processes. *Frontiers in Psychology*, *14*. https://doi.org/10.3389/fpsyg.2023.1247483

Partou. (2024). *Eerste inzichten in onderzoek naar programma en activiteitenaanbod op de bso voor kinderen*. https://www.werkenbijpartou.nl/ontdek-partou/verhalen/eerste-inzichten-in-onderzoek-naar-programma-en-activiteitenaanbod-op-de-bso

Prisma. (n.d.). https://www.prisma-statement.org/

Read, J., Gregory, P., MacFarlane, S., McManus, B., Gray, P., & Patel, R. (2002). An investigation of participatory design with children-informant, balanced and facilitated design. *Interaction Design and Children*.

Read, J., MacFarlane, S., & Casey, C. (2009). Endurability, Engagement and Expectations: Measuring Children's Fun. *Interaction Design and Children*.

Rijnen, & Schreuder. (2000). Geef ze de ruimte. https://www.nji.nl/sites/default/files/2021-05/GeefZeDeRuimte2drZonderIllustraties.pdf

Romijn, Slot, Jepma, Muller, Breedeveld, & Leseman. (2024). Kwaliteit van de Nederlandse kinderopvang. https://www.monitorlkk.nl/Publicaties

Schaper, M. M., Iversen, O. S., Malinverni, L., & Pares, N. (2019). FUBImethod: Strategies to engage children in the co-design of Full-Body interactive experiences [Article]. *International Journal of Human Computer Studies*, *132*, 52-69. https://doi.org/10.1016/j.ijhcs.2019.07.008

Schaper, M. M., Márquez Segura, E. M., Malinverni, L., & Pares, N. (2023). Think-4-EmCoDe framework: Highlighting key qualities in embodied co-design techniques for children. *International Journal of Human-Computer Studies*, *177*, Article 103065. https://doi.org/10.1016/j.ijhcs.2023.103065

Schaper, M. M., & Pares, N. (2021). Co-design Techniques for and with Children based on Physical Theatre Practice to promote Embodied Awareness [Article]. *ACM Transactions on Computer-Human Interaction*, *28*(4), Article 22. https://doi.org/10.1145/3450446

Simko, L., Chin, B., Na, S., Saluja, H. K., Zhu, T. Q., Kohno, T., Hiniker, A., Yip, J., & Cobb, C. (2021). Would You Rather: A Focus Group Method for Eliciting and Discussing Formative Design Insights with Children. *Proceedings of Interaction Design and Children, IDC 2021*, 131-146. https://doi.org/10.1145/3459990.3460708

Slot, Romijn, Jepma, Muller, & Leseman. (2023). Verschillen in kwaliteit. https://www.monitorlkk.nl/Publicaties

SZW. (2021). De betekenis van bso voor ouders en kinderen. https://www.rijksoverheid.nl/documenten/rapporten/2022/02/22/de-betekenis-van-bso-voor-ouders-en-kinderen

Tare, M., & Guha, M. L. (2023). “We’re Hinged. They’re Not. It’s in that Space that Creativity Happens:” Adult co-designers’ perspectives on designing technology with children. *Proceedings of IDC 2023 - 22nd Annual ACM Interaction Design and Children Conference: Rediscovering Childhood*, 574-577. https://doi.org/10.1145/3585088.3593902

Tsvyatkova, D., & Storni, C. (2019). A review of selected methods, techniques and tools in Child–Computer Interaction (CCI) developed/adapted to support children's involvement in technology development. *International Journal of Child-Computer Interaction*, *22*, Article 100148. https://doi.org/10.1016/j.ijcci.2019.100148

Uchidiuno, J. O., Solyst, J., Harpstead, E., & Higashi, R. (2023). *“I'm a little less inclined to do it”: How Afterschool Programs’ Culture Impact Co-Design Processes and Outcomes* Proceedings of the 2023 ACM Designing Interactive Systems Conference, Pittsburgh, PA, USA. https://doi.org/10.1145/3563657.3596006

Van Mechelen, M. (2016). *Designing technologies for and with children: A toolkit to prepare and conduct co-design activities and analyse the outcomes*.

Van Mechelen, M., Gielen, M., Vanden Abeele, V., Laenen, A., & Zaman, B. (2014). Exploring challenging group dynamics in participatory design with children. *ACM International Conference Proceeding Series*, 269-272. https://doi.org/10.1145/2593968.2610469

Van Mechelen, M., Laenen, A., Zaman, B., Willems, B., & Abeele, V. V. (2019). Collaborative Design Thinking (CoDeT): A co-design approach for high child-to-adult ratios. *International Journal of Human-Computer Studies*, *130*, 179-195. https://doi.org/https://doi.org/10.1016/j.ijhcs.2019.06.013

van Zeeland, E. (2022). *Aan de slag met Design Thinking*. FLOOT.

