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A school-based intervention to improve children's eating behaviours in México

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Preface

As a Mexican who was lucky enough to receive quality education, I have always been driven to give back to my country and support those who, unlike me, have not been so lucky. That opportunity was given to me through this project, and for that I cannot be grateful enough.

But this journey has been a collective effort, and I would like to express my gratitude to all those who made it possible.

Throughout this process I had the reassuring words and encouragement of my chair and mentor Rick and Silje. Thank you for sharing your knowledge and for giving me your constant support during this study. Please know that your enthusiasm and curiosity for my project and my findings always lifted my spirits.

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Abstract

Mexico is one of the countries with the highest number of overweight children and adolescents in the world and, unfortunately, schools are an important cause of this problem. Despite the efforts of the Mexican Government in creating new regulations to reduce the availability of high-calorie food products within and near schools, their implementation has not been successful.

To contribute to the alarming problem of childhood obesity in Mexico, this project explored the interactions children have with food at the primary school context. The main motivation was to propose a new perspective on the approaches that can be explored when thinking of potential solutions to this important health emergency. To do so, research was conducted in a city located in the central area of the country, and it was guided by the research question "What are the determinants of children's food choices at primary schools in Querétaro, Mexico?"

A combination of different research methods was used to give answer to the previous question: an explorative approach through generative research techniques such as Context-mapping and Co-design, and a theoretical approach through the Behaviour Change Wheel model. Through this method it was possible to uncover problems that provide a new perspective on children's eating behaviours, such as their partial knowledge of healthy and unhealthy products and the lack of support in building positive associations with food.

Based on these findings, the goal of this project was to generate a design that motivates children from the Naciones Unidas and José Morales Lira primary schools to develop a balanced diet by creating positive associations with healthy food during their school experience.

As a result, a class activity was designed serving the functions of providing a comprehensive education around food options, incentivising children to perform healthier eating practices, providing them with examples of how to do it, and enabling them to construct their own balanced meals. Additionally, a restructuring of the communication language was proposed, in hope of shaping more non restrictive relationships between children and food.

Finally, the activity was tested with a small group of children, and assessed by primary schools professors to obtain insights into the steps that can be taken to extend the impact of this intervention, with the goal of promoting and sustaining healthy behaviours among children.

I. Introduction

Background

Childhood obesity is a growing global concern that, even if preventable, continues to rise at an alarming rate. The shift from traditional diets to Western-style diets is a contributing factor to the increase of childhood obesity in developing countries, including Mexico, where there is a high prevalence of obesity among children and adolescents. In fact, Mexico has more than 6 million overweight children and adolescents, which places it as one of the countries with the highest number of people with childhood obesity in the world (Global Obesity Trends in Children, 2021).

Researchers have identified that one of the main causes of this problem is the high exposure children have to ultra-processed and high-calorie foods, including sweet beverages, in their school environment (Gupta et al., 2012). The Mexican government has recently taken some preventative measures in hopes of reducing the opportunities children have to consume food that is detrimental to their health. An example of this is the increase in regulations for selling unhealthy products inside and around schools. However, to monitor the compliance of institutions in such a big country is sometimes beyond the government's capabilities.

As long as childhood obesity is still a problem, efforts must continue to present innovative ways to improve children's eating habits while taking into account their contextual circumstances. Therefore, the aim of this project is to explore the interactions children have with food at the school context in Mexico, to design an intervention that helps them understand the importance of adopting healthy eating habits and take actions in that direction.

Scope

Studies have shown that children in Mexico have knowledge on healthy eating practices, since due to the emergency situation of childhood obesity, there has been an emphasis on educating children on this topic at the public institutions (N.H.C. Rivera & Lagunes, 2014). However, it has also been demonstrated that taste and texture are more important for children than their knowledge of nutritional value or health consequences when choosing their food (Zapata Cetina & Cervera Montejano, 2016).

Based on this information, we can affirm that reducing a child's consumption of junk food to a sufficient extent would require a systemic effort, and the use of restrictive strategies. However, this project's approach aims to motivate children to try healthy food instead of prohibiting the consumption of unhealthy products.This way, children would be empowered at increasing their ability to look after their own well-being.

For that reason, the goal of this project is to design a school-based intervention that encourages children to increase their consumption of healthy food and, as a result, reduce their consumption of high-fat or high-sugar food.

To narrow down and guide the project, the following research questions were created:

Research question

- What are the determinants of children's food choices at primary schools in Querétaro, Mexico?

Sub-questions

- What elements in the school context influence children's food decisions?
- What are children's values and motivations when choosing what to eat at school?
- What are the obstacles that prevent children from making healthy food choices in their daily lives?

II.

Method

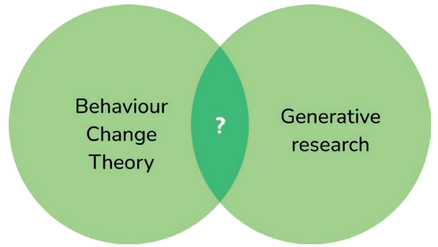
Motivating change in children's eating habits is not an easy task and requires a thorough understanding of why children think and act the way they do. Economic, psychological, social, cultural, and environmental aspects all play a significant role in shaping children's eating habits. Models based on Behaviour Change Theory can help designers achieve that understanding, since they provide a framework for collecting these factors and identifying which ones, if intervened, can help achieve the intended behaviour.

However, it is important to note that every context is unique and designers must carefully study them to be able to recognize the specific elements that facilitate or hinder the desired behaviours in that particular place. To do so, observing from the outside is not enough. Designers must immerse themselves in the world of the people who interact in the selected context and will ultimately become the users of their products/services.

Involving users throughout the design process is a strategy designers can use to make sure that people's needs are addressed and their vision of the future is integrated into the final design solution (Sanders & Stappers, 2013).

To that end, generative design techniques are great at enabling expression to participants so designers can better empathize with their experiences.

This project gives room to explore how both approaches would work together, since the first one provides guidance and structure for understanding the problem from the theoretical perspective of behavioural change, and the second one allows us to include the vision, values, and food experience of the participants in their context, namely, children at school.



The following is a description of the specific methods and tools that were chosen to approach this project.

Behaviour Change Theory

Behaviour Change Wheel

In order to answer the research questions mentioned in the previous section, a structure that allowed for the definition of the problem in behavioural terms was needed. The ideal model to achieve that would be one that takes into account not only the individual aspects that influence a behaviour like skills, beliefs, biases or perceptions to name a few, but also the social and environmental enablers. These aspects are all part of the Behaviour Change Wheel model.

The Behaviour Change Wheel model (Michie, Atkins & West, 2014 was created after the analysis and integration of 19 behaviour change frameworks into one that comprises a coherent and comprehensive depiction of the determinants of a behaviour. Moreover, in contrast with other models, the BCW is action-driven.

This means that not only it helps describe and identify the one or many sources of the behaviour that should be tackled, but also maps out the functions that an intervention should serve for the intended behaviour to be achieved, as well as the best strategies (policies) and techniques to attain those functions (Figure 1).

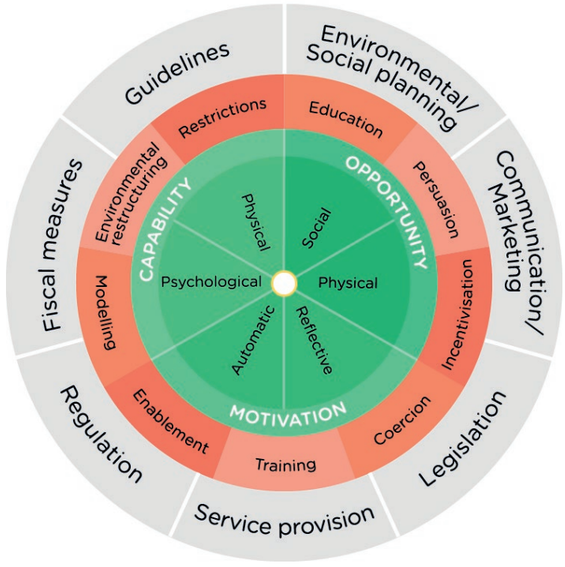


Figure 1. Behaviour Change Wheel. (Michie et al., 2011).

This makes the BCW a great framework for designers to use, because it helps to frame the research phase and also supports the design decisions, and provides a structure for evaluating the outcomes of an intervention.

This is how the process of designing an intervention using the BCW looks like:

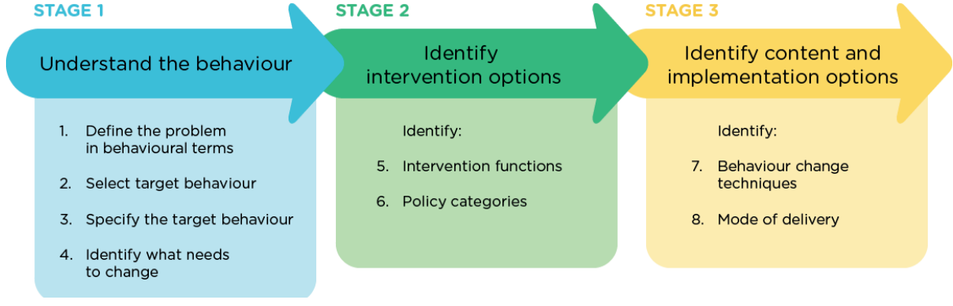


Figure 2. Stages and steps to design an intervention using the Behaviour Change Wheel model. (Michie et al., 2011).

The COM-B model

The Behaviour Change Wheel uses the COM-B model as a central tool to analyze and understand the selected behaviour. By integrating three key components—capabilities, motivation, and opportunities—it provides a holistic perspective on behaviour determinants (Figure 3).

Capabilities refer to physical skills such as the ability to move, and to psychological skills such as knowledge, memory or decision processes. Motivation refers to reflective cognitive processes like beliefs or goals, and to automatic cognitive processes like responses that derive from habits or associative learning Finally, opportunity describes physical factors such as environmental resources, and social factors such as social influence or support. (Michie et al., 2014)

Beyond merely describing the factors, the model shows the correlation between them. The more capabilities and opportunities a person has, the bigger their motivation to perform an action. Ultimately, motivation is necessary for behaviours to happen. Therefore, if a person has skills but there is a lack of opportunities, their motivation decreases. In the same way, if the opportunities are in place but the person lacks skills, they won't find motivation.

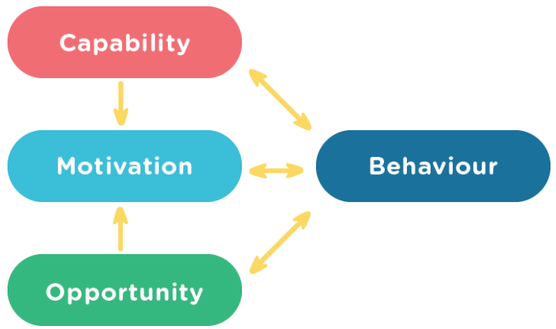


Figure 3. Correlation between the factors defined in the COM-B model (Michie et al., 2011).

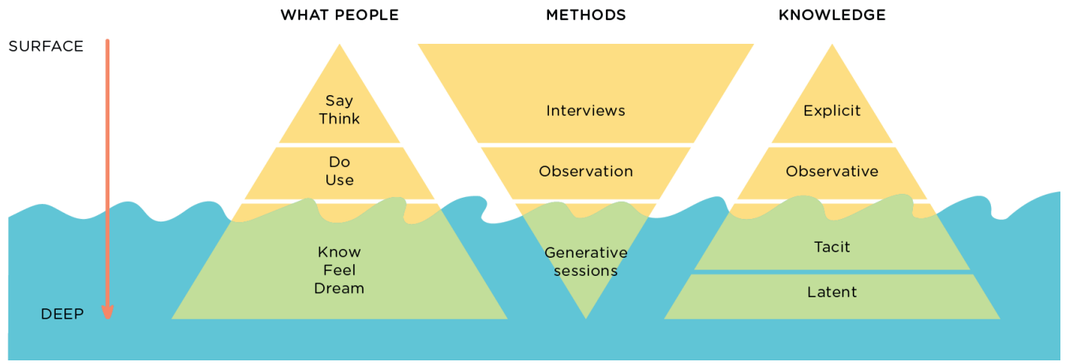


Figure 4. Generative sessions allow for deeper levels of understanding of the user (Sanders & Stappers, 2013).

Generative design

Context-mapping

When talking about food, habits and behaviours have a strong relationship with the context. In the school environment, children's behaviour regarding food choices can be influenced by the rules established by the school administration regarding the selection and availability of food at the school premises, or even by the language used by professors to teach children about eating practices. Social dynamics during lunch breaks can change from place to place, as well as the needs and limitations children face around their eating practices.

Therefore, it is important to get close to the context and the users, since they are the true experts of their own experiences. By involving the people who we are designing for during the process, we can make sure that our solution will cover their needs. (Sanders & Stappers, 2013).

Projects that are aimed to improve the nutrition conditions of children in México are often based on statistical studies, observation from the outside, the experiences of the adults around them or the view and expertise of specialists like paediatricians, pedagogues or psychologists. However, children rarely have direct participation or involvement. Their voices are hardly taken into account.

For this project, the children's perspective will be the most valuable asset to understand how they perceive food, the strategies they use, the emotions that they experience through their eating practices, and their values and visions. This information will allow for the identification of factors that can be changed or leveraged to achieve better and healthier behaviours.

To obtain that information, children will need tools to help them think and express themselves. Context-mapping allows this through artifacts and probes that facilitate deeper levels of understanding of a certain topic and unravels knowledge that not only includes people's opinions, reasons, or descriptions of events and experiences (explicit knowledge), but also what they feel, dream or know (tacit and latent knowledge) (Sanders & Stappers, 2013) (Figure 4).

Co-design

Co-design is commonly used at the initial stages of the design process to explore possible futures together with the final users. By building 2D or 3D artifacts, people can represent desired scenarios or ways of living (E. A. Sanders & Stappers, 2008). But the object will be just a way of communicating a bigger message. Through stories around their creations, people are able to convey ideas that can be full of valuable information that inspires the next steps of the design process, like collective knowledge, values, attitudes or discourses (Van Mechelen et al., 2016).

In this project co-design will be used with children as a way to find out how they perceive the problem and envision possible solutions. More than getting concrete ideas for a design, understanding where children position themselves in the problem's scheme, who they see as influential to their behaviours, and the values that they have developed and would transfer to an "ideal scenario".

III.

Understanding the context

Research / Literature review

To start identifying some relevant factors that influence children's interactions with food at school, a literature review was conducted around the topic of food in Mexico. In this section, relevant data on the evolution of the Mexican diet will be presented, as well as children's diet in Mexico, the role of schools, and the Mexican food culture's impact on children's eating habits.

The transformation of the Mexican diet

Over the past decades, Mexico has experienced what is called a “nutrition transition”. This can be defined as the transformation of food patterns and dietary intake, mostly towards energy-dense processed foods, derived from an accelerated urbanization process and economic growth (Rivera et al., 2004). Although nutrition transitions have happened in places like Europe where eating patterns shifted towards being healthier, social circumstances defined a different route for the nutrition transition in Mexico (Galán Ramírez, 2021).

During the 1990’s many food innovations were incorporated in the daily lives of Mexican people as the demand for more convenient and pragmatic food increased. The integration of women in formal jobs escalated, and as a result, less people had time to cook at home. But most importantly, the path to a new diet in Mexico was marked by a deterioration of the family income (Torres, 2011). People concentrated in cities, where better education level, access to information and to basic services are expected. However, the lack of an adequate family income became a determining factor for the new consumption behaviours.

One of the most important changes brought by this new economic scenario was the rise in wheat consumption. A wide variety of industrialized bread was strategically distributed to be easily accessed by the population who demanded cheap and fast-to-eat products that provide satiety. Although corn was not replaced as the most consumed cereal in Mexico (to this day, corn tortilla represents 25% of the household expenses in low-income families), ultra-processed products derived from wheat like bread, sweet bread, cookies, cakes, pastas and wheat tortillas became popular in the Mexican diet (Torres, 2011). This occurrence had enormous consequences for agriculture in Mexico, which eventually led to a bigger shift in the eating practices, from a Traditional Mexican Diet (TMxD) to a more Western-type diet based in high-energy density foods, specifically high added sugar and high saturated fat content (Afeiche et al., 2017).

The new eating habits of the Mexican population soon represented a problem for the health institutions since, together with a sedentary life, they gave way to a rise in non-communicable chronic diseases (NCCDs) such as obesity, hypertension and type 2 diabetes mellitus.

In response to this emergency, many tactics have surged to try to mitigate the effects of the aforementioned changes in the Mexican diet, and turn around the direction of the nutrition transition. Regulations, educational programs and communication strategies have been spread throughout the country in the last years promoting better eating decisions and a healthier lifestyle. An example of this is “La Dieta de la Milpa”, which is a food model based on the products of the traditional agricultural system called “milpa”. The model was presented by the Ministry of Health as a guide for a sustainable, accessible, healthy and culturally relevant nutrition. La Dieta de la Milpa has corn, beans, chilli and zucchini as main sources of nutrients, and suggests ingredients from different food groups with origins in both the Traditional Mexican Diet and the modern diet (Secretaría de Salud, 2023).

Figure 5. La Dieta de la Milpa. General Direction of Health Planning and Development.

Conclusion

Learning about the social and economical determinants of the nutrition transition in Mexico is the first step to understand the current eating patterns of the Mexican population.

Children and food in México

Despite the efforts made by the government to inform the Mexican population on the risks of unhealthy eating habits, children remain a matter of concern regarding their dietary practices, being sugar intake one of the biggest concerns. Studies have shown that only 14% to 19% of Mexican children and adolescents do not exceed the recommended intake limit of sweetened beverages and products with high sugar and fat content (Galván-Portillo et al., 2018).

One of the main challenges in addressing this issue is that sugar is readily available to kids from the start of their day. According to Afeiche et al. (2017), sugar-sweetened beverages are the most frequently consumed product by children during breakfast (41%), which is one of the most important meals in Mexican culture. This has been linked to the amount of calories children consume throughout the day. Children whose breakfast is based on sweet beverages and sweet bread indicated more eating occasions per day in comparison to children that followed the tortilla-beans dietary pattern. Therefore, we can conclude that children that eat a TMxD-based breakfast are less likely to show high energy intake during the day.

However, many factors influence the type of food children eat. While ingredients from the TMxD are cheaper and more nutritious, the preparation time required is longer.
This is reflected in the fact that children from rural areas are more likely to follow a tortilla-beans pattern for breakfast than those in urban areas (Afeiche et al., 2017). It has also been demonstrated that economic status has little impact on the consumption of junk food since, even if children from families with higher income eat more fruits and vegetables than children from low-income families, they also consume more energy dense products because they can afford them.

Lastly, the advertising of food products plays a role in shaping the nutritional information that children possess. Often, kids are led to believe that products are healthy or natural by including phrases like “contains fruit pulp”, even when such an ingredient is present in small quantities (Théodore et al., 2011). To address this issue, the government of Mexico implemented a regulation in October 2020 requiring one or more black stamps to be added to food and beverages that fail to comply with official nutritional recommendations. Additionally, the government restricted the use of elements like characters, celebrities or games to attract the children’s attention (Lockton, 2022). Although this is an important measure to protect children, it has not been sufficient to achieve the objective.

Figure 6. Characters were removed from cereal boxes.

Figure 7. Visible and easy to understand black stamps.

Conclusion

This information helps us understand the social factors and eating behaviours that impact on the eating patterns that children develop. Additionally, it gives us some insights into the most relevant areas of intervention, like sugar consumption, the role of children’s breakfast in their nutrition, the eating occasions throughout a day, or the approach in food advertising.