Walsh, G., Druin, A., Guha, M. L., Foss, E., Golub, E., Hatley, L., Bonsignore, E., & Franckel, S. (2010). Layered elaboration: a new technique for co-design with children. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 1237 - 1240. https://doi.org/10.1145/1753326.1753512

Walsh, G., Foss, E., Yip, J., & Druin, A. (2013). FACIT PD: A Framework for Analysis and Creation of Intergenerational Techniques for Participatory Design. *Conference on Human Factors in Computing Systems - Proceedings*, 2893 - 2902. https://doi.org/10.1145/2470654.2481400

Wijzer, K. (2024). *Top 100 grootste kinderopvangorganisaties op concerniveau (mei 2024)*. https://www.kinderopvang-wijzer.nl/top-100-grootste-kinderopvangorganisaties-op-concernniveau-mei-2024-marktaandeel/

Yip, J. C., Arnold, L., Gallo, A., Lee, K. J., Pitt, C., Sobel, K., & Chen, S. (2016). How to survive creating an intergenerational co-design group. *Interactions*, *23*(4), 65-67. https://doi.org/10.1145/2933395

Yip, J. C., Sobel, K., Pitt, C., Lee, K. J., Chen, S., Nasu, K., Pina, L. R., & Acm. (2017). Examining Adult-Child Interactions in Intergenerational Participatory Design. *ACM SIGCHI Conference on Human Factors in Computing Systems (CHI)*, 5742-5754. https://doi.org/10.1145/3025453.3025787

Zhao, Z., Arya, A., Whitehead, A., Chan, G., & Etemad, S. A. (2017). *Keeping Users Engaged through Feature Updates: A Long-Term Study of Using Wearable-Based Exergames* Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems, Denver, Colorado, USA. https://doi.org/10.1145/3025453.3025982

14 Appendixes

Appendix A: The Locations

This appendix contains a description of different locations which were visited.

Zuid-Holland

The first ASC is located in a big city in Zuid-Holland. It is located in an old school building with a playground in front. However, this building is planned to be destroyed leading to uncertainty on how long they can be there. On the day of my visit, 36 children divided into three different groups participated in the activity. This location was visited only once as part of the KidReporter activity.

Figure 41, ASC Zuid-Holland

Noord-Brabant

The second ASC is located in a small village in Noord-Brabant. The location is again located inside a school. Currently, they have their own room which they will lose soon since the school wants to use it. As a result, they will have to move in the hallway. In total, 8 children occupied the room making it feel spacious. On the playground the children have access to the closet with outdoor material from school containing bikes, skeelers, skelters and more outdoor toys. This location was visited only once as part of the KidReporter activity.

Figure 42, ASC Noord-Brabant indoors and playground

Noord-Brabant

The third ASC is located in a bigger city in Noord-Brabant. Located in a school, children do not need to be picked up and can play on the school playground. Indoors, they have one room for those older than seven (Figure 43). Outside they can play on the square of the school which has a few obstacles, bushes (which they are not allowed to enter) and

climbing elements. There are more areas nearby where children could play but these are seldom visited. In total, there were 23 children present aged between 7 and 11.

Figure 43, ASC in Noord-Brabant, indoors and playground

Below is the total number of children for each session at this ASC. These numbers are based on the database of Norlandia and might be one or two children off since some parents forget to notify that their children are not coming.

Table 4, the total number of children present at the ASC

Activity	Children	Boys	Girls
Testing	23	12	11
Testing	23	12	11
Prototyping	21	12	9
Prototyping	21	12	9
Prototyping	19	11	8
Sticky noting	19	11	8
Bags of stuff	22	12	10
Bags of stuff	20	11	9
Define	19	10	9
WYR	23	13	10
Ranking	23	13	10
Kidreporter	23	13	10
Introduction	25	14	11

Utrecht

The fourth location is based in a small village in the Utrecht province. These sessions will take place in two ASCs instead of one. Initially, the plan was to visit only one ASC who has eleven children but the other ASC was included in the research as well since they had difficulty with declining numbers of children. Therefore, to capture all the differences in the organization, it was interesting to include them in the research as well. Currently, there are only six children above seven who are joining the sessions from location two.

Each week all the older children (7+) will be either brought to location one or location two for the co-design sessions. Both locations do not have their own playground and they

play at other playgrounds around the village. Location one has one room for the older children and location two has three for all ten children.

Figure 44, ASC location one and "gym room" of location two (right) which are both in the Utrecht Province

Below is the total number of children for each session at this ASC. These numbers are based on the database of Norlandia and might be one or two children off since some parents forget to notify that their children are not coming.

Table 5, the total number of children present at the ASC

Activity	Total children	Boys	Girls
Testing	19	5	14
Testing	12	5	7
Prototyping	20	7	11
Prototyping	19	6	13
Sticky noting	21	7	14
Bags of stuff	20	6	14
Bags of stuff	16	5	11
Define	19	6	13
WYR	19	5	14
Ranking	15	4	11
Kidreporter	17	7	10
Introduction	19	7	12

Appendix B: A Day in the Life

What does a day look like for children at the ASC? Here we describe the story of a fictional girl called Ashley (9 years old). The story of Ashley is based on my observations and shows an average day at the ASC.

Ashley's class has just ended and she is walking with two friends outside. Her friends quickly run to their parents while she heads towards the two PMs sitting on a bench. Mumbling a 'hello', she takes a bright green old safety jacket and turns around trudging away to three other classmates lingering on the square. After about 10 minutes the PM calls her name, and she heads over to the gate. There, the children line up in pairs and begin their walk towards the ASC. She walks with her other friends from the ASC chatting casually, but she feels impatient since the pace of the younger children is sooo slow.

When arriving at the ASC she throws her jacket in a basket, hangs up her bag and runs straight to the room for the older children. She and her friends immediately "claim" the den to chill in before getting called to get food. Then the PM calls the children over for snacks and drinks and they head over.

They go sit at the table where it is quite loud and all the children are talking. Feeling energetic Ashley sits on her knees moving back and forth impatiently waiting for a piece of fruit and crackers. She sits close to the PM and gets her food first and finishes it quickly. She stands up to leave already and starts playing but is called back and needs to remain at the table. Ashley is getting a bit bored and is impatient to leave the table.

Next, the PM takes Ashley and the other kids outside to play outside to the regular playground. When they arrive Ashley runs towards the climbing frame where they start playing "blind man" where there is a tagger who has to close their eyes. After half an hour of fun, she gets bored and moves over to the tumbling frame to chill with the other two older girls. Twenty minutes later they go back towards the ASC. Some children are protesting that they want to stay but Ashley feels tired and is happy they are going back. At the ASC she grabs craft materials from the cupboard to start drawing something together with Sofia. Unfortunately, the PM gets frustrated that they opened the cupboard since they "*always make such a mess*". Nodding and promising that they will not do it anymore Ashley and Sofia start drawing the boat of Sinterklaas. However, before they are finished Sofia gets picked up by her dad early and Ashley is left alone. With only a few children left, Ashley feels lonely and asks the PM if she can watch YouTube on the TV. The PM does not allow it so she tries to

finish her drawing but is mostly just waiting for her mom to come and bring her home. When she sees her mother's jacket through the window she quickly runs over, eager to go home.

Appendix C: Overview of techniques

Table 6, different techniques for co-designing with children

Technique	Description	Design stage	Suitable?
Contextual inquiry	Method of observing activities together with children	Empathize	Yes, but tricky since multiple researchers are recommended.
Technology immersion (Druin, 2002)	Exposes children to a huge variety of different technologies and sees how they interact.	Empathize	Not really, not feasible with the budget and two different locations.
KidReporter (Bekker et al., 2003)	Make a newspaper together with the children.	Empathize	Yes.
Would you rather? (Simko et al., 2021)	Have a line divide the room and have children go to different sides depending on the answer to a question.	Empathize	Yes, but will be important to also have the children make questions to encourage balanced design.
Dwelling space technique (Schaper et al., 2019)	Make a video of a space to get a better understanding of it.	Empathize	Not really since this research avoids video cameras.
Experience gatherer (Delft, n.d.)	Creates awareness of others by mapping their own experience and comparing it.	Empathize	Yes.
Location vlog (Delft, n.d.)	The children will make vlogs of their experiences.	Empathize	No, since filming is not included because of ethical concerns.
Personas (Delft, n.d.)	Develop personas of the target group for a better understanding.	Empathize	Not really since they are their target group so less relevant.
Open your senses (Delft, n.d.)	Series of exercises to explore an environment with different senses.	Empathize	Yes.
Chico technique (Alvarado & Díaz, 2015)	Technology platform that focuses on a combination of technology, social practices and context.	Empathize	No, requires large touch screens.
Comicboarding (Moraveji et al., 2007)	Make comics as a way for children to brainstorm and express their ideas and analyze existing situations.	Empathize, Ideate	No, usually done with an experienced comic artist.
Mission from Mars (Dindler et al., 2005)	Have researchers pose as aliens asking questions from children to stimulate different answers.	Empathize, Define	No, multiple researchers are needed and it does not see children as equals.
Sticky noting (Mona Leigh et al., 2013)	Critique an existing technology or prototype together to provide feedback for future improvements.	Empathize, Define, Testing	Yes, can also be adapted to focus on the ASC in general.

Empathic design challenge (Delft, n.d.)	Use prior knowledge of the empathize phase to define a problem statement and criteria.	Define	Yes, will require some extra help since this is quite complex.
Layered elaboration (Walsh et al., 2010)	Elaborate on previous ideas without destroying others.	Ideate	Yes, but originally focused on screen-based ideas so might be less suitable.
Mixing ideas (Guha et al., 2004)	Combine different ideas into one big one.	Ideate	Yes.
Video prototyping (Iversen & Brodersen, 2008)	Used to interact out interaction such as using an app or an activity	Ideate	No, since filming is not included because of ethical concerns.
Bags of stuff (Mona Leigh et al., 2013)	Bring stuff with interesting materials to prototype with.	Ideate	Yes.
Inverse brainstorm (Delft, n.d.)	Create interesting ideas by exploring the opposite of the status quo.	Ideate	Yes.
Picture brainstorm (Delft, n.d.)	Brainstorm by drawing pictures.	Ideate	Yes.
Word brainstorm (Delft, n.d.)	Brainstorm by coming up with ideas for predetermined words.	Ideate	Yes, but the children should be included in coming up with words for a balanced design.
Combine and fantasize (Delft, n.d.)	Create unusual situations by combining random words.	Ideate	Yes.
Situated Bodystorming Technique (Schaper et al., 2019)	Act out certain movements where children complement each other's movements.	Ideate	Might be useful but depends on the direction of the idea.
Body shadows (Schaper & Pares, 2021)	Have the children express an idea by using shadows.	Ideate	Not really, requires a large canvas and big lights which will be difficult to set up in two locations.
Big props (Walsh et al., 2013)	Using big objects to discover interactions with motion-detecting sensors.	Ideate	Might be useful but depends on the direction of the idea.
Puppet-based design technique (Schaper et al., 2019)	Involves making videos of puppets to explore different movements.	Ideate, prototype	Might be useful but depends on the direction of the idea and if the camera part can be excluded.
Wizard of OZ (Schaper et al., 2019)	Have someone fake the interactions to test out a prototype.	Prototype	Yes, but the children should help in the faking part and not only the adults.
Lo-fi prototyping (Druin, 1999)	Using basic materials to build a quick prototype that can be used for testing	Prototype	Yes.

Line judging (Walsh et al., 2013)	Use a line to have children judge ideas and spark conversation.	Test	Yes, but will need to be careful to not create negative feelings for children with unpopular ideas.
Fun toolkit (Read et al., 2009)	Toolkit with different tools to measure the fun that children had.	Test	Yes, if also filled in by the adults.