The role of schools

Schools play an important role in childhood as it connects children to the social infrastructure (Safdie et al., 2013). Children spend a significant portion of their day at school, where they learn and develop behaviours and beliefs based on their interactions with peers and other role models like professors, school staff, etcetera. This is why schools are a suitable place to encourage healthy relationships between children and food.

Unfortunately, schools in Mexico are one of the main causes of poor eating practices amongst children. In 2018 El Poder del Consumidor (The Consumer's Power), a civil association dedicated to defend consumer rights, published a study in which they provided some statistics that give us a panorama of the problems encountered in urban primary schools in Mexico.

Lunch schemes inside the school

In contrast to many developed countries, the percentage of schools that have a canteen where lunch is provided to children is very low. Studies have been carried out in schools where this modality is available, and results show that children increase their consumption of vegetables and have a more balanced diet overall (Carmona Barrón, 2015).

Sadly, most primary schools in Mexico operate under a different scheme, where parents have the responsibility of either providing a prepared lunch for their kids or giving them money to buy their own food at the school store. Martínez Becerril (2018) describes some of the disadvantages to this model:

- Little offer of fruits and vegetables
- Lack of strategies that prevent the children to consume food that cause overweight
- Lack of involvement of professors in motivating children to eat healthy food

Conclusion

The school context in Mexico offers boundless opportunities for children to develop unhealthy eating habits. Nonetheless, the social aspect, which involves not only professors but also peers and school staff, can be leveraged to improve the support and tools children currently have to increase their motivation to eat healthily.

IV.

Identifying the gap

Research / Analysis, part 1

As mentioned before, the first stage of the Behaviour Change Wheel is to understand the behaviour, which in this project's case is Mexican children eating unhealthy food at school.

After conducting the literature review, a general understanding of the context of children and food at Mexican schools was gained. From this information, factors that were identified as determinants to the behaviour were selected and mapped out using the COM-B Model, which categorizes the factors in Capabilities, Motivations and Opportunities. (Table 1).

Capabilities

In this category, few but important determinants were identified. The first and most important one categorized under **Physical capability** is that, biologically, children have a preference for sweet tastes. Whether that is because of the growing child's need for calories or their ability to recognize sweet tastes when they look for their mother's milk (Mennella & Bobowski, 2015), this is a quality that can hardly be changed. Children will be attracted to sweet tastes before any other.

In terms of **Psychological capabilities**, it was found that knowledge of healthy and unhealthy practices is not a problem. Mexican children are capable of differentiating healthy from unhealthy food (N. H. C. Rivera & Lagunes, 2014), but this has little impact on their eating behaviours.

Motivations

Little information was found on reflective motivations, which is no surprise since goals, intentions and beliefs are commonly context specific. However, on the automatic motivations side, valuable insights came up around cultural associations with food. For example the fact that Mexicans believe that sweet beverages help "pass the food" after eating a meal, or that drinking water does not provide the same effect, and instead, it is mostly related to moments of physical activity.

Although "Motivations" is a gap found during the literature review, the aforementioned insights give valuable clues into how to direct future research activities. Understanding the types of food that people associate to specific rituals, customs or moments of the day, can help shape better and healthier connections.

		Source
Capability	**Physical** *Physical skill, streght or stamina*	
	Preference for sweet tastes in early stages of life	(N. H. C. Rivera & Lagunes, 2014)
	Psychological *Knowledge or psychological skills*	
	There is not a lack of knowledge, for young mexican children (preschool) are capable of differentiating healthy from unhealthy food.	(N. H. C. Rivera & Lagunes, 2014)
	Affective issues, such as self-esteem and empathy, as well as the individual's need for social acceptance, influence the construction of the repertoire of eating behaviors.	(De Los Ángeles Pérez Pedraza et al., 2021)
Motivation	**Reflective** *Beliefs, self-identity, intentions, goals & plans*	
	Although younger children often carry a homemade lunch box (tiffin) to school, older ones do not because they consider it childish.	(Gupta et al., 2012)
	People associate healthy food with the "home-made", and unhealthy with the processed one, even though food made at home is not always healthy.	(Gupta et al., 2012)
	Automatic *Emotions, feelings, associative learning, habits & drives*	
	Children associate certain foods and drinks to a specific moment of the day, for example, they associate sweet beverages with lunch and dinner, and water with something one drinks after exercising or "going out for a walk to the park".	(Théodore et al., 2011b)
	It is a Mexican tradition to combine meals with sweet drinks "to pass the food." Somehow, by always combining sugary drinks with savory foods, it's as if you didn't think that water could cover the same function.	(Théodore et al., 2011b)
	The "food tastes" of the lower classes are focused on producing a sense of satiety promptly.	(González Montoya, 2020)
Opportunity	**Physical** *Time, location, money, resources*	
	Lack of free drinking water in schools constitutes an important barrier to its consumption.	(Théodore et al., 2011a)
	Advertising for sugary drinks contains the words "with fruit pulp", to create an illusion that it is natural.	(Théodore et al., 2011a)
	Children receive part of their nutritional information through the marketing of the products themselves.	(Théodore et al., 2011a)
	School's facilities and surroundings have plenty of advertising for hypercaloric foods.	(De Los Ángeles Pérez Pedraza et al., 2021)
	Lack of integration of the social and cultural context in the official guidelines for healthy eating provided by school undermines their implementation.	(Cano, 2015)
	Vegetables and other healthy foods are often not integrated in the daily diet of an low class Mexican family.	(Carmona Barrón, 2015)
	Parents don't have time to prepare healthy meals, so they go for fast preparations that often contain highly processed food.	(Carmona Barrón, 2015)
	Sodas (fizzy drinks) are commonly present at Mexican families' tables during meals	
	Social *Social norms, environmental, cultural & social cues*	
	Children often imitate eating behaviors from their peers observed during recess.	(Valencia Niño De Rivera et al., 2018)
	Family context influences the child's preferences for certain foods, and mothers are primarily responsible for the eating behaviors of children.	(Anaya-García & Gallego, 2018)
	In Latin America professors and parents have a lack knowledge on nutrition and healthy eating, which plays in favor of unhealthy behaviors.	(Anaya-García & Gallego, 2018)
	Activities such as work and school set the pace of daily life.	(González Montoya, 2020)
	Food does not structure time, but rather time structures food that is established between two extremes: work (industrialized products) and leisure (social and ritualized meals)	(González Montoya, 2020)
	There is a lack of involvement of professors in motivating children to eat healthily.	(Carmona Barrón, 2015)
	Most children won't find that motivation or guidance at home. Mothers can't encourage their children to eat a healthy diet since they have little time to cook.	(Carmona Barrón, 2015)

Table 1. Factors that influence children's unhealthy eating at school.

Opportunities

Opportunity is the factor that impacts the most on the eating behaviours of Mexican children.

The **Physical opportunities** that hinder children's nutrition are primarily related to the little time parents have to cook healthy meals, and the enormous availability of ready-to-eat ultra processed foods. The convenience offered by large food corporations, combined with excessive marketing, creates an environment conducive to unhealthy behaviours.

Social opportunities are related with the lack of time, but also with the overall educational level. First, children cannot find enough encouragement or support from their family in acquiring healthy eating habits because they have little time to cook and provide healthy meals, and second, they will not find this social support at school either since professors and school staff have little involvement, and sometimes knowledge, in guiding them with their eating practices.

Convenience store in México. Image by ZetaTijuana (2020).

Conclusion

From this initial analysis it can be concluded that physical opportunities are the most determinant in the Mexican children's eating behaviours. However, accessibility to ultra processed food and time availability of the parents to provide healthy food are unlikely to change without policies and regulations, which require a different level of intervention.

Social opportunities, on the other hand, can be explored at different levels, like promoting peer support in benefit of a favourable food experience, or increasing knowledge and awareness in professors and school staff so they are more qualified to give children the encouragement they need.

Motivation opportunities show potential for intervention, since they can correlate to collective beliefs or associations that are acquired through common practices. Nevertheless, in order to identify those that can be used in favour of better food decisions, further exploration in the context of the intervention is needed. Thus, the next steps of the research activities will focus on exploring the context and understanding, from the user perspective, the factors that motivate their eating behaviours at school.

V.

Context-mapping

Research / Generative sessions

As mentioned in the previous chapter, Reflective and Automatic motivations play an important role in the children's eating decisions. However, these are context specific and require participant involvement.

To fill the knowledge gap of the beliefs, emotions, feelings, intentions and learned associations that determine the children's eating behaviours, a context mapping activity was carried out in primary schools in Querétaro, México.

Sample

According to Martorell et al. (1998), childhood obesity is primarily present in urban areas, which is why the study demanded it be conducted in a city context. Additionally, due to the relationship between educational level and nutrition quality, the context-mapping sessions were done in primary schools located in a low-middle income area of the city.

To conduct the study, permission was granted by the USEBEQ, a public organisation that coordinates educational activities in the state of Querétaro. They determined the two schools to participate: a morning school and an evening school in the Felipe Carrillo Puerto delegation.

Since the age range in primary schools is wide, two age groups were selected for the study to include a variety of skills and knowledge, which ultimately will have to be considered for the final design. The first age group was children of 7-8 years old, and the second age group was children of 9-11 years old.

Total
146 children

Morning school
88 total
39 of 7-8 years old
49 of 9-11 years old

Evening school
58 total
30 of 7-8 years old
28 of 9-11 years old

Impressions of the food environment in primary schools in Querétaro

Observation

Before working with the children, observation was carried out at different spots where interactions with food take place inside and outside the schools. This was important since ideas were gathered on topics that could be approached with the children during the context mapping sessions to get a deeper understanding of their experience.

Moreover, observation was essential since, according to some studies, people tend to lie about their eating behaviours to make themselves seem healthier when interviewed. Also, people can be unaware of what they do or have misconceptions that can influence their perception of their behaviours (Sanders & Stappers, 2013) (Dartmouth College & Tuck School of Business., 2013).

Lastly, although food providers are not the target of the study, they play an essential role in the food dynamics at schools. Therefore, approaching them prior to the interactions with the children allowed for an understanding of the perspective vendors have on their job and the impact they have on children. Also, talking with them brought ideas of what would be feasible and accepted in the solution space by such important stakeholders.

Morning school

When it comes to food selling inside and around the morning school, the dynamics are very specific. Vendors know that time supposes a constraint for parents, since children start classes at 8:00 a.m. They know that parents have to drop their child earlier so they can get to work on time, so they offer a solution: an assortment of snacks that parents can conveniently get outside the school to give their kids as lunch.

Surroundings
Early in the morning, between 3-4 businesses are open right in front of the school. Here, parents and kids can find savoury lunches like sandwiches, tortas (Mexican sandwich with thicker bread made at bakeries), hot dogs, fried wheat-based chips, regular chips and even chicken nuggets. Additionally, they have bottled water, a few juices made with natural fruit, and plenty of sweetened beverages like sodas, “fruit” juices, flavoured milk and Yakult. They also offer a variety of sweets and industrial cookies and biscuits.

Besides the established stores, 3-4 itinerant street vendors arrive with tables to sell similar lunches. In comparison with the stores, they offer a larger variety of fruit, but also of sweet products like jelly, pancakes and sweetened yoghurt.

After school, a different group of around 6 to 8 itinerant street vendors gather outside the building waiting for the children to exit the building to go home. This time mostly products with high-sugar content like ice-cream, doughnuts, agua fresca (sugared fruit-based water) and sweets can be bought.

Figure 8. Products sold at stores around the morning school

Figure 9. Products sold by street vendors outside the morning school.

Figure 10. Street vendors in the afternoon, waiting outside the morning school.

Inside the school
The selected morning school has two food booths. The first one provides children and professors with “home-made” food options for them to buy, such as soups, stews, tacos, and more. The owner of the booth prepares one or two different dishes every day, which she changes on a weekly basis. Additionally, she sells bottled water and sweetened juices.

Figure 11. Street vendors in the afternoon, waiting outside the morning school.

The second booth is specific for sweets. When asked, the booth owner mentioned that the school originally had one booth for both prepared food and sweets, but they added a second one to keep the children organized during the lunch break. The new place provided not only with a more convenient layout for the vendors, but also with a larger space to sell a wider variety of sweets.

Figure 12. Variety of sweets found at one of the booths in the morning school.

Social influence
During the lunch break professors guard at different points of the school to watch over the children. They also use this time to eat their lunch, and often buy food from the same booth that children do.

During the break, professors interact with the children, but they don’t interfere in their play or food decisions.Peers however do. Children sometimes switch lunches with each other, or combine them and share them. They also like to experiment, making unconventional combinations with the food they find around them. At the store, children can influence the decisions of their friends.

Sellers
Sellers have a big influence in the eating behaviours of children at school. In the case of the morning school, the booth owner decides the food of the day and provides a variety of sweets that children can choose from. When asking her what she thinks children buy more, she replied that both booths sell the same amount, even though “you could see more kids in the sweets booth, but they pay very little money for candy”. For her, both booths generate similar earnings and that is how she evaluates consumption.

After school, children can also be influenced to buy sweet snacks from the street vendors when they see their peers do it. Having products ready to be bought and consumed right outside of the school and on the children’s way home is a big factor that contributes to their sugar overconsumption.

Evening school

Evening school starts at 2:00 p.m., and the food environment inside and outside the building is determined by the fact that children can have one or more meals at home before attending classes.

Surroundings
Outside the evening school only a couple of itinerant street vendors could be found. They brought their carts at the beginning and at the end of every school day, but did not have as many sales as the ones located at the morning school. Street vendors at the evening school sell peanuts, green chickpeas, watermelon and corn on the cob, all these seasoned with lime, salt and chilli, which is a typical combination of ingredients that Mexican people add to fruits and vegetables.

Inside the school
At the evening school only one booth was found. Similarly to the previous one, the owners prepare a couple of different dishes everyday, which they sell to professors and children at a very convenient price. Additionally to the prepared food, they sell chips (mainly spicy ones, with added salsa), cups filled with fruit, cucumber or jicama topped with lime, salt and chilli powder, sandwiches and drinks like plain water or sugared fruit-based water.

Figure 13. Snacks sold by street vendors outside of the evening school.

Figure 14. Food and snacks sold at the evening school booth.

Social influence
At the evening school, lunchtime is organized in rounds. In the first round, which lasts for 30 minutes, students from first, second, and third year have their lunch. The remaining students have their lunch in the second round. Similar to the morning school, teachers supervise various areas of the playground during recess. Similar interactions were observed amongst students in both schools: professors are not involved in what or how children eat their lunch, and children experiment with their food and share their lunch and experiments with friends.

Sellers
It was observed that three people take part in selling food to the children. One person is responsible for serving and distributing the prepared food, while two others sell and distribute sweets. This gives a hint on the demand for these products.

The staff has a considerable influence on what children buy, not only because of what they decide to sell inside the school, but because when asked, they mentioned that 80% of the time children ask for suggestions on what to buy. One staff member said that she usually recommends fruits and healthy food first. However, during the observation, it became evident that children were persuaded by the quantity of food offered for their money. This means that one of the selling strategies is to provide the largest amount of products, typically sweets as they are the cheapest, for the lowest price.

Context mapping activities

Experts input

Interview with **Mathiew Gielen**
Co-creation and research with children

Insights were obtained about facilitating sessions with large groups of children, different ways of expression for children, registering data, analyzing different types of data and validating the outcomes with the children.

Interview with **Ilse van Lier**
Food literacy for children

Insights were obtained about different ways of approaching the topic with children and what to pay attention to when talking about their eating habits. Also, strategies to engage children were discussed to use in the sessions.

Procedure

When confronting people with their own experiences, it is important to guide them through that thinking process. Starting with questions about needs or obstacles can be difficult to process without an initial reflection.

This is why context mapping techniques follow a model called “the path of expression”. This model guides people’s creative process around a certain topic by creating awareness of the current experiences (now), then taking them to the past to reflect on it, and finally allowing them to create different futures (E. B. Sanders & Stappers, 2013).

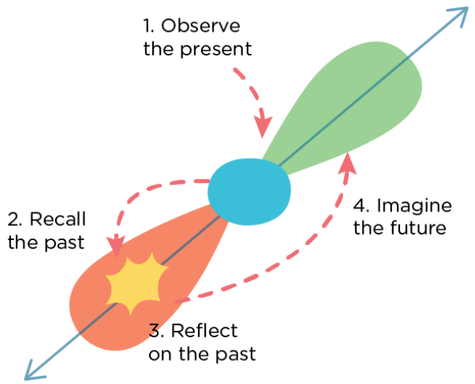


Figure 15. Path of expression for understanding an experience during a creative process. (E. B. Sanders & Stappers, 2013).

In view of these facts, as a first step and in preparation for the context mapping sessions, children were asked to do an assignment in which they reflected on current and past food experiences. The assignment was adapted to fit the skills of each age group, but the topics approached were the same.

This had two purposes: on the one hand, to identify if there were substantial differences in needs, perceptions and preferences between age groups, and on the other hand, to have a coherent data set that could be later analyzed in a consistent manner.

The assignment was provided to them through printed materials, and included the following activities:

1. To list (write or draw) what they ate the day before for breakfast, lunch and dinner, and to circle the food they liked the most.

2. To describe and compare their eating experiences at school and at home. Children in the first age group (7-8 years old) were asked to draw their favourite/least favourite food to eat at home, school, and in general, and children in the second age group (9-11 years old) were asked to complete the sentence “Eating at school/home is... because...” providing 5 different responses for each context.

3. To draw/write recommendations they would give to a little boy called Lalo to be a healthy person. Children in the second age group were additionally asked to identify the recommendations that would be more/less enjoyable to carry out.

At the primary schools, an in-class session of 90 minutes was conducted with 6 different groups. Sessions were conducted by the researcher in collaboration with each of the group’s professors, who helped the students when they had questions or struggled at coming up with ideas, and to maintain silence during the presentations.

To start the sessions, a short ice-breaker was used to set the expectations children would have of the researcher and gain their trust, since she was an unfamiliar person to them (Gielen, 2013). Moreover, this activity encouraged the children to participate freely, and showed them that all opinions were welcome.

First activity

In the first activity children shared their answers to the second part of the personal assignment. Since groups were between 20-35 students, they were divided in two so everyone had the chance to participate. A roulette was given to each group to randomize the turns to speak and make the sharing activity more engaging. While sharing their experiences, an open discussion was encouraged through questions from the researcher, which allowed peers to express agreement or disagreement, add on and comment on their classmates' opinions.

Objective
The purpose of this activity was to gain a deeper understanding of the associations children have with their eating experiences at home and at school, as well as the emotions, social influences or environment qualities that might impact on their perception of the experience.

Second activity

For the second activity, children were given materials to work with on an individual collage assignment about their envisioned experience with food at school. This is the last step of the path of expression, and was facilitated by the reflection and discussion fostered during the previous activities.

Children in the first group were asked to draw what their ideal school lunch would look like. Afterwards, a set of images with ingredients from different food groups was given to them to select, cut and paste those they would include in their school lunch.
Children in the second group were given a set of images and words that they could cut and paste to make a collage that represented their ideal school eating environment.
While they were working on the collage, children were individually approached and asked to explain their creations and the reasoning behind them.

Objective
The goal of this activity was to learn about the children's values, goals and strategies in their interactions at school, particularly those regarding their food choices. Also, this activity was meant to give children a space to raise their concerns and share the problems or challenges they see concerning their eating experience at school.