Appendix D: ranking ideas for the ASC

Nr.	Idee	Uitleg	Score
1		**Eigen hut bouwen** Bouw van echt hout een gave hut.	Points: 51 Std. Deviation: 1.0 Median: 10
2		**Vriendenkaartjes** vier keer per jaar mag je een vriendje meenemen naar de BSO	Points: 42 Std. Deviation: 4.1 Median: 11
3		**BSO kamp** Samen op kamp en avontuur (alleen met de 7+ groep)	Points: 41 Std. Deviation: 4.0 Median: 10
4		**Maakplek** Werkplaats om coole dingen te maken en te experimenteren	Points: 40 Std. Deviation: 2.8 Median: 8
5		**Lego Mindstorm** Maak je eigen robot en progameer het	Points: 36 Std. Deviation: 1.2 Median: 7
6		**Picoo** Speel buiten met deze spelcomputer met wel meer dan 40 spellen.	Points: 34 Std. Deviation: 2.6 Median: 7
7		**Springfloor** Speel allemaal spellen op deze interactieve vloer	Points: 33 Std. Deviation: 2.2 Median: 6
8		**Greenbox** maak je eigen videos en geef ze special effects	Points: 31 Std. Deviation: 3.2 Median: 6
9		**Magical climb** Je hoort een dierengeluid en klimt daarna zo snel mogelijk naar het juiste dier in het klimrek	Points: 26 Std. Deviation: 2.9 Median: 4

Appendix E: WYR questions

Op de ASC, wat wil je liever...	
Altijd binnen spelen	Altijd buiten (zelfs met regen) spelen

Op de ASC, wat wil je liever...	
Iedere dag een grote hut bouwen	Iedere dag op je telefoon

Op de ASC, wat wil je liever...	
Iedere maand een groot gaaf duurder activiteit doen	iedere week een klein goedkoop activiteit doen

Op de ASC, wat wil je liever...	
De ASC kamer opdelen in vier aparte ruimtes	De ASC kamer twee keer zo groot maken

Op de ASC, wat wil je liever...	
Een bos voor de deur	Een meer voor de deur

Op de ASC, wat wil je liever...	
Elke dag wat anders doen	Altijd hetzelfde doen maar jij kiest wat

Op de ASC, wat wil je liever...	
Iedere dag activiteiten maar je moet meedoen	Nooit activiteiten en alleen vrij spelen

Appendix F: Newspaper questions

- Wat zijn 10 leuke dingen op de ASC?
- Wat zijn 10 stomme dingen op de ASC?
- Hoe ziet een dag op de ASC eruit?
- Wat vinden de juffen/meesters van hun werk?
- Hoe ziet de ASC van de toekomst (100 jaar) eruit?
- Als we konden toveren zou de ASC er zo uit zien:
- Wat hebben wij geleerd of de ASC?
- Als wij de baas waren op de ASC dan:
- Als wij activiteiten mochten organiseren zouden we graag:
- Op de ASC voelt iedereen zich:
- Thuis doen wij het liefst:

Appendix G: The ASC shop booklet

ASC WINKEL

Norlandia
KINDEROPVANG

0 Walkie talkie: 400

2 Walkie Talkies met oortjes, opladers en

5 kilometer berijk.

1 Throw Throw Burrito: 330

Trefbal maar dan als bordspel met kaarten, en burrito’s.

2 Powerup je vliegtuig: 240

Voeg een propeller toe aan je vliegtuig waardoor het blijft vliegen!

3 Voetbal goals: 510

Neem deze doeltjes overall mee naartoe.

4 Microscoop: 240

Bekijk alles van dichtbij met deze microscoop.

5 Knutselmateriaal: 340

Knutselpakket met allemaal leuk materiaal.

6 Scrapbox: 500

Grote verhuisdoos vol met leuke en duurzaam hergebruikte spullen.

7 Potloden: 250

Set van 250 potloden.

8 Tent: 200

Stevige en makkelijke tent met isolatielaag zodat het lekker warm blijft.

9 Camouflage net: 240

Groot camouflage net (1 bij 2 meter) waarmee je kunt verstoppen of een hut mee kan bouwen.

10 Led strip: 260

Led strip met afstandsbediening en 16 verschillende kleuren. Werkt op batterij.

11 Hangmat: 350

Hang deze buiten in het klimrek om lekker te chillen. Er moet wel een stevige boom of paal staan.

Appendix H: Arduino code

```
#include <EEPROM.h>
#include <SPI.h>
#include <MFRC522.h>
#include <MD_Parola.h>
#include <MD_MAX72XX.h>
#include <Adafruit_NeoPixel.h>
#include <Keypad.h>

// EEPROM Configuration
#define EEPROM_SIZE 512
#define TAG_SIZE sizeof(TagInfo)
#define MAX_TAGS 55
#define START_ADDRESS 0

// RFID and LED Matrix
#define RST_PIN 5
#define SS_PIN 53
#define HARDWARE_TYPE MD_MAX72XX::FC16_HW
#define MAX_DEVICES 4
#define CLK_PIN 2
#define DATA_PIN 4
#define CS_PIN 3

// NeoPixel Progress Bar
#define LED_PIN 6
#define MAX_LEDS 29
#define BRIGHTNESS 0.5

// Keypad Configuration
const byte ROWS = 4;
const byte COLS = 4;
char hexaKeys[ROWS][COLS] = {
  {'1', '2', '3', 'A'},
  {'4', '5', '6', 'B'},
  {'7', '8', '9', 'C'},
  {'*', '0', '#', 'D'}
};
byte rowPins[ROWS] = {22, 24, 26, 28};
byte colPins[COLS] = {30, 32, 34, 36};
Keypad customKeypad = Keypad(makeKeymap(hexaKeys), rowPins, colPins, ROWS, COLS);

// Categories and Goals for each location
#define CATEGORY_POINTS_START_ADDRESS (START_ADDRESS + MAX_TAGS * TAG_SIZE)
#define CATEGORY_POINTS_SIZE (sizeof(categoryPoints))
#define MODE_ADDRESS (START_ADDRESS + MAX_TAGS * TAG_SIZE) // Address for current mode
#define CATEGORY_POINTS_SPOOR_ADDRESS (MODE_ADDRESS + sizeof(char[10])) // Address for
"spoor" points
#define CATEGORY_POINTS_MAARSSEN_ADDRESS (CATEGORY_POINTS_SPOOR_ADDRESS +
sizeof(categoryPoints))
String currentMode = "spoor"; // Default mode

String names[] = {"Talkie", "Burrito", "Vliegtuig", "Goals", "Micro", "knutsel", "Scrap",
"Potloden", "Tent", "Camouflage", "LED", "Hangmat"};
int categoryPoints[] = {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0};
int categoryGoals[] = {400, 330, 240, 510, 240, 340, 500, 250, 200, 240, 260, 350};
int lastCategoryIndex = -1;

// Buzzer Pin
#define BUZZER_PIN 11

// RFID and LED Matrix Instances
MFRC522 mfrc522(SS_PIN, RST_PIN);
MD_Parola parola = MD_Parola(HARDWARE_TYPE, DATA_PIN, CLK_PIN, CS_PIN, MAX_DEVICES);
Adafruit_NeoPixel strip = Adafruit_NeoPixel(MAX_LEDS, LED_PIN, NEO_GRB + NEO_KHZ800);

// Structure for Tag Information
struct TagInfo {
```

```
  char uid[16];
  char name[16];
  int points;
};

// Tag Database
TagInfo tagDatabase[MAX_TAGS];
int tagCount = 0;

// System Mode
bool queryMode = true;
int scannedTagIndex = -1; // To store the index of the last scanned tag in query mode

// Function Prototypes
void updateProgressBar(int categoryIndex, bool animate = false);
void displayNameAndPoints(int categoryIndex);
void displayName(const char *name);
void displayPoints(const char *points);
int findTag(String uid);
void saveTagToEEPROM(int index, TagInfo tag);
TagInfo readTagFromEEPROM(int index);
void loadAllTags();
void initializeEEPROM();
String getCardUID();
void fullScoreAnimation();
uint32_t calculateColor(int points, int goal);
bool confirmPayment();

//pay all the children
bool paydayMode = false; // Tracks whether the system is in payday mode
bool cleanPaydayMode = false; // Tracks whether the system is in clean payday mode
bool receivedBonus[MAX_TAGS]; // Tracks if a tag received its bonus

void setup() {
  Serial.begin(9600);
  SPI.begin();
  mfrc522.PCD_Init();
  parola.begin();
  parola.displayClear();
  parola.setIntensity(5); // Adjust brightness for LED matrix (0 = dimmest, 15 = brightest)
  strip.begin();
  strip.show();
  pinMode(BUZZER_PIN, OUTPUT);
  initializeEEPROM();
  loadAllTags();

  for (int i = 0; i < MAX_TAGS; i++) {
    receivedBonus[i] = false; // Initialize bonus tracking
  }
  Serial.println("System Ready. Query mode active. Scan a card to see points.");
}

void loop() {
  handleModeChange();
  // Handle Keypad Input
  static char lastKey = NO_KEY; // Tracks the last key pressed

  char customKey = customKeypad.getKey();
  static String keySequence = ""; // Track key sequence
  if (customKey) {
    paydayMode = false;
    Serial.println("Exiting Payday Mode.");
    if (isdigit(customKey)) {
      // Add digit to the sequence
      keySequence += customKey;
      Serial.print("Current input: ");
      Serial.println(keySequence);
      // Display the current input on the LED matrix
      displayKeySequence(keySequence);
    } else if (customKey == '#') {
```

```
135.       // Confirm the category selection
136.       if (keySequence.length() > 0) {
137.         int categoryNumber = keySequence.toInt();
138.         if (categoryNumber >= 0 && categoryNumber <= 12) {
139.           queryMode = false; // Exit query mode
140.           lastCategoryIndex = categoryNumber; // Map to category index (0-11)
141.           displayNameAndPoints(lastCategoryIndex);
142.           updateProgressBar(lastCategoryIndex, true);
143.         } else if (categoryNumber == 1998) {
144.           // Clear all tags from the system and EEPROM
145.           clearAllTags();
146.           keySequence = ""; // Reset sequence
147.
148.           // Clear the display when clearing tags
149.           parola.displayClear();
150.           Serial.println("All tags have been cleared from the system and EEPROM.");
151.         } else if (categoryNumber == 2024) {
152.           // Trigger the red siren effect
153.           Serial.println("Red siren effect activated!");
154.           redSirenEffect(10); // Siren effect for 10 seconds
155.           keySequence = ""; // Reset sequence after effect
156.         } else {
157.           Serial.println("Invalid category number. Enter a number between 1 and 12.");
158.         }
159.         keySequence = ""; // Reset sequence after confirmation
160.
161.         // Clear the display after confirmation
162.         parola.displayClear();
163.       } else {
164.         Serial.println("No input to confirm.");
165.       }
166.     } else if (customKey == '*') {
167.       // Enter query mode
168.       queryMode = true;
169.       keySequence = ""; // Reset sequence
170.
171.       // Clear the display when entering query mode
172.       parola.displayClear();
173.       Serial.println("Query mode activated. Scan a card to see points.");
174.     }
175.   }
176.
177.   lastKey = customKey;
178.
179.   // Check Serial Input for Adding Points
180.   if (queryMode && scannedTagIndex != -1 && Serial.available() > 0) {
181.     String input = Serial.readStringUntil('\n');