Third activity

During the third activity children shared their answers to part three of the individual assignment. As a group, healthy practices were discussed as well as preferences for performing or not performing them. The first group was asked to play "Choose your side", in which one of the healthy practices they recommended was selected, and children formed a group with those who like that activity and another group with those who don't like it. Children were asked to explain the reasons for their preference, and to discuss with the group. The second group was asked to collectively rank their recommendations for healthy practices in terms of how easy or enjoyable they are to perform. With each practice, discussion was incentivized.

Objective
The purpose of this activity was to find out which factors impact on the perception children have of healthy practices, as well as first ideas of the elements they would integrate to make them more appealing or pleasant.

Analysis

For the analysis of the Context Mapping outcomes, a strategic method was necessary. Let's remember that this step is meant to give us the missing piece that resulted from the initial literature review analysis. The way in which the data generated by the children is to be processed should allow for its integration in the Behaviour Change Wheel framework.

This is a key part of this study's process, since it is where the convergence of explorative approaches like Generative research and theoretical approaches like Behaviour Change Theory is proposed.

Grounded Theory (Glaser & Strauss, 1968) was chosen to analyze the Context Mapping data, since this research methodology is suitable for qualitative research in which an explanatory theory or conclusion is meant to be obtained out of a set of collected data (Figure 18). Moreover, it allows for flexibility in the research methods used to generate the data, such as observation, focus groups and interviews, or literature review (Tie et al., 2019).

This inductive method involves an iterative process of comparing data. Initially, data abstracts are compared to identify codes. Then, codes are compared to create categories. Finally, the categories are compared to explore their relationship and develop a theory or worldview (Tie et al., 2019).

Figure 16. Children sharing the results of their individual assignment.

Figure 17. Children working on a collage about their envisioned eating experience at school.

Step 1:
To begin the data processing, 529 minutes of audio were listened to. Audio recording was the main material used for the data analysis, since it was in the conversations and discussions with the children that most of the relevant and thoroughly described insights were collected.

While reviewing the audio, cards were created that included both original quotes from the children and their paraphrased versions, presenting a comprehensive perspective on their input.

Later, the materials created by the children were revised. Those that validated information mentioned in the audios, or revealed new and pertinent insights were added to the cards.

As a result, 142 statement cards with children's data were collected (Figure 19).

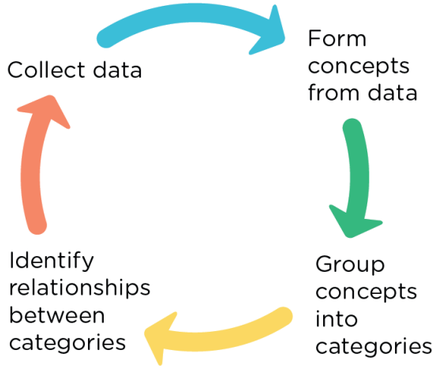


Figure 18. Iterative process of data analysis as part of the Grounded Theory Methodology.

Step 2:
A comparison of the statement cards was made in order to find common themes. As a result, 32 themes were generated, each of which was given a title in the form of an assertion (Figure 20).

Step 3:
The themes previously formulated were compared again and clustered accordingly, which originated 11 new categories.

Step 4:
The categories were organized to find the relationship between them. This resulted in a world view, which incorporated the most important insights that resulted from the activities and conversations with the children. (Figure 21).

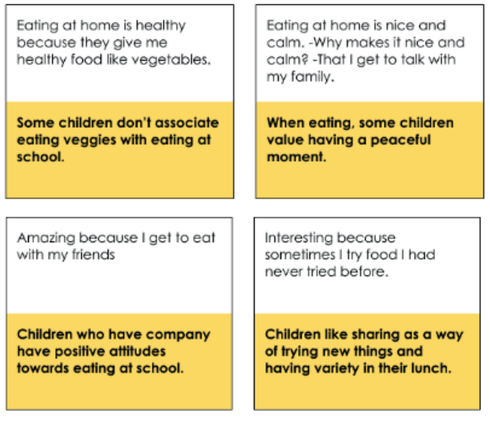
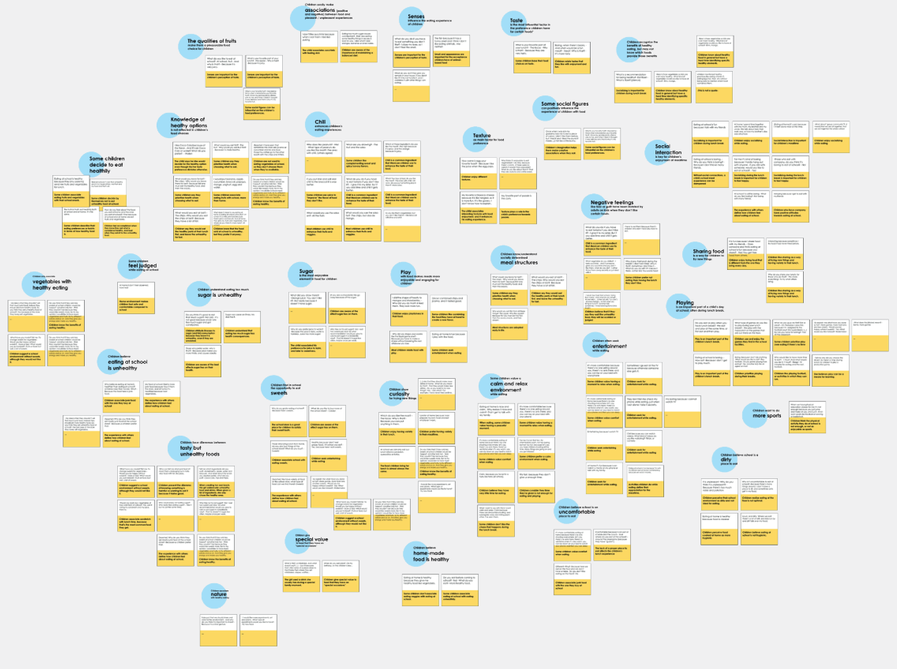


Figure 19. First step: data abstraction. Example of statement cards.



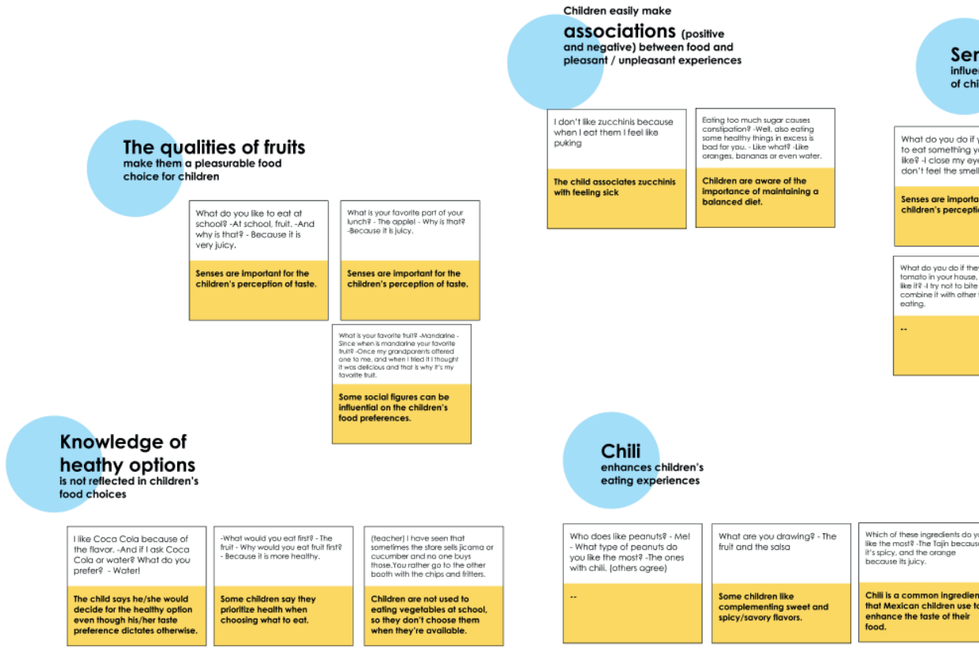


Figure 20. Groups of statement cards similar in content formed themes.

The eating experience of children in primary schools in Querétaro

The eating experience of children at primary schools in Querétaro, México is divided in two main aspects: the food experience and the social experience.

Food experience

HOW THEY FEEL	WHAT THEY KNOW	WHAT SCHOOL REPRESENTS
Sensory experience is key for children's food preferences	Children have partial knowledge on healthy/unhealthy food	Children enjoy the few opportunities they find to explore food at school
Chili enhances the children's eating experiences	Lack of support to create new and positive food associations	School stores facilitate children indulgent and unhealthy eating behaviours

Social experience

HOW THEY FEEL	WHAT SCHOOL REPRESENTS
Enjoyment and food go hand in hand for children	Eating on the floor disrupts their expectations of where and how they should eat
Some want to play, some want to talk. All want company.	Playing conditions conflict with eating conditions

Figure 21. Worldview of the Eating experience of children at primary schools in Querétaro, México.

Food experience

Children expressed insights about what they feel, what they know and what the school represents in regards to their food experience. From those, it was notable that, contrary to initial thoughts based on the literature review, children have a partial knowledge on what healthy and unhealthy food entitles.

Children are able to differentiate healthy from unhealthy for most of the food products, but it is concerning that sweetened beverages like milk or juices are not classified by kids under the unhealthy category (especially because both are present in their school lunch quite often).

Additionally, children mostly relate healthy food with vegetables and fruits, which limits the possibilities they have for exploring healthy alternatives. Children make references to elements of food like fibre, vitamins, or proteins, but are unable to identify which products provide those benefits.

Another point that stood out was the lack of support children have to create positive and healthy associations with food. Emotions like guilt, remorse or shame are vastly present when children talk about the food they like, since they know it is "the unhealthy kind".

Additionally, strategies like scolds and punishments are frequently used by parents to force children to eat the food they do not like. It was remarkable that children mentioned positive associations with "uncommon" foods, like fish, based on social experiences outside of their home environment, such as the house of a friend or grandparent and the lunch break at school.

Finally, schools are unfortunately a major source for children's unhealthy eating behaviours, since a great variety of products with high sugar content are available inside and outside the school facilities. Not only children eat sweets at school, but also they buy candy to bring home with them. Availability is a big problem, but also that they cannot regulate their sugar consumption.

Social experience

Children also expressed the importance of others in their eating experience. At school, most children had positive experiences due to being in the company of their friends while having their lunch, and the few who expressed dislike towards eating at school was mainly because they were not included in social activities.

It is not new to say that children enjoy playing. What stood out from the conversations with the kids, was that play was a preferable (if not necessary) condition for their enjoyment of a meal. Both at home and at school, children look for means of entertainment in their eating experience; food seems to have a second place for them. In the school context this is facilitated by having friends they can play with, and a big space to run or take part in games.

However, it was also mentioned by many that eating and playing at the same time was not always convenient. Children at public primary schools do not have an adequate space to eat. They eat on the floor surrounded by children running and playing, and dust that sometimes gets on their food. This seems to represent an unpleasant eating experience for children, especially the older ones.

Member check

After arriving at the aforementioned conclusions, it was important to validate if children could relate to them, and to what extent. This is important in research since it provides confidence in the accuracy of the results, and the direction of the project. To this end, a member check activity was organized in a new in-class session.

In the worldview, all sorts of insights were presented: those related to knowledge, to environment conditions, social conditions, play, etc. Nonetheless, it would be complicated to approach all of them in a single intervention, additionally to the fact that some of them are outside of the initial scope of the project. Therefore, in preparation for the member check activity, and to narrow down the intervention, three main insights were selected for validation. Those insights were translated to "children's language" so they could easily decide if they relate to them or not.

- School stores facilitate indulgent and unhealthy eating behaviours in children.
- Playing conditions conflict with eating conditions.
- There is a lack of support in creating new and positive associations with food.

Children were asked to place a star under the sentence(s) that represented a real problem for kids, from their perspective and own personal experience. Children were let known that eating experiences are different for each individual, and that great value could be found in those differences. Thus, they should give their opinion without taking into consideration what others thought or expressed.

After everyone voted, a discussion was encouraged for children to elaborate on the reasons why they thought one problem could have more importance than other.

Based on the votes visualization (Figure 23) we can say that all three statements are problems children can relate to. However, the first and the second one seem to have more relevance.

During the conversation following the activity, children stated that, although all three are common issues, eating a large amount of sweets and junk food was the most critical one, since they acknowledge these eating habits will affect their health in the long term.

Figure 22. Through placing a star under the statements, children were asked to specify which problems resonated with them.

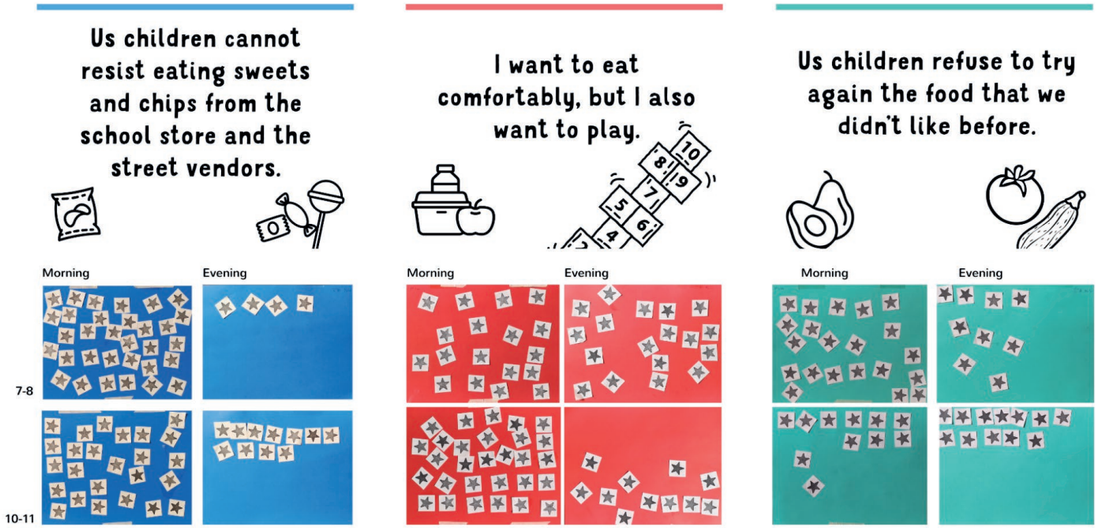


Figure 23. Results of the Member Check activity show that children could relate to all three of the problems presented to them.

VI.

Filling the gap

Research / Analysis, part 2

In this chapter we look back at the COM-B model to integrate the outcomes of the generative research sessions. By doing so we got a comprehensive view that informs on the aspects that the intervention must act upon to achieve change.

Later, following the Behaviour Change Wheel model, the intervention functions are identified, thus discovering possible directions for the design of the school intervention.

Limitations to healthy eating behaviours at school

The research described in the previous chapter had two main purposes. Fistly, it adressed the knowledge gap from the initial COM-B analysis, which gave a deeper understanding of the reflective and automatic motivations that play a role in children's food choices. Secondly, the activities provided context-specific insights, including needs and limitations to be considered in the design solution. In this phase, the COM-B model was completed by integrating learnings from the context-mapping (Figure 24).

Capability	**Physical** *Physical skill, streght or stamina*	**Source**
	Preference for sweet tastes in early stages of life	(N. H. C. Rivera & Lagunes, 2014)
	Sensorial experience is key for children's food preferences	Context-mapping activities
	Psychological *Knowledge or psychological skills*	
	There is not a lack of knowledge, for young mexican children (preschool) are capable of differentiating healthy from unhealthy food.	(N. H. C. Rivera & Lagunes, 2014)
	Affective issues, such as self-esteem and empathy, as well as the individual's need for social acceptance, influence the construction of the repertoire of eating behaviors.	(De Los Ángeles Pérez Pedraza et al., 2021)
	Partial knowledge of healthy food; they mainly identify fruits and vegetables.	Context-mapping activities
	Partial knowledge of unhealthy food; they mainly identify candy, chips and some fried mexican dishes.	Context-mapping activities
	General understanding of benefits of healthy eating, but inability to identify which foods provide those benefits.	Context-mapping activities
Motivation	**Reflective** *Beliefs, self-identity, intentions, goals & plans*	
	Beliefs that home-made food is healthy, although this is not always true.	(Gupta et al., 2012)
	Beliefs that healthy food cannot provide the same taste experience than unhealthy food.	Context-mapping sessions
	Beliefs that they need sugared food to obtain energy.	Context-mapping sessions
	Children's greater motivation to play than to eat during school lunch breaks.	Context-mapping sessions
	Automatic *Emotions, feelings, associative learning, habits & drives*	
	Associations of certain foods and drinks to specific moments of the day, for example, children associate sweet beverages with lunch and dinner, and water with something one drinks after exercising or "going out for a walk to the park".	(Théodore et al., 2011b)
	Associations of sweet drinks with savory meals due to Mexican belief that sweet drinks help "to pass the food". Water is not associated to the same function.	(Théodore et al., 2011b)
	Flavor and texture are more important to children than their knowledge on the nutritional value and consequences to their health.	(Zapata Cetina & Cervera Montejano, 2016)
	The "food tastes" of the lower classes are focused on producing a sense of satiety promptly.	(González Montoya, 2020)
	No support to create new and positive associations with food.	Context-mapping sessions

	Eating patterns followed by their families.	Context-mapping sessions
	Children give special value to food they eat on "special occasions", like pizza.	Context-mapping sessions
	Associations (positive and negative) children have between food and past pleasant/ unpleasant experiences	(Child Feeding Guide, n.d.) Context-mapping sessions
Opportunity	**Physical** *Time, location, money, resources*	
	Lack of free drinking water in schools promotes consumption of sweetened beverages.	(Théodore et al., 2011a)
	Advertising for sugary drinks containing misleading phrases like "with fruit pulp", to create an illusion that it is natural.	(Théodore et al., 2011a)
	Advertising as one of main sources of "nutritional information" for kids.	(De Los Ángeles Pérez Pedraza et al., 2021)
	Lack of integration of the social and cultural context in the official guidelines for healthy eating provided by school, like El Plato del Buen Comer, or La Dieta de la Milpa.	(Cano, 2015)
	Insufficient integration of vegetables and other healthy foods in the daily diet of an low class Mexican family.	(Carmona Barrón, 2015)
	Limited time for parents to prepare children's lunch and/or family meals.	(Carmona Barrón, 2015) Context-mapping sessions
	Unvarying lunch options for most children.	Context-mapping sessions
	No opportunity to explore new food at school.	Context-mapping sessions
	Ready availability of a variety of sweets at school, which turns it into one of the main sources for children to get candy and other sugary snacks.	Context-mapping sessions
	Money given to children for their free use during lunch.	Context-mapping sessions
	Sale of prepared lunches outside the school for the convenience of parents.	Context-mapping sessions
	Presence of vendors selling a variety of unhealthy snacks (mainly highly-sugared) after school.	Context-mapping sessions
	Social *Social norms, environmental, cultural & social cues*	
	Children often imitate eating behaviors from their peers observed during recess.	(Valencia Niño De Rivera et al., 2018)
	Lack of involvement of professors in motivating children to eat healthy food inside the school.	(Carmona Barrón, 2015)
	In Latin America professors and parents have a lack knowledge on nutrition and healthy eating, which plays in favor of unhealthy behaviors.	(Anaya-García & Gallego, 2018)
	Limited motivation or guidance at home. Mothers can't encourage their children to eat a healthy diet since they have little time to cook.	(Carmona Barrón, 2015)
	Ease to indulge themselves with sweets and unhealthy treats without consequences.	Context-mapping sessions
	Wish of parents to treat their children when they finish school day.	Context-mapping sessions
	Influence from school store staff based on personal economic interests.	Context-mapping sessions
	Punishment and reward dynamics with food enforced by Mexican parents.	Context-mapping sessions

Figure 24. Integration of the Context Mapping insights into the COM-B model for understanding the determinants of the selected behaviour.