182.     input.trim();
183.     int pointsToAdd = input.toInt();
184.     if (input.length() > 0) { // Check if input is not empty
185.       tagDatabase[scannedTagIndex].points += pointsToAdd;
186.       saveTagToEEPROM(scannedTagIndex, tagDatabase[scannedTagIndex]);
187.       Serial.print("Added ");
188.       Serial.print(pointsToAdd);
189.       Serial.print(" points to ");
190.       Serial.println(tagDatabase[scannedTagIndex].name);
191.
192.       // Display updated points
193.       displayName(tagDatabase[scannedTagIndex].name);
194.       String pointsMessage = String(tagDatabase[scannedTagIndex].points);
195.       displayPoints(pointsMessage.c_str());
196.     } else {
197.       Serial.println("Invalid input. Enter a number to add points.");
198.     }
199.   }
200.
201.   // Check RFID Tag
202.   if (!mfrc522.PICC_IsNewCardPresent()) return;
203.   if (!mfrc522.PICC_ReadCardSerial()) return;
204.
```

```
  String uid = getCardUID();
  tone(BUZZER_PIN, 1000, 100); // Beep for 100ms

  int tagIndex = findTag(uid);
  if (tagIndex == -1) {
    if (tagCount >= MAX_TAGS) {
      Serial.println("Tag database full!");
      return;
    }
    Serial.println("New tag detected. Enter a name for this tag:");
    while (Serial.available() == 0);
    String name = Serial.readStringUntil('\n');
    name.trim();

    TagInfo newTag;
    uid.toCharArray(newTag.uid, sizeof(newTag.uid));
    name.toCharArray(newTag.name, sizeof(newTag.name));
    newTag.points = 30;

    tagDatabase[tagCount] = newTag;
    saveTagToEEPROM(tagCount, newTag);
    tagIndex = tagCount++;
    Serial.print("Tag registered as: ");
    Serial.println(name);
  }

  TagInfo &info = tagDatabase[tagIndex];
  if (paydayMode) {
    handlePaydayMode(tagIndex); // Call payday handling logic
  } else  if (queryMode) {
    scannedTagIndex = tagIndex; // Store the scanned tag's index for adding points
    displayName(info.name);
    String pointsMessage = String(info.points);
    displayPoints(pointsMessage.c_str());
    Serial.print("Name: ");
    Serial.println(info.name);
    Serial.print("Points: ");
    Serial.println(info.points);
  } else if (lastCategoryIndex != -1) {
    if (info.points >= 10) {
      if (confirmPayment()) {
        info.points -= 10;
        categoryPoints[lastCategoryIndex] += 10;
        saveTagToEEPROM(tagIndex, info);
        saveCategoryPointsToEEPROM(); // Save updated category points

        Serial.print("Added 10 points to ");
        Serial.println(names[lastCategoryIndex]);
        updateProgressBar(lastCategoryIndex, true);
        displayNameAndPoints(lastCategoryIndex);

      } else {
        Serial.println("Payment not confirmed. Transaction cancelled.");
      }
    } else {
      Serial.println("Not enough points.");
    }
  }

  mfrc522.PICC_HaltA();
  mfrc522.PCD_StopCrypto1();
}

bool confirmPayment() {
  parola.displayClear();
  parola.displayText("Ja = #", PA_CENTER, 50, 0, PA_PRINT, PA_NO_EFFECT);
  while (!parola.displayAnimate());

  while (true) {
    char customKey = customKeypad.getKey();
```

```
275.     if (customKey == '#') {
276.       return true; // Payment confirmed
277.     } else if (customKey == '*') {
278.       return false; // Payment cancelled
279.     }
280.   }
281. }
282.
283.
284. void redSirenEffect(int durationSeconds) {
285.   unsigned long startMillis = millis();
286.   while (millis() - startMillis < durationSeconds * 1000) {
287.     // Flash all LEDs red
288.     for (int i = 0; i < MAX_LEDS; i++) {
289.       strip.setPixelColor(i, strip.Color(255, 0, 0)); // Red color
290.     }
291.     strip.show();
292.     delay(250);
293.
294.     // Turn off all LEDs
295.     for (int i = 0; i < MAX_LEDS; i++) {
296.       strip.setPixelColor(i, 0); // Turn off
297.     }
298.     strip.show();
299.     delay(250);
300.   }
301. }
302.
303. void clearAllTags() {
304.   // Clear EEPROM storage
305.   for (int i = 0; i < EEPROM_SIZE; i++) {
306.     EEPROM.write(i, 0);
307.   }
308.
309.   // Clear in-memory tag database
310.   tagCount = 0;
311.   for (int i = 0; i < MAX_TAGS; i++) {
312.     memset(&tagDatabase[i], 0, sizeof(TagInfo));
313.   }
314.
315.   // Reset category points
316.   memset(categoryPoints, 0, sizeof(categoryPoints));
317.   saveCategoryPointsToEEPROM();
318.
319.   Serial.println("EEPROM and tag database have been wiped.");
320. }
321.
322. void displayNameAndPoints(int categoryIndex) {
323.   char buffer[32];
324.   sprintf(buffer, "%s %d/%d", names[categoryIndex].c_str(), categoryPoints[categoryIndex],
categoryGoals[categoryIndex]);
325.   parola.displayClear();
326.   parola.displayText(buffer, PA_CENTER, 50, 2000, PA_SCROLL_LEFT, PA_SCROLL_LEFT);
327.   while (!parola.displayAnimate());
328. }
329.
330. void displayName(const char *name) {
331.   parola.displayClear();
332.   parola.displayText(name, PA_CENTER, 50, 0, PA_SCROLL_LEFT, PA_SCROLL_LEFT);
333.   while (!parola.displayAnimate());
334. }
335.
336. void displayPoints(const char *points) {
337.   parola.displayClear();
338.   parola.displayText(points, PA_CENTER, 0, 2000, PA_MESH, PA_MESH);
339.   while (!parola.displayAnimate());
340. }
341.
342. void displayKeySequence(const String &sequence) {
343.   parola.displayClear(); // Clear the current display
```

```
344.   parola.displayText(sequence.c_str(), PA_CENTER, 50, 0, PA_PRINT, PA_NO_EFFECT);
345.   while (!parola.displayAnimate()); // Ensure the animation completes
346. }
347.
348. void updateProgressBar(int categoryIndex, bool animate) {
349.   int litLEDs = categoryPoints[categoryIndex] * MAX_LEDS / categoryGoals[categoryIndex];
350.   for (int i = 0; i < MAX_LEDS; i++) {
351.     if (i < litLEDs) {
352.       uint32_t color = calculateColor(categoryPoints[categoryIndex],
categoryGoals[categoryIndex]);
353.       strip.setPixelColor(i, color);
354.     } else {
355.       strip.setPixelColor(i, 0);
356.     }
357.     if (animate) strip.show();
358.     if (animate) delay(50); // Animation effect
359.   }
360.   strip.show();
361.
362.   // Check if category goal is achieved
363.   if (categoryPoints[categoryIndex] >= categoryGoals[categoryIndex]) {
364.     fullScoreAnimation();
365.     categoryPoints[categoryIndex] = 0; // Reset progress after celebration