The goal of learning more about the Motivational aspects of the children's eating behaviours at school was met, but in addition, many context-specific factors were added to the Opportunities (both physical and social) as determinants to the behaviours occurring at the selected primary schools in Querétaro.

We can conclude from this that Opportunities are, although difficult to change, the most important type of determinants for the eating habits and practices of a person.

Changing the unwholesome environment around schools requires multi-element interventions that have an impact at the top levels of the system, such as legislation and regulation, which is out of the scope of this project. However, environmental resources and social support can be leveraged to improve the conditions that children have for making decisions regarding their nutrition.

Identifying what needs to change

After having a complete picture of the determinants of unhealthy eating behaviours in children at primary schools in Querétaro, México, and following the process suggested by the Behaviour Change Wheel, a set of factors were selected as those that need to change and will be prioritized during the design of the intervention.

Identifying barriers to the behaviour using the Theoretical Domains Framework (TDF)

Using the COM-B model in this study proved beneficial in providing a structure to gather data from various domains. It also allowed for a general categorization of the data, enabling a thorough understanding of the context and informing the design of generative research activities. However, for a more detailed analysis and definition of what needs to change and the strategies to do so, the Behaviour Change Wheel model incorporates the Theoretical Domains Framework, which is an integrative framework composed by theoretical constructs used in 33 behaviour change theories, that allows to "expand on COM-B components identified in the behavioural diagnosis" (Michie et al., 2014). By utilizing the TDF, findings can be broken down into more specific and actionable elements.

The more relevant factors from the COM-B model analysis were selected and rephrased as "Barriers of the behaviour", and later mapped out to the different constructs of the TDF (Figure 25).

Defining suitable intervention functions

As a first step to defining qualities for the design of the intervention, the BCW model provides linking principles, strategies or "functions" that interventions should serve so that they are more likely to be effective in achieving change (Michie et al., 2014).

The barriers of the behaviour were evaluated and matched to one or more intervention functions that are suitable for the context. Here are some examples (full list of Intervention functions in Figure 25).

Capability
In terms of capability, the principal barriers for children to achieve better food decisions are the partial knowledge of healthy and unhealthy foods, and the lack of knowledge on how to achieve a balanced meal. The intervention function that would best achieve change is Education on the resources that are available to children and the ways in which they can achieve better behaviours.
Another example is that children do not evaluate their food choices in terms of healthy and unhealthy. A function that could help children is environmental restructuring of the school store. By providing children with hints or symbols that they can easily identify and relate to, they can start considering this factor in their decision-making process.

Motivation
In conversations with the children they mentioned frequently that it is only natural for them to like sweets and therefore, they cannot avoid eating them. That lack of self efficacy in achieving healthier behaviours can be influenced by functions like Incentivisation, in which every time a good practice is achieved, they receive positive feedback or recognition.
Another example is that children lack support in building positive associations that add value to choosing healthy food. Through functions like Environmental restructuring, for example introducing social support practices, children could build pleasant associations that evoke a sense of reward in achieving healthy behaviours.

Opportunity
Environmental restructuring would be the most efficient intervention function to achieve better eating behaviours, since regulating the availability of unhealthy products would give children less chance to indulge in unhealthy practices at school. However, it is the most complicated to achieve since conflict of interest impacts many parties involved in the system. However, for barriers like the lack of social interactions that support healthy behaviours, functions like Modelling can influence the behaviour if an example of the intended behaviour is set by strong social figures at school, like professors or peers.

Evaluation with APEASE criteria

As a last step, after having a comprehensive list of options for the functions of our intervention, a selection of the most adequate ones was made. To that end, the APEASE criteria was used (Michie et al., 2014).

A= affordability P=practicability E= effectiveness A=acceptability S=side effects/ safety E=equity

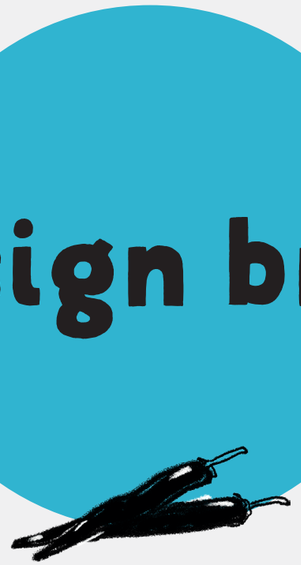
Each candidate function to change a barrier was evaluated for deciding whether the function could be integrated in the final design or not. The decisions and argumentations for each function can be consulted in Figure 25.

COM-B component identified in the behavioural analysis	Domains linking to COM-B component	Barriers to the behaviour	Intervention functions	Examples of BCTs	APEASE
Psychological capability	Knowledge	Partial knowledge of what is healthy (only vegetables), and what is unhealthy (only sweets and fried food) Lack of knowledge on how to achieve a balanced meal	Education		Yes
	Cognitive and interpersonal skills	Not relevant to eating unhealthy food at school *E.g. problem solving / trust / leadership*	--		
	Memory attention and decision process	Children don't evaluate their options in terms of healthy/unhealthy before making a decision	Environmental restructuring		Unlikely that store staff accepts to change or restructure it. Interest conflicts.
	Behavioural regulation	Absence of goal setting skills and strategies for monitoring or regulating their sugar/fat intake	Modelling / Enablement	Practical social support, goal setting, action planning	Unlikely to be effective at promoting less sugar/fat consumption on children.
Reflective motivation	Social role and identity	Not relevant - Only effective when belonging to a group is important to the individual's identity	--		
	Beliefs about capabilities	Low self-efficacy at regulating their sugar intake	Education / Persuasion / Incentivisation	Feedback on behaviour or outcomes of behaviour	Yes
	Optimism	Not relevant to eating unhealthy food at school	--		
	Intentions	Little or no intentions. Pre-contamplation stage of change.	Education / Persuasion / Incentivisation		Effectiveness can be cuestionable
	Goals	Currently not a goal. Can be initiated by controlled motivation strategies.	Incentivisation / Modelling / Enablement	Cue signalling reward, action planning	Yes
	Beliefs and consequences	Children already know the effects and consequences of unhealthy behaviors, but they believe they cannot enjoy healthy food.	Persuasion/Modelling	Reframing, Demonstration of behaviour	Yes
Automatic motivation	Reinforcement	No support in building positive associations that add value to choosing healthy options	Training / Environmental restructuring	Instruction, Exposure, Associative learning	Yes, as part of learning moments and lunch breaks
	Emotion	Negative associations and emotions around eating healthy food are constantly maintained by parenting and other social practices	Enablement / Incentivisation	Practical social support	Yes, as part of learning moments and lunch breaks
Physical opportunity	Environmental context and resources	Increase the opportunities for healthy eating at school	Training / Environmental restructuring / Enablement	Instruction, Exposure, Action planning,	Unsure if support will be provided by parents or school staff for offering healthy food options to the children
Social opportunity	Social influences	Stakeholders like store staff, misguide children's eating habits at school No social interactions that support and spur the desired behavior.	Enablement / Modelling	Practical social support, action planning or reframing, demonstration	Yes, at least from professors and peers

Figure 25. By using the Theoretical Domain Framework, more specific barriers to the behaviour could be identified. Intervention functions suitable for each barrier were mapped out and finally assessed through APEASE criteria to define which elements need to change.

VII.

Design brief



Design

After the analysis of the information collected by the literature review and the Context Mapping activities with the children, it was possible to come up with a Problem Statement and a Design Goal.

Problem Statement

Children from the Naciones Unidas and José Morales Lira primary schools in Querétaro, Mexico find the school environment ideal to indulge in unhealthy eating practices.

The main reasons why children have unhealthy eating behaviours at school are:

- An excessive and unrestricted access to unhealthy food and beverages at school.
- Partial knowledge of what unhealthy and healthy food is.
- Beliefs that healthy food cannot provide the same taste experience than unhealthy food.
- Insufficient involvement of school staff in encouraging children to make healthy food choices.

Why is this a problem?
The health emergency that childhood obesity has brought in Mexico requires that contexts in which children interact facilitate and foster healthier habits.

If school is one of the places where children spend more time besides their homes, it is important that they take part in guiding the students towards practices that benefit their overall wellbeing. However, this is not happening at the moment. As seen in the results of the research, not only are schools not being sufficiently involved in finding ways for children to adopt better eating practices, but they are actually a big part of the problem, since children find in schools a major source of junk food.

However, the research also confirmed that the school environment and interactions can be intervened to promote and cultivate a healthy lifestyle. The influence that professors and friends or classmates have on children can be leveraged to provide kids with models, examples and opportunities to experience healthy eating in a fun, engaging, and stimulating way.

Therefore, in order to propose a solution to the previously mentioned problem statement, a design goal was generated.

Design goal

I want children from the Naciones Unidas and José Morales Lira primary schools to **feel motivated to develop a balanced diet** by creating positive associations with healthy food during their school experience.

Part of this design goal is to extend the effects of the intervention to the children's life inside and outside school. This is why positive food experiences are meant to be provided at school, but the motivation to achieve healthier eating practices should ideally go beyond the context of the intervention.

Design criteria

In order to achieve the intended Design goal, and defined based on the research outcomes, the final design should:

Inform children in a comprehensive manner about the options they have to develop a healthy diet.

Consider school staff as active participants in promoting healthier behaviours among children.

Create opportunities for children to develop positive associations towards healthy food.

Be culturally and context appropriate.

Increase their self-efficacy in moderating their consumption of junk food.

Be applicable in both primary schools, independently of their contextual differences.

Intervention functions

Finally, through the Behaviour Change Wheel model, the principles or functions that the intervention should follow to achieve the intended behaviour are:

1. Education

To increase the children's knowledge on how to put together a balanced meal, and the resources that they have to do it.

2. Modelling

To provide children with concrete examples that serve as guide or reference for them to replicate and practice the intended behaviour.

3. Environmental restructuring

To adapt the physical and/or social context to promote dynamics and interactions that are supportive of the desired behaviour.

4. Incentivisation

To engage the children in achieving that understanding by making the behaviour more attractive.

5. Enablement

To provide children with resources or means to understand and achieve the behaviour.

Changing children's eating habits is not an easy task: there can be many types and sizes of interventions, and they require the involvement of all the stakeholders that represent an influence on children's food decisions.

This project aims to suggest a way of initiating change within schools. Therefore, the purpose of the final design is not to give an ultimate solution, but rather to **demonstrate the effectiveness of school interventions that follow the recommended criteria and include elements that afford the specified intervention functions.** If successful, these design guidelines could enhance the influence school interventions have on children's abilities, opportunities and motivations to achieve healthier eating behaviours.

VIII.

Conceptualization

Design

Once the design criteria and intervention functions were defined, some cues were needed that revealed the strategies that would be most successful to use when designing activities for children. Such cues can be found through pedagogical methods but also through kids themselves. In this chapter both sources are investigated to find inspiration and possible directions for the final design.

Another key aspect to consider, as mentioned in the design criteria, is to make the intervention cultural and context appropriate. This relates to the content of the intervention and the way it is communicated to children. In the second part of this chapter qualities of the content are explored and defined.

Lastly, design concepts based on the acquired knowledge are introduced. This chapter illustrates the process of ideation, evaluation and iteration that contributed to the development of the final design.

Experts input

Interview with **Dr. Madeleine Vera**
Pediatric nutricionist

Insights were obtained about opportunities and limitations to a healthy diet in the context of Querétaro. Also, strategies to persuade children and parents to follow dietary recommendations were discussed.

Interview with **Ilse van Lier**
Food literacy for children

Insights were obtained about the best food models and methods to convey dietary information to children, as well as the most appropriate communication approach.

Co-creation sessions

Co-creation is a valuable tool that not only inspires the design process, but also provides a space for collective creativity in which deeper levels of knowledge such as needs, ideals and hopes can be revealed, and desired futures can be imagined (Van Mechelen et al., 2016).

In this project, creation was used to understand the strategies children see as feasible and effective when thinking of potential solutions to their eating habits problems. Furthermore, these strategies helped to recognize the values embedded within children's eating practices, which shed light on the reasons behind children's motivations to engage in certain behaviours.

To inspire the session, and to provide continuity to earlier discussions, the problems validated during the Member Check activity were used:

1. Us children cannot resist eating sweets and chips from the school store and the street vendors.
2. Us children refuse to try again the food that we did not like before.

Before starting the session, a small activity was carried out to explain the concept of "brainstorming" to the children. Then, they were divided in groups of 4 to 6 and were randomly assigned one of the problems.

During the first part of the session, children were asked to generate as many ideas as they could to address the given problem. To trigger their imagination, the task was formulated as "What would a superhero do to help children solve this problem?".
Once each group came up with a list of ideas, children were instructed to choose their strongest concept and build it with crafting materials such as paper plates, cups, pipe cleaners, styrofoam balls, and other items that were provided to them. Lastly, they were invited to present their creation to the rest of the class and explain the reasoning or story behind it.

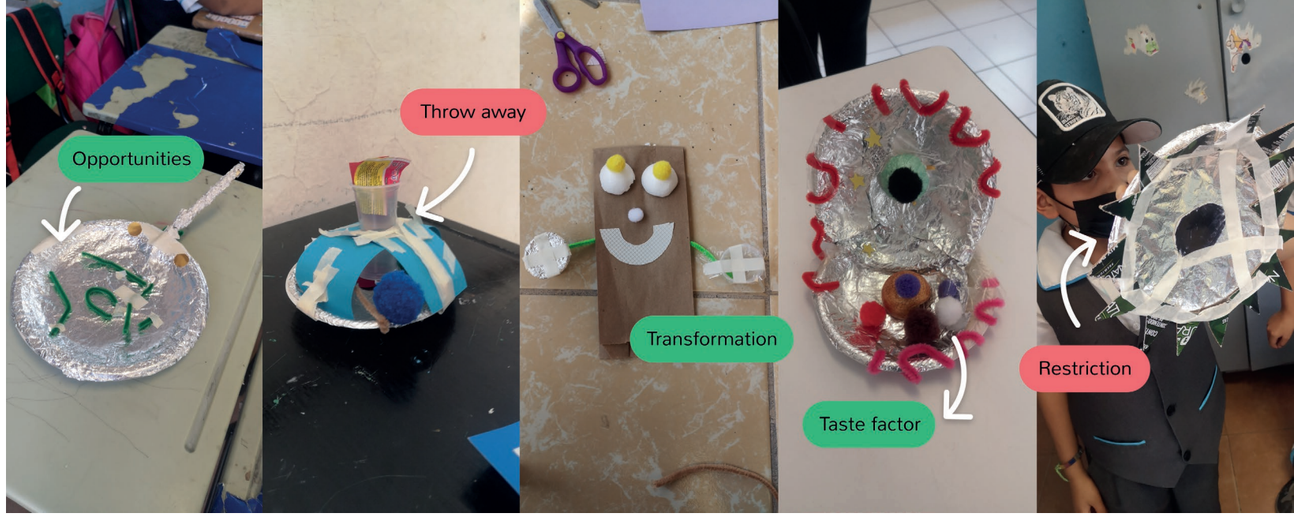


Figure 26. Tools children made to give a solution to the problems they were given about children's eating practices. From left to right: A pan that cooks ingredients you didn't like before in a new way; a machine that when used over your meal, absorbs the unhealthy ingredients and filters them out through the top part; a puppet that shoots healthy sweets to children, a machine that transforms the veggies into nice sweets, a shield that protects children from junk food by absorbing it through the central part.

Analysis

In order to analyze the outcomes of the co-creation activity, discussions from the ideation phase and final presentations were documented through audio recording and pictures. All the children's ideas were listed, compared, and annotated based on their explanations for their inventions.

As a result, five common themes were identified, which showed the main strategies children integrated as part of their solutions. Then, those strategies were categorized as positive or negative depending on how they attempted to provide a solution to the problem.

Negative strategies

Throw away the unhealthy food

Restrict yourself from unhealthy food

The ideas containing these strategies revealed that the narrative used to educate children on how to eat is very polarized: certain food is good and you must consume it in big amounts and certain food is bad and you must avoid it.

The solutions kids presented assume the role of an intermediate mechanism between them and unhealthy food, which creates a barrier that frvustrates their attempts to eat it.

Although children seem to think that restriction is an effective solution, establishing extreme limits regarding the food they enjoy the most can result in a negative relationship with food.

Thus, the main takeaway from these strategies is that the final design should avoid the use of restrictive language, and instead, provide ways for children to healthily integrate the food they like into their diet.

Positive strategies:

- Create opportunities for re-exploring ingredients
- Consider the taste factor in the healthy eating experience
- Transform the appearance of natural taste of food to make it more appealing

Contrary to the restrictive functions of the previous strategies, some concepts enabled opportunity. Since the research phase children expressed their desire to explore and have fun with food, which is something they rarely experience. If the school intervention offers them a space to discover food through a new lens, kids might be more open to grant second or third chances to new or disliked ingredients.

On a different note, since the initial research phase it was clear that taste is the most determinant factor on children's preference towards certain foods. Above anything, children prefer food when they find it "tasty", which was very much present in children's creations during the sessions. Therefore, it should not be disregarded. Making food appealing by integrating the "tasty factor" can be a strategy to leverage healthy eating practices.

Thus, the main takeaway from the positive strategies is that the final design should enable opportunities to explore food, and provide children with flexibility to integrate the tasty elements in their meals in a healthy manner.

First ideas

After defining the design criteria, intervention functions and desired strategies, the stage was set for formulating first ideas for potential design solutions.

I. La Dieta de la Milpa

As mentioned in the first chapter of this report, La Dieta de la Milpa is a model based on the products of the traditional agricultural system called "milpa". This model was used as reference to create the first intervention concept. The intervention would be integrated by three elements:

1. A marketing campaign in which the ingredients of the Dieta de la Milpa would be advertised around the school. A set of 4-5 ingredients would be selected every week to be promoted through big posters placed outside the classrooms.
2. A recipe book containing different preparations with the ingredients of the week would be shared with parentsvthrough WhatsApp, which is the main communication channel between parents and teachers.
3. At the end of the week, a potluck activity would take place at school, in which children would bring different dishes containing the ingredients of the week to share with their peers.

The dynamic would be repeated every week for a month with different ingredients so children expand their knowledge and experience with healthy, easily available and accessible ingredients.

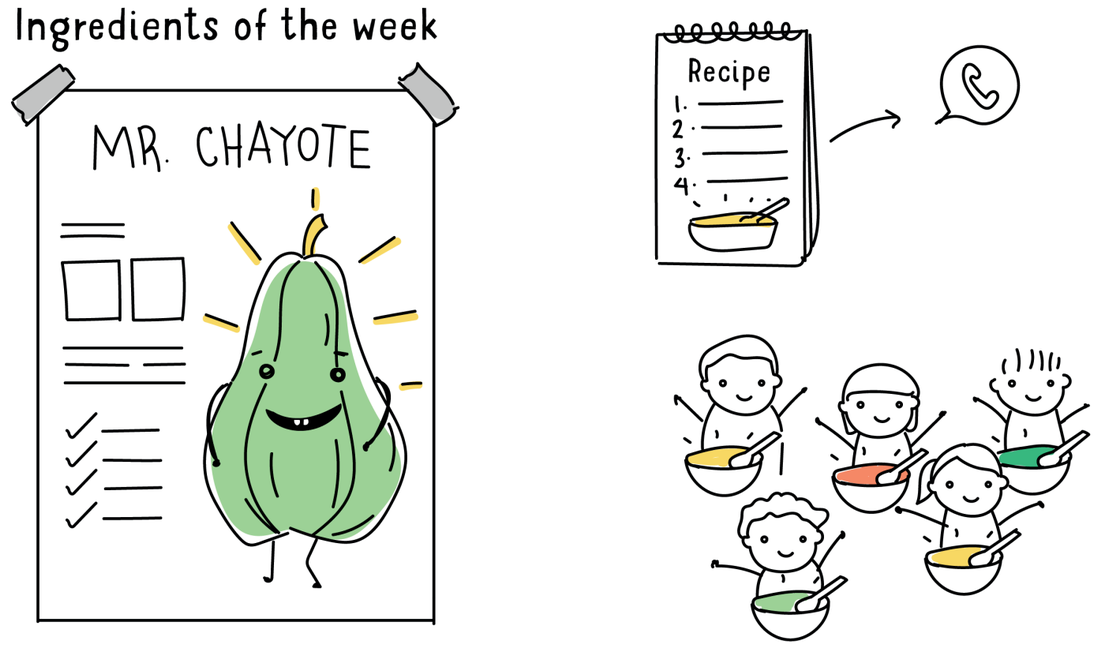


Figure 27. La Dieta de la Milpa intervention concept

Objective
The goal of this concept is to create opportunities for children to learn about new ingredients, explore the different ways to prepare them, and experiment with a variety of tastes in a context that promotes fun and engaging dynamics. This would facilitate the creation of positive associations with food. Furthermore, this concept aims to transmit part of the new knowledge to parents and give them tools to include a wider variety of healthy ingredients and preparations in their family meals.

II. My balanced school lunch

One of the main research learnings was that children have partial knowledge of food. They understand that it is important to consume protein, fibre or vitamins, but they don't know which products contain them. Food categorization and the way it is currently communicated at school makes it hard for them to relate with the knowledge. Additionally, even though they are taught models to guide their regulation of food portions, children struggle to put this into practice.

Thus, the second intervention idea involves an ingredient template that can be used for two different moments and purposes:

1. To educate children about food theory. With the template, professors can guide children in learning and identifying the different ingredients, categories and their particular characteristics. By use of color coding, children can make visual associations that help them connect food with their common qualities.

2. To guide them in creating their own lunch. By means of the previously learned color codes, the template would indicate the recommended portion for each food category. They would be able to select the ingredients of their lunch and come up with a balanced dish based on that selection.

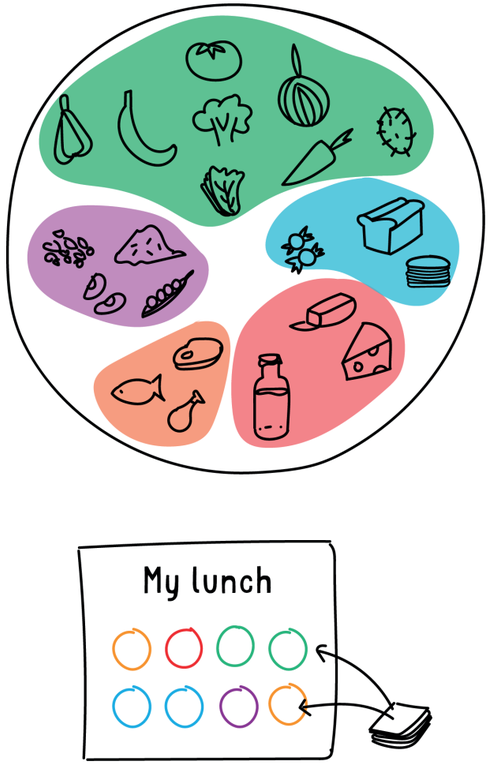


Figure 28. My Balanced School Lunch intervention concept

Objective
This concept has two main goals: one one hand, the intervention aims to provide children with an explorative and relatable way of categorizing and understanding food. On the other hand, it invites children to go beyond the lecture and apply what they learned to a real life and familiar situation for them: their own school lunch. The tool would enable them to create balanced meals through examples and visual cues, facilitating the transition from knowledge to skill development.

Evaluation

For the initial ideation phase, intervention concepts were pitched to supervisors and peers. After informing them about the characteristics of the context in which interventions would take place and the dynamics that the intervention should support, they were asked to provide feedback based on the perception of effectiveness each concept evoked.

Furthermore, a consultation was held with the professors from the participating schools. First, the research outcomes and intervention directions were shared with them. Then, they were interviewed to explore the terms of the integration of an external intervention into their course planning. Discussing with professors was crucial to understand the resources in terms of material, time and staff support that the school would see as acceptable to provide for such an intervention.

Conclusions
Although the "Dieta de la Milpa" concept seemed appealing in terms of content and cultural integration, the main concern for supervisors, peers and school professors was the parents' involvement. Lack of time for parents to cook is one of the big challenges children have for eating healthily in the first place. Thus, creating a school activity that is so dependent on the parents' participation might hinder the childrens' experience.

However, some positive aspects of this concept emerged: firstly, the use of characters seemed to make the content more relatable and likeable, and secondly, the activity gives children an opportunity to make their own food choices. Lastly, while requiring active participation of the parents seems impractical (and parents don't like to be told what to do), thinking of a solution that potentially informs and benefits them in some way came up as an opportunity that can be derived from this idea to include it in the selected concept.

"My balanced lunch school" concept not only seemed more feasible but also inspired more opportunities for designing educational artifacts that enable children to create balanced meals, while introducing them to a variety of ingredients that would broaden their opportunities around food.

In addition, lack of awareness about nutrition at a young age came up as an important topic, since children are more commonly guided by their ideas of what is tasty or not when they make food choices. This relates to one of the insights provided by Dr. Madeleine Vera, who explained that children must be able to eat what they like, although in the correct portions. If we help them build better relationships with food, the spectrum of products they like and consider tasty would be wider and, hopefully, would include some healthy ingredients too. This aspect can be leveraged through this intervention concept and expanding the scope for exploration.

Dealing with limitations

From the discussions with the school professors new concerns came up: Who will pay for the materials needed for the activities? How much time will parents be required to spend helping their child? If a child's parents fail to provide the materials needed for the activities of the intervention, how will the child take part? How much time will they (professors) have to invest preparing for the activity?

After these questions, it was clear that schools' resources are extremely limited when it comes to supporting class activities. "We struggle a lot, I had to print your assignment for them (the initial sensitizing activity) because sometimes they don't do it, or say printing is expensive."

Therefore, the final design should take into consideration the following limitations:

- ✗ No computers or electronic devices available
- ✗ No resources for materials
- ✗ No resources for printing in color
- ✗ Easy to assemble or put together by children

Refining the concept: content definition

In México, the Official Mexican Norm (NOM) has established "El Plato del Buen Comer" (Healthy eating plate) as the eating guide or model to be used when promoting and educating children on healthy eating practices (Gobierno de México, 2019).

This model categorizes ingredients into three main groups: vegetables and fruits, cereals and legumes and products of animal origin.

As seen in Figure 29, the sizes of the sections in the plate aim to represent the portion in which each food group should be consumed. However, the research phase of this project showed that children find the Plato del Buen Comer "hard to follow" as well as ineffective in generating useful long-term knowledge, meaning children cannot remember the products that belong to each group.

Figure 29. El Plato del Buen Comer. Model used by schools under the instruction of the Mexican Government (Gobierno de México, 2019).

Furthermore, professors declared that they have taught this model in a superficial manner, which implies that they do not give enough importance to the topic during the class.

It became evident that not only a new format for teaching about portions and balanced meals was needed, but also a new communication language. There are many models that seek to simplify the understanding of what a healthy diet encompasses. This project will take the Australian Healthy Eating Pyramid as a reference (Figure 30) since it complies with two essential requirements that came up from the expert interviews: first, it should promote a non-restrictive language and second, it should provide a child-friendly portion guidance.

Therefore, the activities of the intervention will replace "healthy" and "unhealthy" or "good" and "bad" for more flexible labels like "anytime food", "sometimes food" and "every now and then food".

Figure 30. Elements that make the Healthy Eating Pyramid a good fit for children (Nutrition Australia, 2014).

Refining the concept: learning through play

Once the content approach was defined, a strategy for making the activity more engaging was needed.

Initially, while prototyping different ideas, characters and doodle-like elements were used to try to make the content more appealing for children. Then, different types of interactions with the artifact were explored (Figure 31).

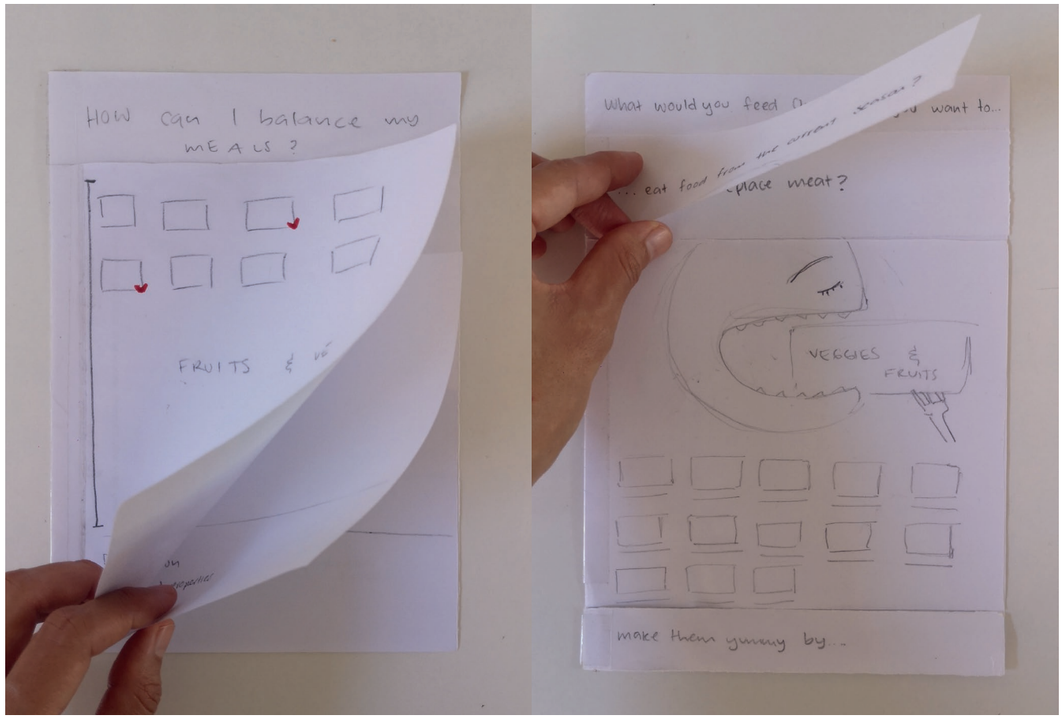


Figure 31. Folding interactions explored in a booklet prototype.

Nevertheless, the educational materials started to feel too complex, which made them hard to use and understand even for some of the designer peers who tested them. So the question was then, how to craft an activity that is entertaining enough for children to engage with it, while keeping it simple?

First, sources of inspiration were collected from the **edutainment** industry, which is a teaching method that uses media such as music, film, video games, etc. to make educational content both pedagogic and attractive (Krunal, 2022). But while studying those examples, a dilemma between Education and entertainment v.s. Learning and play came up. In his essay “Edutainment? No tanks. I prefer playful learning”, Mitchel Resnick (2004) states that edutainment sees entertainment as a way of rewarding learners for bearing with a little bit of education.

More importantly, it places participants as passive recipients. Education and entertainment are provided: people are told what they need to know and they memorize it, while play is something that they do triggered by a challenge, puzzle, problem, etc. and learn from it as a consequence. (Kumar et al., 2013) In sum, deeper levels of understanding can be reached if participants process challenges or real-world experiences through reflective observation. In the case of this project’s topic, children have been learning about healthy eating inside the classroom, but, what if the intervention invites them to explore their own particular context and learn from it?

Therefore, it was finally defined that the experience of the intervention activities should look like this:

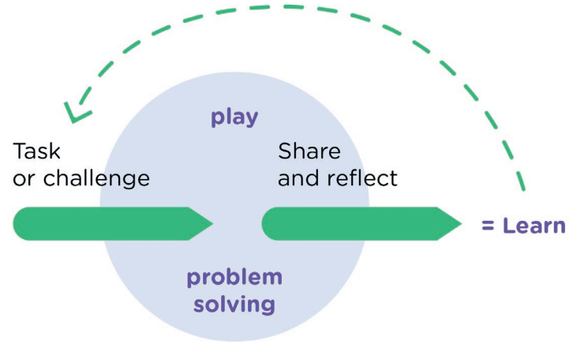
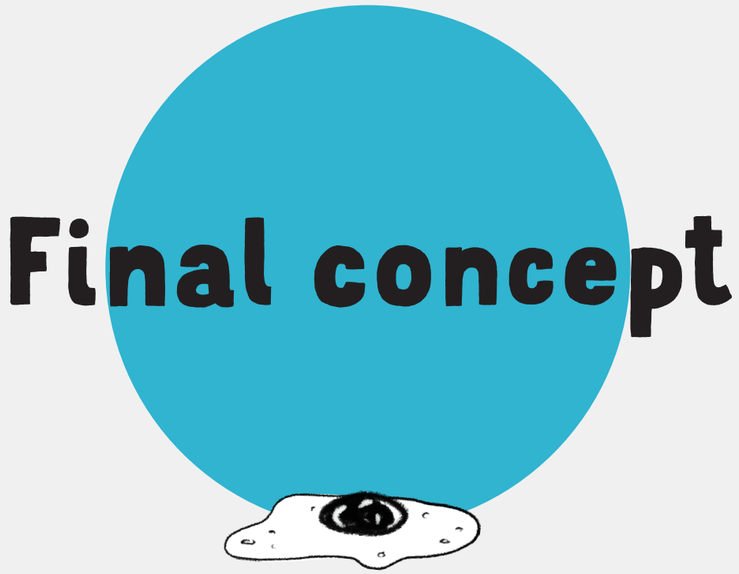


Figure 32. “Learning through play” loop.

VIII.



Design

The final concept for the intervention is a small set of activities in which professors are the facilitators of the children's exploration journey. It came as a result of two main aspects: first, the criteria defined by means of the Behaviour Change Wheel, and secondly, the inspiration gathered from the selected educational strategy.

It is important to say, that more than suggesting an ultimate design, the final concept is meant to serve as an example of the qualities a class activity must comply with for it to be effective in educating children on healthy eating.

This chapter presents a description of the intervention design, the relation of its elements with the theory, and the value it provides to the stakeholders involved in children's nutrition, particularly in the school context.

Description

The final intervention design is a two-step class activity aimed at children between 7 and 10 years old. This age range was defined due to the fact that children within this age group share similar skills and perceptions of enjoyment. Moreover, it aligns with the primary school curriculum since, according to professors, healthy eating education is taught mostly between 2nd and 5th grade.

Although the activities are meant to be solved individually, they promote social interactions and exchanges inside and outside the school.

Part 1. Play and learn: exploration board game

Objective
The goal of this activity is, firstly, for children to recognize the full range of ingredients that are available to them, and secondly, for them to understand the recommended portions for each food type.

Description
The first part of the intervention consists of a story that professors will tell to the students during the class, followed by an activity related to the story.

Los Comelones are a group of Foodie Heroes that watch over the people of the city by magically presenting all types of ingredients in their kitchens. Each Foodie Hero has a special power that allows them to provide specific ingredients. However, the heroes are losing their powers due to the people's eating misbehaviours, and now their ingredients have gone missing!

Figure 33. Los Comelones . Each character represents a food group.

The child will be in charge of helping the Comelones find their ingredients via different challenges that include exploring the school store, their home, the closest market, thinking of ingredients they have not tried before, etcetera. As they "collect" ingredients, they should write or draw them on a board game that will be provided to them.

The board game was designed to be printed in black and white so it is accessible to all children, which was one of the limitations of the context.

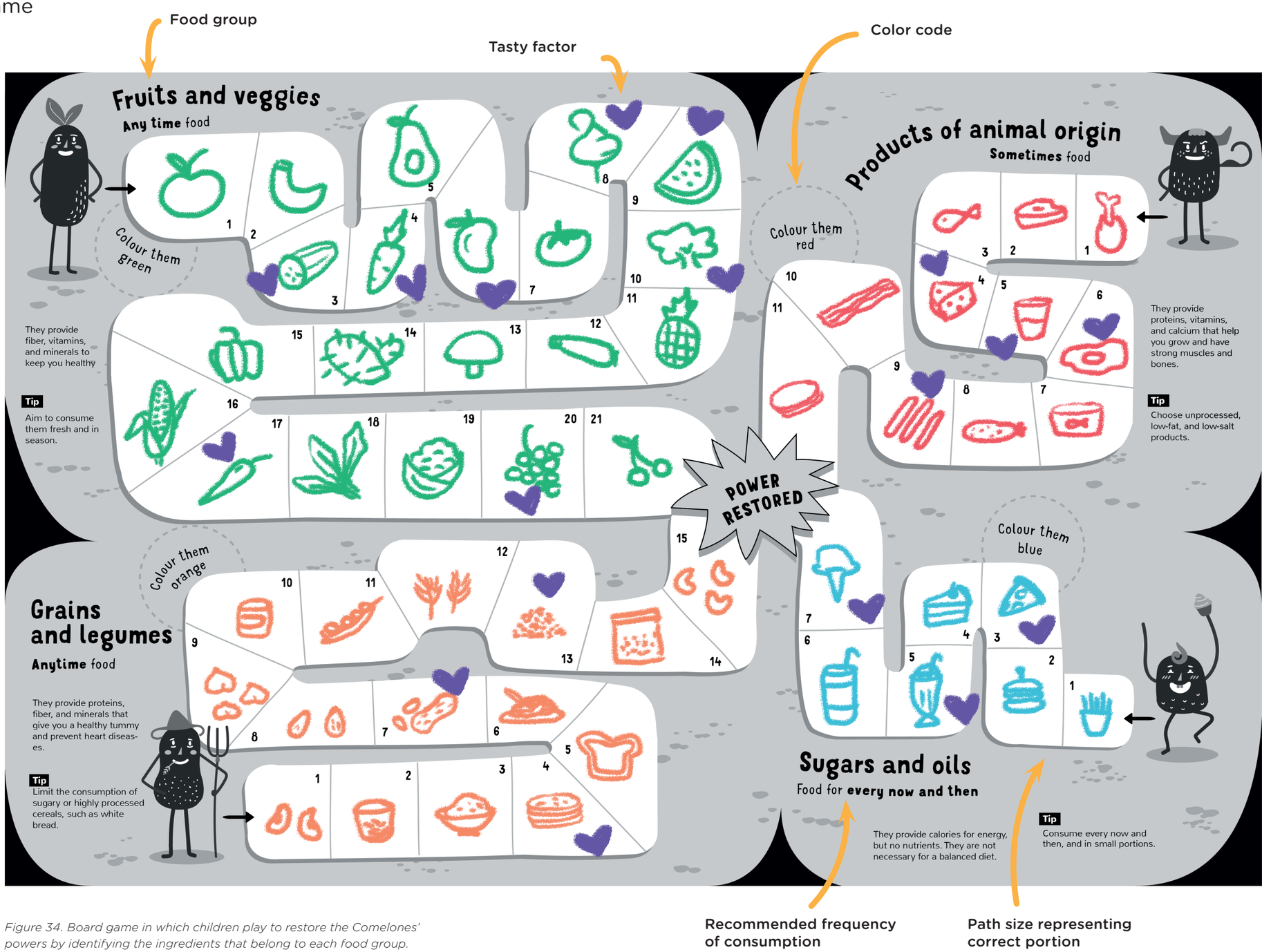


Figure 34. Board game in which children play to restore the Comelones' powers by identifying the ingredients that belong to each food group.