366.     updateProgressBar(categoryIndex, false); // Turn off all LEDs
367.   }
368. }
369.
370. uint32_t calculateColor(int points, int goal) {
371.   float progress = (float)points / goal;
372.   int hue = (int)(progress * 360) % 360; // Hue based on progress
373.   return strip.ColorHSV(hue * 182); // Convert to NeoPixel's HSV scale
374. }
375.
376. void fullScoreAnimation() {
377.   for (int cycle = 0; cycle < 3; cycle++) {
378.     for (int hue = 0; hue < 360; hue += 30) {
379.       uint32_t color = strip.ColorHSV(hue * 182);
380.       for (int i = 0; i < MAX_LEDS; i++) {
381.         strip.setPixelColor(i, color);
382.       }
383.       strip.show();
384.       delay(100);
385.     }
386.   }
387.   // Turn off all LEDs after celebration
388.   for (int i = 0; i < MAX_LEDS; i++) {
389.     strip.setPixelColor(i, 0);
390.   }
391.   strip.show();
392. }
393.
394. int findTag(String uid) {
395.   for (int i = 0; i < tagCount; i++) {
396.     if (String(tagDatabase[i].uid) == uid) return i;
397.   }
398.   return -1;
399. }
400.
401. void saveTagToEEPROM(int index, TagInfo tag) {
402.   int address = START_ADDRESS + index * TAG_SIZE;
403.   EEPROM.put(address, tag);
404. }
405.
406. TagInfo readTagFromEEPROM(int index) {
407.   int address = START_ADDRESS + index * TAG_SIZE;
408.   TagInfo tag;
409.   EEPROM.get(address, tag);
410.   return tag;
411. }
412.
```

```
413. void loadAllTags() {
414.   tagCount = 0;
415.   for (int i = 0; i < MAX_TAGS; i++) {
416.     TagInfo tag = readTagFromEEPROM(i);
417.     if (tag.uid[0] != '\0') { // Correct comparison
418.       tagDatabase[tagCount++] = tag;
419.     }
420.   }
421. }
422.
423. void initializeEEPROM() {
424.   // Uncomment to clear EEPROM during development
425.   /*
426.     for (int i = 0; i < EEPROM_SIZE; i++) {
427.       EEPROM.write(i, 0);
428.     }
429.   */
430.   loadAllTags();
431.   loadCategoryPointsFromEEPROM();
432.   loadModeFromEEPROM();
433.   loadCategoryPointsFromEEPROM();
434.   Serial.print("Loaded mode: ");
435.   Serial.println(currentMode);
436. }
437.
438. String getCardUID() {
439.   String uid = "";
440.   for (byte i = 0; i < mfrc522.uid.size; i++) {
441.     if (mfrc522.uid.uidByte[i] < 0x10) uid += "0";
442.     uid += String(mfrc522.uid.uidByte[i], HEX);
443.   }
444.   uid.toUpperCase();
445.   return uid;
446. }
447.
448. void saveModeToEEPROM() {
449.   int address = MODE_ADDRESS;
450.   char modeBuffer[10];
451.   currentMode.toCharArray(modeBuffer, sizeof(modeBuffer));
452.   EEPROM.put(address, modeBuffer);
453. }
454.
455. void loadModeFromEEPROM() {
456.   int address = MODE_ADDRESS;
457.   char modeBuffer[10];
458.   EEPROM.get(address, modeBuffer);
459.   currentMode = String(modeBuffer);
460. }
461.
462. void handleModeChange() {
463.   if (Serial.available() > 0) {
464.     String input = Serial.readStringUntil('\n');
465.     input.trim();
466.
467.     if (input.equalsIgnoreCase("payday")) {
468.       paydayMode = true;
469.       cleanPaydayMode = false; // Regular payday
470.       queryMode = false;
471.       Serial.println("Payday mode activated. Scan tags to distribute 10 points.");
472.     } else if (input.equalsIgnoreCase("payday clean")) {
473.       paydayMode = true;
474.       cleanPaydayMode = true; // Clean payday
475.       queryMode = false;
476.       Serial.println("Clean Payday mode activated. Scan tags to distribute 5 points.");
477.     } else if (input.equalsIgnoreCase("query")) {
478.       paydayMode = false;
479.       queryMode = true;
480.       Serial.println("Query mode activated. Scan a card to see points.");
481.     } else if (input.equalsIgnoreCase("spoor")) {
482.       currentMode = "spoor";
```

```
483.       saveModeToEEPROM();
484.       loadCategoryPointsFromEEPROM(); // Reload category points for "spoor"
485.       Serial.println("Switched to spoor mode.");
486.     } else if (input.equalsIgnoreCase("maarssen")) {
487.       currentMode = "maarssen";
488.       saveModeToEEPROM();
489.       loadCategoryPointsFromEEPROM(); // Reload category points for "maarssen"
490.       Serial.println("Switched to maarssen mode.");
491.     } else {
492.       Serial.println("Unknown command. Valid options: payday, payday clean, query, spoor,
maarssen.");
493.     }
494.   }
495. }
496.
497.
498.
499. void handleCleanPayday() {
500.   Serial.println("Clean Payday activated: Adding 5 points to everyone.");
501.   for (int i = 0; i < tagCount; i++) {
502.     if (!receivedBonus[i]) {
503.       tagDatabase[i].points += 5; // Add 5 points to each tag
504.       receivedBonus[i] = true;   // Mark bonus as received
505.       saveTagToEEPROM(i, tagDatabase[i]);
506.       Serial.print("5 points awarded to ");
507.       Serial.println(tagDatabase[i].name);
508.     }
509.   }
510.   Serial.println("Clean Payday complete.");
511. }
512.
513. void handlePaydayMode(int tagIndex) {
514.   if (!receivedBonus[tagIndex]) {
515.     int pointsToAdd = cleanPaydayMode ? 5 : 10; // Add 5 points for clean payday, 10 for
regular payday
516.     tagDatabase[tagIndex].points += pointsToAdd;
517.     receivedBonus[tagIndex] = true; // Mark bonus as received
518.
519.     // Save the updated points to EEPROM
520.     saveTagToEEPROM(tagIndex, tagDatabase[tagIndex]);
521.
522.     // Provide feedback in the serial monitor
523.     Serial.print(pointsToAdd);
524.     Serial.print(" points awarded to ");
525.     Serial.println(tagDatabase[tagIndex].name);
526.
527.     // Update the display
528.     displayName(tagDatabase[tagIndex].name);
529.     String pointsMessage = String(tagDatabase[tagIndex].points);
530.     displayPoints(pointsMessage.c_str());
531.   } else {
532.     Serial.println("This tag has already received the bonus.");
533.   }
534. }
535.
536.
537.
538.
539. void saveCategoryPointsToEEPROM() {
540.   int address = (currentMode == "spoor") ? CATEGORY_POINTS_SPOOR_ADDRESS :
CATEGORY_POINTS_MAARSSEN_ADDRESS;
541.   EEPROM.put(address, categoryPoints);
542. }
543.
544. void loadCategoryPointsFromEEPROM() {
545.   int address = (currentMode == "spoor") ? CATEGORY_POINTS_SPOOR_ADDRESS :
CATEGORY_POINTS_MAARSSEN_ADDRESS;
546.   EEPROM.get(address, categoryPoints);
547. }
```