Game elements

Communication of portions
The path to restore the power of each character has a different size, which represents the proportion in which we must include each food group in our meals. This is also accompanied by the labels “Anytime food”, “Sometimes food” and “Food for every now and then”, which explain in a simple language that certain types of food are great on a regular basis, and some others we can eat, but not too often.

Figure 35. Each path shows the recommended portion for its food group.

Challenges
Six different challenges will be presented to the children for them to explore their surroundings in search for ingredients to fill in the board. Only after they solve one challenge will they be given the next one. By encouraging them to scout the places near them children can recognize the variety of food that is available for them, and hopefully, increase their interest or curiosity in trying new and healthier products than the ones they are used to.

Figure 36. Through different challenges children explore their context in search of ingredients.

Colour coding
As mentioned before, the use of colors in the design was a limitation due to its potential difficulty for some children to access. Thus, to enhance the connection between ingredients within each group, children are requested to use a designated color to draw all the products in a food group. This approach leverages the initial limitation into a strategy to build stronger associations.

Food group facts
Basic information about the main benefits of each food group are presented on the board, together with some tips that guide children to make better choices when having food from each group, like avoiding processed meat or highly-sugared bread.
Although it is out of the scope of the activity to provide in-depth information about food properties, it is important for children to grasp the importance of eating grains over sugars, so these brief texts support that understanding.

The tasty factor
An especially important element in the board game is the identification of the food with the “tasty factor”. From both the literature review and the research activities with the children, it became evident that kids follow their taste buds above anything else when making food choices. Adults are capable of restricting their consumption of fats or carbs when following a diet, or using less salt in their food to avoid health problems. But children mainly choose the food that “is very tasty”.

This should not be left out when educating children about healthy eating, and, in fact, including the tasty factor in one’s meals is a first step towards building a positive relationship with food.

Andersen and Hyldig (2015) studied the difference between physical fullness and mental satisfaction. They discovered, among other things, that people who did not fulfill their expectations through their meal or found it boring were more likely to seek for more food even if they are physically full. Nutritionists who follow approaches like Intuitive eating recommend patients to include elements you crave or enjoy in your meal, and balance it out with ingredients you should eat. This way, the eating experience becomes both filling and satisfying.

In this activity, children are encouraged to find the tasty factor in the ingredients that they found around them.

Part 2. Put food knowledge into practice: building their lunch

Objective
The objective of the second activity is to bridge the gap between knowledge and action when it comes to eating balanced meals. Through the use of a tool, children will begin to develop the necessary skills for making balanced food combinations.

Description
The second activity involves children crafting a balanced school lunch recipe. To make it more exciting, a surprise ingredient will be given to each student for them to integrate it to their meal. As a result, the class will have a collection of recipes that include a variety of ingredients, showcasing multiple examples of what they can do to keep their school lunches fun, tasty and nutritionally balanced at the same time.

To do so, they will use the second tool, which is a template that guides them at choosing the right amount of ingredients for each food group. Furthermore, by filling the template in, they will understand that integrating a variety of ingredients in their meals is not as hard as it sounds and that they can enjoy the process of experimenting with food. The last step is to draw how the lunch would look, and write down the recipe so other kids can recreate it. These recipes would be collected by the professor, compiled and distributed to parents as a recipe book created by the kids.

The design of this activity reinforces the concepts learned through the board game: food groups, portions and a friendly language that indicates which groups are “Anytime food”, “Sometimes food” and “Food for every now and then”.

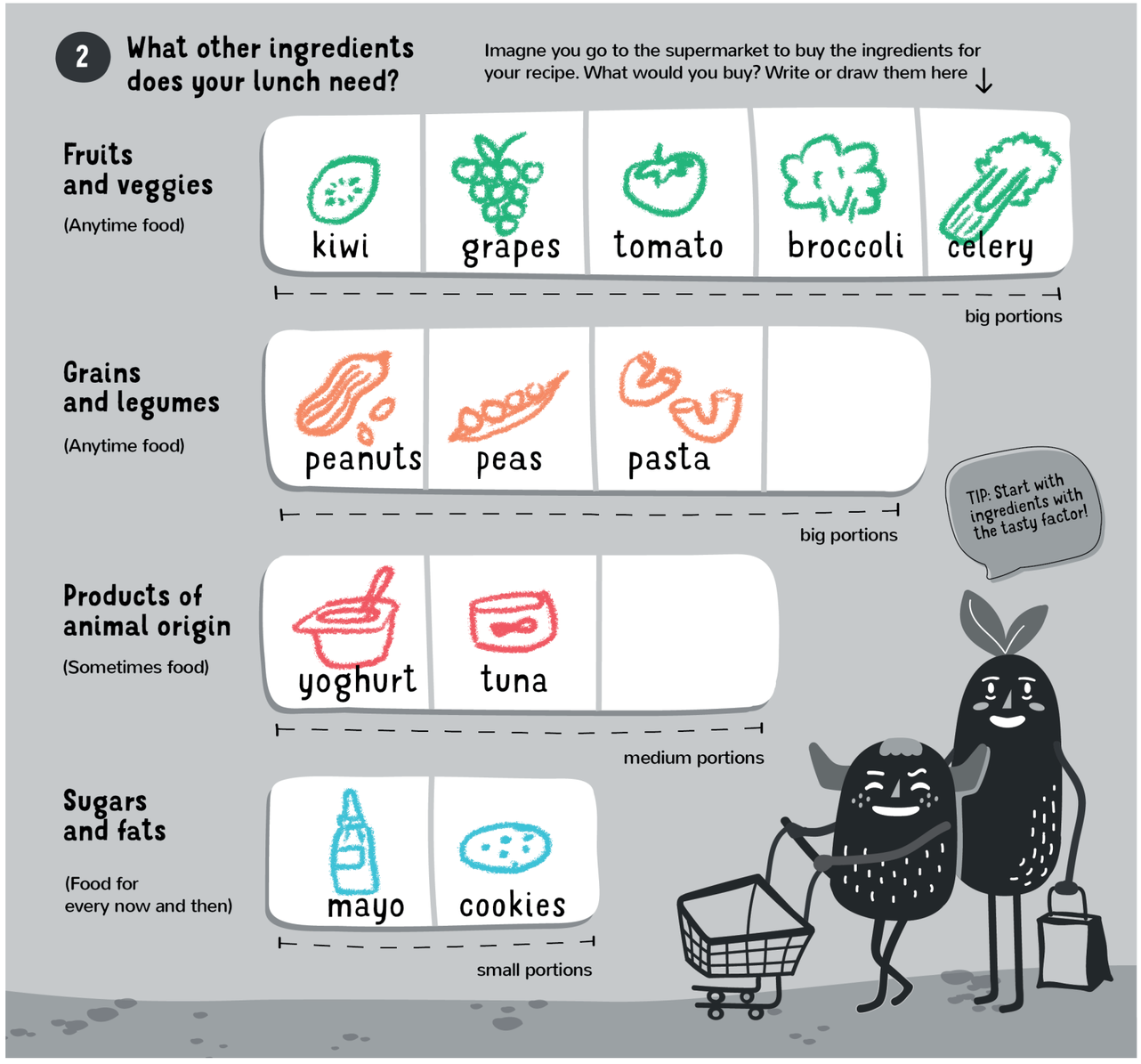


Figure 36. Abstract of the template to guide children in creating a varied and balanced school lunch. See appendix E for the complete version.

Compliance of design criteria and intervention functions

The design of the activities that comprise the school intervention were thought around the design criteria defined by the outcomes of the research phase, and the intervention functions defined through the Behaviour Change Wheel model. The following is a description of how the design's qualities relate to each of the previously mentioned criteria.

Design criteria

Comprehensively inform on available food options

Children can broaden their knowledge of food by means of exploration and social exchanges.

Develop positive associations towards healthy food

The language used to inform about portions, together with a non-restrictive approach, can motivate children to, for example, try healthy ingredients together with those they enjoy the most. The activity promotes tasty but balanced eating experiences.

Increase their self-efficacy in moderating their consumption of junk food.

Exploring their surroundings can increase children's knowledge of food, and having hands-on experience in combining "Food for every now and then" with other ingredients of different food groups can result in new skills. Increased knowledge and improved abilities empower children to apply these behaviours in the future.

Consider school staff as active participants in promoting healthier behaviours among children.

The adoption and promotion of a new language to refer to what is healthy and unhealthy can little by little break the negative associations children showed to have about food. Professors can play an important role in how children feel about what they eat and, therefore, in their eating habits, by discussing food in a more friendly and non restrictive manner.

Be cultural and context appropriate.

The activity allows each kid to explore their own particular context and identify the products that they have at reach. Therefore, not only the activity adapts to the Mexican context, but also to very specific areas where the activity takes place.

Be applicable in both primary schools, independently of their contextual differences.

By letting children discover the products that belong to each category by themselves, not only the activity is cultural and context appropriate to Mexico but also to the specific context in which the activity takes place. This makes the intervention highly scalable and adaptable.

Intervention functions

1. Education

The intervention promotes learning through play and exploration, with which children can increase their knowledge of both food and how to balance their meals.

2. Incentivisation

Storytelling, challenges and play are used to engage the children in learning about food. Additionally, the promise of having a recipe book with their creation in it can motivate them to create a lunch that complies with the recommendations for a healthy meal.

3. Modelling

Children not only are given examples and guidance on how to achieve a balanced lunch for their activity, but, by means of the recipe book that results from this intervention, they will have a variety of school lunches that are healthy and enjoyable for them to replicate, fostering the continuation of healthy eating habits. It should be noted that parents could also benefit from this outcome, since it will give them more tools to deliver healthy meals to their kids.

4. Enablement

The tools designed for children to use during the intervention are aimed to provide guidance so they can achieve the goal of creating a balanced lunch for themselves. If it has an impact on them, this practical intervention would qualify children to achieve the behaviour again.

5. Environmental restructuring

due to the complexity of the school vendors' system, changing the physical environment conflicts with established interests and social dynamics. However, the intervention promotes social interactions that support change in children's perception of food. Professors initiate a new way of communicating about food, knowledge exchange among peers is fostered, parents indirectly engage in the intervention through the game's challenges and as recipients of the intervention's final outcome, which is the recipe book. If the new approach to food pervades the child's social influences, their eating habits can potentially be redefined.

IX.

Evaluation

Design

When designing an intervention that targets a specific behaviour, defined metrics and parameters are used to evaluate how effective the solution is in achieving the desired change. However, to give an accurate diagnosis of its efficacy, the intervention has to be measured over time.

The timeframe allocated for this project does not allow to conduct such in-depth evaluation. Therefore, and to gain more varied impressions into how this activity could work, two strategies were applied.

First, a small group of children tested the final design facilitated and guided by a professor. Then, interviews were conducted with public primary school professors.

In this chapter, the insights obtained from both evaluation activities are presented, as well as recommendations following the observations.

Testing the activity with children

Approach

In order to evaluate the interaction and engagement children could achieve with the designed activities, 3 boys and 3 girls in a summer school context took part in the evaluation. The activity was facilitated by a professor, who guided them through it.

In a real case-scenario, before implementing an activity, professors would have a guide or manual that explains the dynamics to them and provides them with support materials to use during the session. To emulate this, a document was created where professors could find the objective of the activity, the instructions to facilitate it, and an example of the desired outcomes. No additional context or explanation was given to them. This to conduct the evaluation under real conditions, for both the children and the professor.

Limitations

The context of a summer school is very different from their regular classes at a primary school. In the former, children have the chance to do more outdoors and play-driven activities, which can affect the engagement they experience with the activity.

Due to the summer school's logistics, both activities were done in a single day. This means children did not have the chance to explore all the contexts that the challenges indicate, such as their home or the supermarket. Therefore, their understanding of the variety of ingredients that are available to them is reduced to what they know and what they can share with one another.

There was not enough time to explain in depth the concepts of food groups and portions to the children. Therefore, the objective of enabling them to configure balanced meals can hardly be achieved.

Results

Despite all the limitations to the study, children worked on both activities and new insights were provided:

- Out of the four food groups, children have the most difficulty identifying grains and legumes. This resulted to be hard not only for children but also for the adult facilitating the activity.
- The activity was conducted with children from 8 to 10 years old, because the facilitator expressed that younger children did not have enough space on the board for their big letters and drawings.
- From the participants, 8-9 year olds felt more engaged with the activity than 10 year olds. Also, girls showed more engagement to drawing and writing than boys, who wanted to go play.
- Even when girls were younger, they showed more knowledge of ingredients and integration of healthy products in their meals than boys.
- It was observed that, when building their lunch recipe, the template really guided them in the amount of ingredients they could add per food group. Most of them balanced out the sweets with a larger number of fruits and vegetables. But even those who did not add as many fruits and vegetables found a limit in incorporating more sugar-based products to their lunch, since the template only allowed for one or two.

Figure 37. Children at summer school testing the final design activity, guided by their professor.

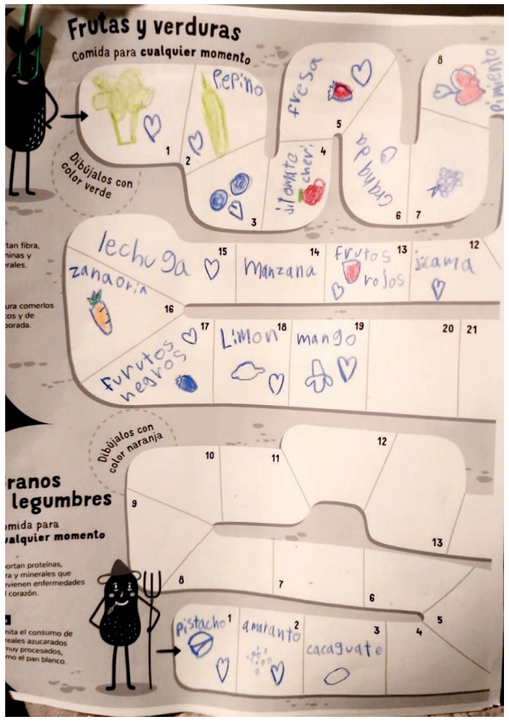


Figure 38. This participant showed a comprehensive knowledge of fruits and vegetables, but found it difficult to identify grains and legumes.

Recommendations

1. Use the initial story and the characters to help children make connections to ingredients in real life that can appear difficult to identify, such as the grains and legumes.

2. Adapt the format for different age groups according to their particular skills.

3. Promote exchange of information between peers at every challenge. This way, those that have little knowledge or struggle identifying food products will not get bored and drop the activity.

Expert interviews

Approach

For the second part of the evaluation, and as a means to address the limitations of testing with children, four semi-structured interviews were conducted with primary school professors with experience teaching at public institutions. These turned out to be quite insightful.
The participants received a small presentation on the outcomes of the study and the objectives of the designed activity. Then, they were asked to provide their considerations in terms of age appropriateness, perception of effectiveness, content, engagement mechanisms and learning approach.

Results

All participants showed positive reactions to the activity and perceived it as a novel approach in relation with the activities they currently use to educate children on this topic. They mentioned that the proposed activity fits well in the program of the “Healthy Living” course, and that it would increase the level of detail and effort professors would put in teaching about healthy eating.

Perception of effectiveness

Professors perceived the activity as more effective than the current “Plato del buen comer” model imposed by the government. They appreciated that children can start their exploration from the school context and expand it to a community level, and later bring their discoveries back to the school again. They mentioned that children usually get confused with the food categorization and the adequate portions for each food group, and that they believe this activity can make it easier for them.

Concerns were expressed about the timeframe in which the activity would take place. For some, the pace at which the activity must be done was not clear enough. Are all the challenges provided in a single session or in different ones? The last concern was the absence of a long term plan. Participants envisioned such an activity spanning a more extended period to better reinforce knowledge and encourage the intended behaviour.

Content

The content might have been the one aspect that professors liked the most. Firstly, the use of characters and storytelling to build on the explanations of the different food groups was seen as fun and engaging, and they even found potential for extending the story to explain aspects like the specific benefits each food group provides. However, they mentioned this specific storyline is ideal for use with children up to 10 years old, because older ones might find it silly or too childish. Secondly, they recognized the importance of the language shift, and even reflected about the consequences using restrictive words has had on children’s eating habits or even on themselves. Lastly, professors valued the clear intention to communicate portions, since they believe it is one of the most important things to teach children since they are little.

Appropriateness to the age group

All participants agreed that the activity would be more suited for children between 8-9 years old. This is not only because they already developed the required skills to do the activity, but also because it is a crucial age at which children start to become more independent and make their own decisions, including what food to eat. Professors mentioned that the activity seemed easy to adapt for both younger and older children by simplifying it or adding complexity, depending on the age. It was mentioned that, for example, since older children have some knowledge on the topic, it would be more engaging to use a powerful motivation that comes together with the activity, like solving a social problem.

Learning approach

The learning approach was found adequate. They mentioned the importance of being involved in the learning process. “When children are actively involved in the construction of their recipe or lunch, the topic has more relevance to them.” “Owning the process and the knowledge they generate gives them confidence and they get motivated.” “I think it is great and necessary that children explore to solve problems, but they will need someone prepared to guide them because they will have a lot of questions”. A participant shared that what matters the most is not that children know how to do something, but that they are able to explain what they did, why they did it and how they did it, since that gives opportunity for the creation of new and significant knowledge. She saw the activities fitting and supporting this ideal learning scenario.

Potential activities in relation to the game or recipe making

All the participants expressed the importance of two main things: Integrating parents in this learning process.
Having a space for children to actually prepare or share food at school.
In regards to the first point, they believe that, even if sometimes it is hard to achieve, making parents part of the learning process of this specific topic is crucial since they are the ones guiding children’s eating habits. They acknowledge the problem that lack of time represents for them, but suggested mechanisms to keep them interested and more participative in the school activities, such as knowing the purpose of what they have to contribute to, or receiving the final result.
Regarding the second point, and in contrast with what the professors from the schools that participated in the research phase said, encouraging a tasting activity at the school is essential not only for reinforcing learning but also for increasing the child’s commitment and interest in the topic. Tactics like cooking for someone else or sharing with the rest of the school is highly significant for children, so they pay more attention to grasp the content accurately.

Recommendations

1. Although instructions for professors are included in the final design, more guidance is needed as to how many days the activity can take, and what kind of content or material can support them in explaining the food groups.

2. For a lasting impact, it’s suggested to promote the behaviour over multiple instances rather than just once. Thus, it is beneficial to consider how the story or the materials can be integrated into a broader intervention.

3. For the current design, an audience of 8 to 10 years old was taken as a basis, and according to the feedback, the activities are appropriate for that age group. However, professors shared that educating younger children on this matter is highly important so they can develop better habits and a healthy communication around food over the first three years of school, before they become more independent. Therefore, the activity must be adapted to the skills of a younger age group by reducing the amount of information, increasing the space they have to draw and creating group dynamics so children can support each other.

4. Although during the research phase professors showed resistance to the idea of having a potluck activity because it compromises the parents’ time, the four professors that participated in the interviews agreed that it is very important to have it because of two reasons: on the one hand, experiencing with actual food can bring more long-lasting effects. Playing with food is a way for them to understand it, so providing this opportunity rather than just having them draw a lunch is essential. Also, through these activities, behaviours that are inherent to children can be leveraged, such as imitating what they see, which can lead them to try new ingredients when they see their peers doing it. On the other hand, sharing dynamics increase the commitment children have towards an activity. When they have to share, they want to get it right and feel proud, so they give their best.