548.

Appendix I: Interview Questions

Design partner

- Waren de activiteiten makkelijk? Of te moeilijk?
- Paste ze bij jullie leeftijd? Of te kinderachtig/volwassen?

Equity and balance

- Konden jullie ook helpen met organiseren? Of deed ik alles?
- Deed ik gezellig mee of deed ik meer mijn eigen ding?
- Deed ik mee? Of bleef ik vooral toekijken?
- Besproken jullie ook ideeën met elkaar? Of alleen met mij?

Fun

- Hoe leuk was het hele onderzoek?
- Zou je nog een keer zo'n onderzoek willen?
- Wat was het leukste wat je hebt gedaan?
- Wat was het stomste?

Empowerment

- Weet je waarom wij deze weken al die activiteiten deden?
- Werd er naar je geluisterd tijdens de activiteiten? Kon je alles zeggen wat je wilde?
- Werden jou ideeën gewaardeerd?
- Hoe heeft jou meedoen geholpen bij wat we hebben gemaakt?
    - Werd er naar jou ideeën geluisterd?
- Vond je dat we goed hebben samengewerkt als team?

Idee

- Wat vind je van het idee?
- Is het geschikt voor jullie leeftijd?
- Denk je dat het de ASC leuker kan maken?
    - Waarom?
- Zorgt het denk je dat jullie meer te zeggen hebben op de ASC?
- Heb je alle informatie die je nodig hebt over de punten en dingen die je kan kopen?

- Voel je je hierdoor serieuzer genomen?
- Voelt jou bijdrage van punten belangrijk voor hoe de ASC eruit ziet?