5. Lastly, all four professors mentioned the importance of bringing home what was learned. Generating evidence that children can share with their families, or actively involving parents in the learning process can have an impact on the way they make food choices for their child. The recipe book was perceived as a nice addition, but giving them more participation throughout the activity can increase their interest and willingness to take part.

X.

Discussion and conclusion

Design

The goal of this project was to motivate Mexican children at primary school level to consume more healthy products and moderate their intake of food with high sugar and fat content.

Conducting such a project in this context presented many challenges and limitations along the way, including the lack of resources in public schools, the extended effect that social issues have in the school environment and the educational level (which was even more affected by the pandemic), just to name a few. However, such challenges brought interesting experiences that can be translated into valuable insights for future projects with a similar approach or in a similar context.

In this chapter, a discussion of the main learnings will be presented, as well as a more detailed description of the limitations.

Combining research approaches

While framing the project, involving children through generative research seemed like an interesting approach to get new and fresh insights that are unlikely to be found in literature. Although children and their eating practices have been widely studied, the specific conditions of the Mexican context could offer new perspectives of how to approach the problem. However, when talking about influencing a behaviour, children's views and opinions are not enough to formulate an effective solution, and that is why the use of a Behaviour Change theory was suggested.

The combination of the two methods yielded positive results. Using the Behaviour Change Wheel model to process the findings of the literature review provided structure to a phase that is often overwhelming. Getting lost in information is easy when starting a project, so using a model helped identify what was important and what was missing.
The structure of this initial research revealed there was a knowledge gap in the motivational aspects of the children's eating behaviours. Not only the model served to identify that gap, but also to understand the kind of information that was missing so future research activities could be designed around it.

Using Context-mapping to fill that gap proved to be effective, since expressing motivations requires a level of reflection that is hard to achieve with simple questions, especially when talking to children. Navigating the problem with the children through fun in-class activities revealed personal and collective determinants of children's eating behaviours, thus allowing for a complete overview of the factors that facilitate unhealthy practices in the school context.

Finally, integrating the insights from the Context-mapping sessions to the Behaviour Change Wheel structure provided guidance and a clearer direction for the design solution, since it shed light on the criteria a design solution should meet to be successful in promoting the intended behaviour.

In sum, combining these two approaches is recommended when non-observable determinants of a behaviour have to be understood to act upon them, such as beliefs, needs, plans, intentions or drives. Additionally, when context-specific information is required, using these two approaches and involving the people immersed in the place, culture and circumstances can unveil valuable perspectives.

Using co-design with children in low SES contexts

Creativity is an innate trait of humans that comes even more naturally to children. Therefore, it is easy to assume that they will come up with inventive responses and solutions to a given problem, or even imaginative answers to a simple question. However, creativity needs to be exercised, and the educational approach determined by the context can either boost or hinder the child's ability to freely explore their creative intuitions.

When using generative techniques to work with children in Mexico during the research phase, it was evident that most of them struggled participating. Some factors were identified as potential causes of this situation.

1. They are used to traditional educational strategies in which information is given to them, maybe in a playful way, but without encouraging reflection or problem-solving dynamics. Thus, they are good at following instructions and emulating actions, but show limitations when they have to solve a task on their own.

2. They have limited resources to explore the world. As mentioned in previous chapters, schools offer insufficient materials for children to work during classes, starting with a lack of a printer. This represents a barrier to children's creativity since it is constrained to basic elements that they can bring from home, such as colours or crayons, and occasionally "out-of-the-box" activities that take place as an initiative of their professors.

3. The lifestyle of a low-middle income family restricts the variety of activities children can be involved in, inhibiting their creative exercise. Parents work most of the time so they have little room for playing or engaging in family activities, leaving children at home watching TV or playing with their phones. Moreover, walking or playing around by themselves, outside of their house, is not an option for children anymore due to security reasons.

4. Language and cultural barriers showed up in simple activities like collages, where many students did not know what "collage" meant. This influences the understanding children have of the tasks that are given to them, which of course, affects the results of the study.

Some recommendations:

- When structuring the sessions, consider some time to explain the concepts you will use in the activity.
- Bring simple examples of the type of outcomes they are expected to produce, and have small warm-up activities so they can practice beforehand.
- Give more time to activities that involve creation, and later create a space for reflection. Foster critical thinking, but allow them to open their minds first.
- Validate the activities with professors, since they know the children and understand if the language used or skills required during the session are appropriate to their age and context.

The intervention design

Coming up with a final design was not an easy task, especially after learning about the limitations in terms of resources and staff support that had to be considered. However, it was possible to ideate a solution that not only adheres to the criteria defined by the theory, but also overcomes the previously mentioned constraints.

The Behaviour Change Wheel model was useful as a tool to go back to during the ideation process to validate roughly thought concepts. In the end, using this method made sure that the design, as simple as it seems, integrates all the qualities that an intervention requires to succeed in motivating better eating practices.

Although the conducted evaluation cannot provide certainty on how effective such an activity is in fostering that motivation, it does provide insights into the immediate efficacy of the tool in aiding children to explore the context and create balanced meals.
With this we can conclude that knowledge generation and practical experience are successfully provided by the design solution.

However, if we refer to the sustained impact, the design must be further explored. Providing children with one isolated experience is unlikely to achieve change in their behaviours. Thus, if the intervention was to be implemented, a long-term plan must be formulated. To do so, the same principles and intervention functions that were used to design the final solution for this project can be leveraged, taking into consideration that an intervention can be made out of different components that separately serve each of the required intervention functions.

The purpose of the final design was to provide professors with an example of the type of dynamics they can incorporate in their school activities around food to promote healthy eating habits. If these principles are applied throughout the experiences children have with food in the school context, they can become active agents in creating better relationships between children and food.

Limitations

Integration of stakeholders

The first limitation of this project was the lack of involvement stakeholders had in its development, especially professors. Due to time constraints and school logistics it was difficult to collaborate with teachers, which was crucial since they can play an important role in the way children interact with food if they commit to that cause. Although some perceive it is not their responsibility or place to tell children what to eat and what to avoid, that attitude can change by integrating them and their opinions in the initiatives that are proposed around this topic.

Testing the interaction

It was not possible to obtain an accurate conclusion of how children interacted with the activity because the conditions and the context in which children tested the final design were very different from the ones at a primary school. In an ideal scenario the assignment would take place over the course of a week so children have enough time to explore different contexts and collect, little by little, all the ingredients they can. After each task, professors would encourage reflection to reinforce their understanding of the subject.

Evaluating the effectiveness of the intervention

After the implementation, an evaluation of the effectiveness in the short-term could be conducted based on the activity outcomes, complementing it with an assessment of the following learning objectives:

- The student identifies the category to which a specific food belongs.
- The student understands in which proportion they should eat a specific type of food.
- The student is able to apply the categorization and proportion knowledge to food products they have around them.
- The student can create a balanced meal with the food they have at reach.
- Students can collaborate and exchange knowledge and experiences to complement their own.

Different activities can be done to assess the knowledge and skills they developed through the activities.

However, evaluating their motivation to develop a balanced diet is something that can only be looked at through time. If the intervention was to be extended for months or even a year, dietary patterns could be recorded at different stages to see if there is a difference in children's eating practices. Additionally, tools like the Intrinsic Motivation Inventory questionnaire can be adapted to the topic and used at the starting point, middle point and end of the intervention to compare the differences between children's answers on aspects like the perceived effort, value, or enjoyment of their food choices (Intrinsic Motivation Inventory (IMI), n.d.).

Conclusion

This project explores new approaches when addressing the problem of childhood obesity. On the one hand, it considers children as valuable sources of information, and gives them an opportunity to express themselves in regards to food. On the other hand, it uses a theoretical model to map out the context and guide design decisions.

The result was the definition of a guideline of the qualities and functions that interventions that aim to improve children's eating behaviours should follow to achieve that objective.

The resulting design principles are: to comprehensively inform on available food options, to develop possitive associations with food, to increase the child's self-efficacy in balancing their meals, to consider school staff as active participants in promoting healthier behaviours, and to be cultural and context appropriate.

The functions that the intervention should serve to be effective are: education, incentivisation, modelling, enablement and environmental restructuring.

By following the previously mentioned principles and functions, an example of a school activity was designed. This, with the purpose of assessing if it was possible to integrate all these characteristics in a simple but engaging solution that professors can use to promote active learning of how to create a balanced meal.

Through an evaluation with children it was proved that the tools are effective in mapping out the food resources children have at reach, and in increasing their understanding of how a balanced meal looks like in terms of the different food groups.

By means of interviews with professors it was proved that the proposed structure, learning approach, language and content are clear and found relevant by these stakeholders. They recognized the importance of addressing food from a new perspective that encourages positive associations. Furthermore, they saw potential in expanding the intervention to increase its chances of being effective in achieving change.

For the future, integrating tasting sessions at school and increasing the parents involvement should be explored as means to broaden the impact that such an intervention can have, not only in children's eating habits, but in their families' and communities'.

Thank you for reading!

XI.

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XII.

Appendix

DESIGN FOR our future

TU Delft

IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT
Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME
Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy".
Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name: Álvarez Villagómez
initials: G given name: Guadalupe
student number:
street & no.:
zipcode & city:
country:
phone:
email:

Your master programme (only select the options that apply to you):
IDE master(s): ( ) IPD (★) DfI ( ) SPD
2nd non-IDE master:
individual programme: - - (give date of approval)
honours programme: ( ) Honours Programme Master
specialisation / annotation: (★) Medisign
( ) Tech. in Sustainable Design
( ) Entrepeneurship

SUPERVISORY TEAM **
Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair: Rick Schifferstein dept. / section: HCD/DA
** mentor: Silje Dehli dept. / section: DOS/MCR
2nd mentor:
organisation:
city: country:
comments (optional)

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..

Second mentor only applies in case the assignment is hosted by an external organisation.

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

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Procedural Checks - IDE Master Graduation

APPROVAL PROJECT BRIEF
To be filled in by the chair of the supervisory team.

chair Rick Schifferstein date 21 - 02 - 2023 signature Rick Schifferstein - IO Digitally signed by Rick Schifferstein - IO Date: 2023.02.21 13:49:21 +01'00'

CHECK STUDY PROGRESS
To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: _____ EC
Of which, taking the conditional requirements into account, can be part of the exam programme _____ EC
List of electives obtained before the third semester without approval of the BoE

YES all 1st year master courses passed

NO missing 1st year master courses are:

name Robin den Braber date 24 - 02 - 2023 signature Robin den Braber Digitaal ondertekend door Robin den Braber Datum: 2023.02.24 15:08:37 +01'00'

FORMAL APPROVAL GRADUATION PROJECT
To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **.
Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: ★ APPROVED NOT APPROVED

Procedure: ★ APPROVED NOT APPROVED

comments

name Monique von Morgen date 06 - 03 - 2022 signature

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Personal Project Brief - IDE Master Graduation

A school-based intervention to improve children's eating behaviours — project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple.
Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 21 - 02 - 2023 23 - 07 - 2023 end date

INTRODUCTION **
Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

1.1 Background: Childhood obesity is a medical condition that starts children in the path to an unhealthy adulthood and potential comorbidity. In México, >34% of children and adolescents between 5 and 19 years-old have obesity, due mainly to insufficient physical activity and high caloric-intake. Moreover, factors like socio-economic status, area of residence and cultural beliefs play a determinant role in the prevalence of obesity in this country. (World Health Organization, 2021)
Studies performed in developing countries have linked school cafeterias with childhood obesity since they are an easy point of access to unwholesome food (Figure 2) (Gupta et al., 2012). Policies have been recently promoted by the National Ministry of Health of Mexico to regulate the distribution of prepared and processed food and drinks in school cafeterias. However, the implementation of these policies is slow, and schools are not always monitored and/or compliant (Pérez-Ferrer et al., 2018).
Within schools, the Ministry of Education has a program called "Escuela y Salud" (School and Health), coordinated at a State level. Its purpose is promoting a healthy lifestyle and informing about health related issues in Mexico, including obesity and malnutrition. In this program, professors have the task to educate parents and their children through talks and workshops. Additionally, they provide online materials such as PDFs, infographics and videos where they explain the benefits of having a nutritious diet and how to achieve it. Although it is an official initiative, studies have reported that not all professors are trained on the program and that its lack of structure causes inconsistencies or absence of its implementation. (EscuelaSalud - USEBEQ, n.d.)

Therefore, new strategies are needed to improve the quality of the interventions and make sure the intended effect is achieved, which is to impact positively on the children's nutrition.

1.2 Stakeholders: Stakeholders with high interest and influence in addressing childhood nutrition are mainly the Ministries of Health and Education both at national and local levels, and the policy makers that have power in regulating the distribution of ultra-processed and highly sugared foods. Stakeholders with high influence but low interest are the school canteens or cafeterias, and unhealthy food manufacturers, since conflict of interest might affect their willingness to contribute to improving the children's health. Finally, stakeholders with high interest but low influence are parents and teachers, who can make recommendations to the children but have no control over the environment and social influence that determines the child's decisions and behaviours (Figure 1).

1.3 Opportunities and limitations: Although regulating the environment is important to minimize the opportunities children have of accessing unhealthy food, little has been done regarding the children's interaction and relation with food itself. This is an opportunity because reflection and understanding can be achieved when involving users through experience, ultimately impacting their behaviour. Another opportunity when approaching the food topic in Mexico is the country's culture. For example, in the existing materials there is an effort to integrate the cultural context into strategies schools present to parents and children. Currently, economic and time constraints lead parents and their children to consume inexpensive filling foods (low-quality, ultra-processed products with high energy density) sometimes tailored and advertised for this target group. However, food culture can be leveraged in the communication and guidance provided to parents and children, since it is quite significant to the Mexican population.

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Personal Project Brief - IDE Master Graduation

introduction (continued): space for images

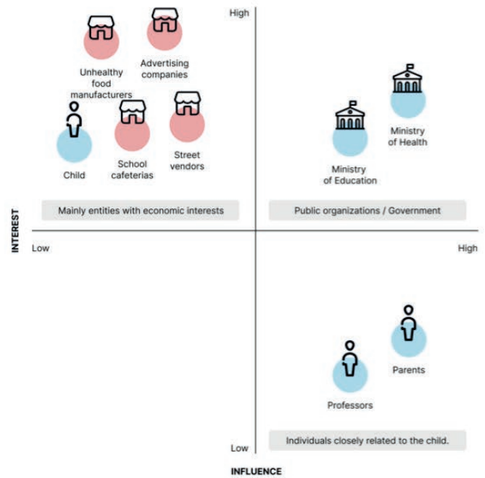

image / figure 1: Stakeholders involved in the children's nutrition

image / figure 2: Candy offer at school's cafeteria in Mexico

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Personal Project Brief - IDE Master Graduation

PROBLEM DEFINITION **
Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

Although obesity is the predominant condition Mexican children present due to unhealthy eating habits, this project's focus will be Childhood Nutrition. This, in order to broaden the spectrum of conditions and illnesses attributable to unhealthy eating, and to approach children in a more sensitive manner.
As described before, many elements in the existing context present improvement opportunities, for example, communication materials, the design of the School and Health program or the role of professors in promoting healthy habits. For this thesis project, the interaction between children and food found at school will be the main driver of the intervention, since it is a starting point for children to reflect on the effect their own food choices have on their health.

Thus, the goal of this project is to facilitate the children's understanding of what is healthy and unhealthy amongst their food options at primary schools, in order to encourage healthier food choices.

To do so , the project will cover the following research aspects:

1. Understanding of the children's context in primary-schools in Mexico and the key social, cultural and environmental determinants of the development of illnesses or conditions related to malnutrition. This will be achieved through literature review.
2. Behaviour analysis using to map out the factors that determine children's decision-making process when buying or choosing their own food. This will be achieved through the application of health psychology theory.
3. Identification of key aspects in the interaction between the children and food found at school that can be leveraged to influence their behaviour. This will be achieved through context-mapping.

ASSIGNMENT **
State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

Use psychology theory and generative research with children and professors in primary schools in Mexico, to find areas of intervention that promote healthy food choices during the interaction between children and food at school. Then, design an intervention composed by an element (product-based) embedded in the school environment, and a second element (content-based) integrated in the School and Health program.

The expected outcomes of this project are:

1. A report of the behavioural analysis, where determinants of the children's behaviour are specified, and the direction for the generative research is defined.

2. Materials designed to conduct generative research with children in the context of primary schools, together with a report on the insights obtained during their application. Here, interactions that should be later addressed through the design are specified.

3. A design concept that (potentially) includes a physical element(s) to be integrated in the school environment and a content strategy to accompany the intervention to be integrated in the School and Health program.

4. A report of the method used, together with the identification of key variables to consider for replicating the intervention in other primary-schools in Mexico.

5. Medisign specialisation: A description of the Medisign-related methods used, and how these reflect on the effects that the intervention has on childhood nutrition.

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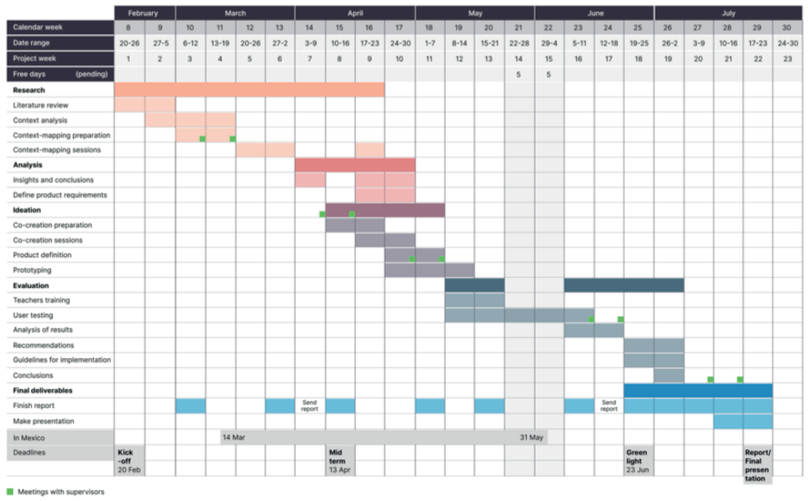
Personal Project Brief - IDE Master Graduation

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 21 - 2 - 2023 23 - 7 - 2023 end date



In the presented planning I illustrate the stages of the project. The first stage consists of individual research based on literature, which will serve as basis to prepare the materials and probes to be used in the contextual research. This will be done in site through context mapping, in which professors and primary school students will participate. Later, after analyzing the results of the context-mapping sessions, I will design and carry out co-creation sessions with the children as a means to define the qualities of the final design. Based on the children's input I will build a concept and prototype of the final solution which together with the professors, I will integrate later it in the school context to test it for a period of time (to be determined). Collaboration with professors will be key in the execution of this project, since they will be the link between me, the schools' guidelines, rules and environment, and the children.

My stay in Mexico will be a total of 11 weeks. Mexican schools go on holidays during two weeks at the middle of my research phase. This is why, I am reserving the last two weeks of my stay there as free days. This will allow for more flexibility in case the process is delayed due to logistics and coordination with the institutions.

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Personal Project Brief - IDE Master Graduation

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

My decision to study at TU Delft was based on two main factors. On one hand, the research-driven approach to design is unique amongst design schools and hard to apply in the professional environment (at least outside of the Netherlands). I was eager to learn design research skills that increased my abilities and opportunities to work closer to the people and advocate for their needs and goals in front of the business interest of product leaders out there.
On the other hand, while working back in Mexico, I found the possibility of contributing to make improve people's lives by designing in the healthcare domain. Thus, TU Delft's Medisign specialization convinced me this was the place I needed to be to gain a deeper understanding of the possibilities I could bring to the field as a designer.

During the masters I learned about context-mapping and co-creation, and how those two techniques not only allow for a better understanding of a context (research aspect) but also to empower the people who will be using our products, services or systems.
While taking the Medisign electives, I understood that health psychology is a tool we designers can use to conduct our process utilizing a theoretical background which supports us in taking design decisions.
These are only two of many examples of how TU Delft allowed me to achieve my two main goals.

However, while working on a project for the Gemeente Rotterdam, I gained a new passion: social innovation. Through this experience I understood that it is possible for designers to use our skills, within institutions, to bring forward change and transitions to futures that challenge our most complex social problems.

The project I am proposing for my thesis allows me to apply the aforementioned aspects: doing research while empowering the final users, using design to improve the health of a specific population, combining a qualitative method like context-mapping with a psychology theoretical framework and contributing, through public institutions, to the wellbeing of people who have been neglected by social, financial and political circumstances in my country.

Finally, my last motivation is bringing these specific design skills to Mexico and finding out how cultural and social aspects play a role in their application.

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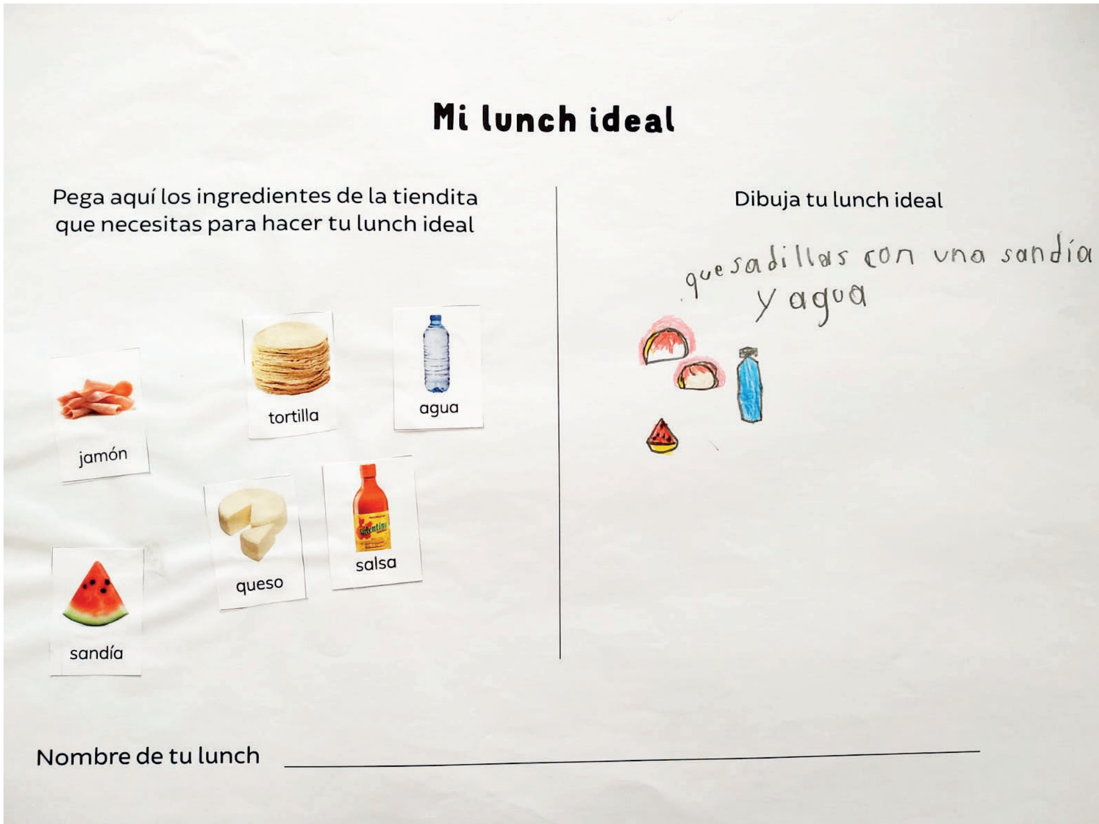
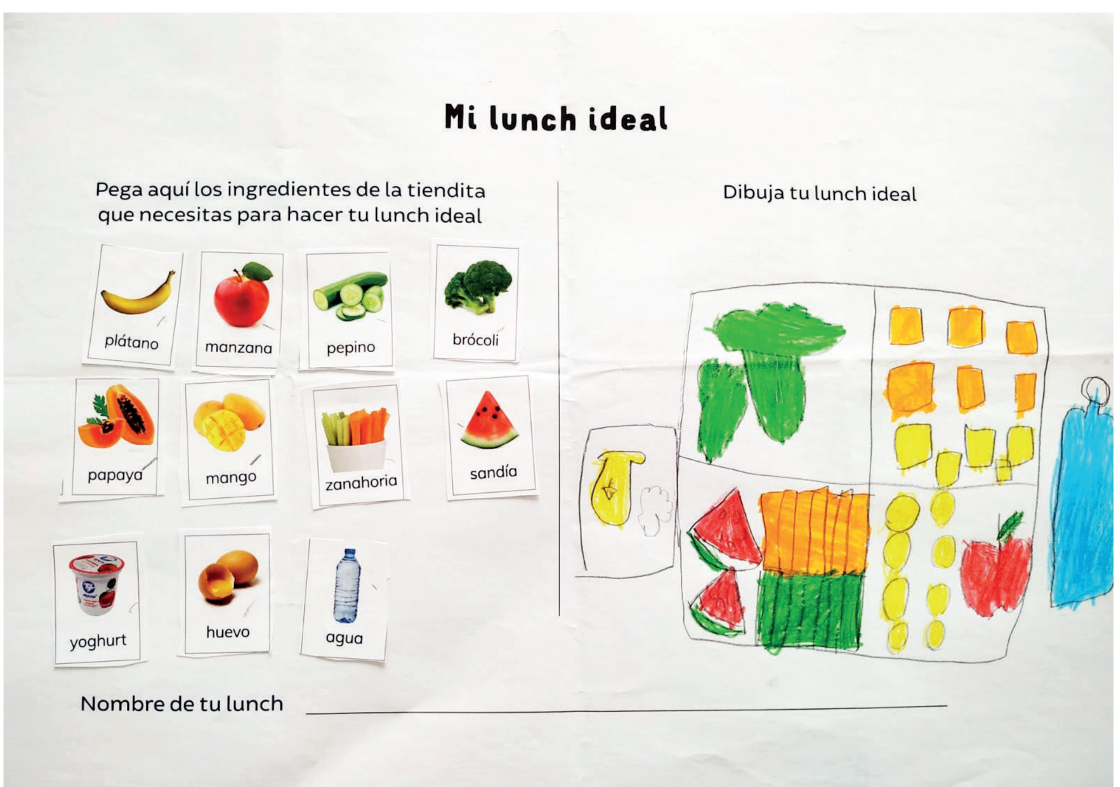
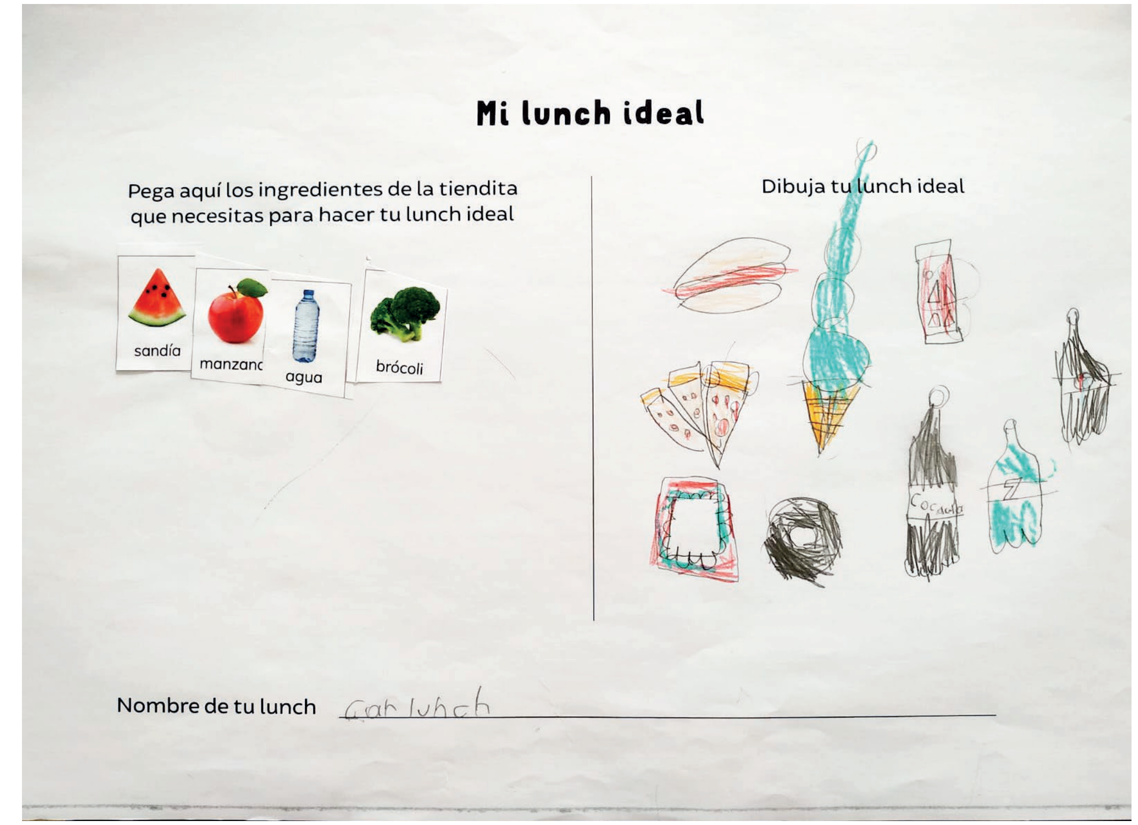
FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.


Mi lunch ideal
Pega aquí los ingredientes de la tiendita que necesitas para hacer tu lunch ideal
jamón
tortilla
agua
sandía
queso
salsa
Dibuja tu lunch ideal
quesadillas con una sandía y agua
Nombre de tu lunch


Mi lunch ideal
Pega aquí los ingredientes de la tiendita que necesitas para hacer tu lunch ideal
plátano
manzana
pepino
brócoli
papaya
mango
zanahoria
sandía
yoghurt
huevo
agua
Dibuja tu lunch ideal
Nombre de tu lunch


Mi lunch ideal
Pega aquí los ingredientes de la tiendita que necesitas para hacer tu lunch ideal
sandía
manzana
agua
brócoli
Dibuja tu lunch ideal
Nombre de tu lunch


Mi lunch ideal
Pega aquí los ingredientes de la tiendita que necesitas para hacer tu lunch ideal
salsa
papitas
agua
cacahuates
sandía
elote
yoghurt
leche
mango
queso
Dibuja tu lunch ideal
Nombre de tu lunch


Alimentación escolar
¿Cómo imaginas que debe ser tu entorno escolar para lograr una alimentación ideal?
¿Qué cambiarías? ¿Qué mejorarías? ¿Qué agregarías?
aprender
delicioso
saludable
sabiduría

Alimentación escolar
¿Cómo imaginas que debe ser tu entorno escolar para lograr una alimentación ideal?
¿Qué cambiarías? ¿Qué mejorarías? ¿Qué agregarías?
orden
calma
grupal


Alimentación escolar
¿Cómo imaginas que debe ser tu entorno escolar para lograr una alimentación ideal?
¿Qué cambiarías? ¿Qué mejorarías? ¿Qué agregarías?
orden
juegg

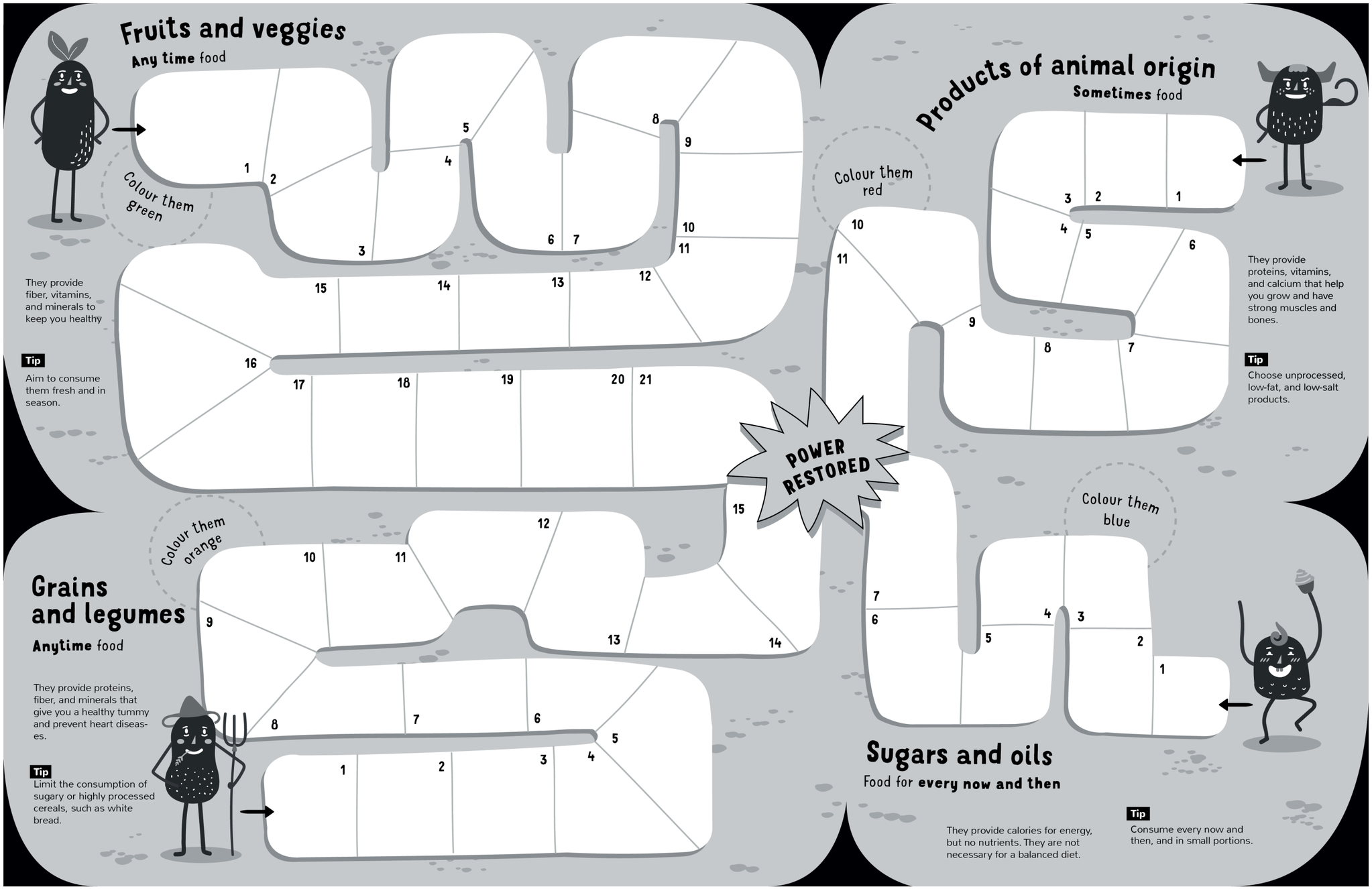

Alimentación escolar
¿Cómo imaginas que debe ser tu entorno escolar para lograr una alimentación ideal?
¿Qué cambiarías? ¿Qué mejorarías? ¿Qué agregarías?
entorno
saludable
calma
grupal
creativo
CASERO

Appendix C:
Data sample from Context-mapping analysis

I don't like zucchinis because when I eat them I feel like puking **The child associates zucchinis with feeling sick**	My favorite part of pozole is the corn. **Texture plays a role in the child's preference towards pozole.**	What do you like to eat at school? -At school, fruit. -And why is that? - Because it is very juicy. **Senses are important for the children's perception of taste.**	What do you do if you have to eat something you don't like? -I close my eyes, so I don't feel the smell. **Senses are important for the children's perception of taste.**
I like Coca Cola because of the flavor. -And if I ask Coca Cola or water? What do you prefer? - Water! **The child says he/she would decide for the healthy option even though his/her taste preference dictates otherwise.**	What did you include in your ideal lunch? -Two quesadillas. -And what else is inside your quesadillas? -Ham and cheese, my grandma prepares them for me with flour tortillas. **Some social figures can be influential on the children's food preferences.**	How come is egg your favorite food? - Because I like the juice when the egg pops. **Children enjoy different textures.**	My favorite is Oaxaca cheese because it is like tangled, so it is more fun. It is like gooey, I don't know how to explain. **The child associates interesting textures with food enjoyment, and it enhances his eating experience.**
Once I combined chips and jicama, and it tasted good. **Some children like combining the food they have at hand to create a new flavor.**	- Why did you shape your cookie like the Squid game one? - Because you have to make a shape without breaking the rest, otherwise you lose. **Most children relate food with play.**	-What would you eat first? - The fruit - Why would you eat fruit first? - Because it is more healthy. **Some children say they prioritize health when choosing what to eat.**	What would you leave for last? - The chips - Why would you leave them for last? -Because first one must eat the healthy food, and then the snacks. **Some children say they prioritize health when choosing what to eat.**
What are you drawing? - The fruit and the salsa **Some children like complementing sweet and spicy/savory flavors.**	If you put lime and salt and chili to the broccoli it is way better. **Some children use spice to "improve" the flavor of food they don't like.**	I drew my lunch bag because I don't like the food to combine. **Some children drew very organized lunch bags.**	What is your favorite part of your lunch? - The tacos - Why is that? - Because they are very tasty. **Some children base their food choices on taste.**
I created a biscuit with potatoes, salsa and cheese. **Some children like doing experiments with their food.**	I did the shape of hearts to mangos and strawberries. - Why did you do that? -I liked them. They look more fun. **Children enjoy playfulness in their food.**	What do you do if you have to eat tomato if you don't like it? - I give it to my sister. But if you add lime and chili it gets better. **Chili is a common ingredient that Mexican children use to enhance the taste of their food.**	I would put banana, apple, cucumber, broccoli, papaya, mango, yoghurt, egg and water. **Some children associate eating fruits with school, more than home.**
Once when I was sick my grandma told me to eat a piece of carrot, I didn't like them before, but I tried it and I liked the sound it made(...) I felt like a little bunny. **Some social figures can be influential on the children's food preferences.**	The fish because it has a funny smell and I think I don't like eating animals. -Me neither! **Smell and appearance are important for the acceptance children have of animal-based food**	What would you use the salsa for? -The chips, but also de mango. **Most children use chili to enhance their fruits and veggies.**	Do you think it's good to eat that much sugar? -No! (all) - It's not good because once I ate too much sugar and got constipated. **Children attribute illnesses to sugar (and fat) consumption because they know it is unhealthy, even if they are unrelated.**

Appendix C:
Data sample from Context-mapping analysis

-Those who eat with company, do you think it's boring to eat at school? - No! **Socializing during the lunch break is important for children to feel happy.**	Eating at school is fun because I talk with my friends **Socializing is important for children during lunch break**	Why do you prefer juice to water? -Because the juice is tasty, water is tasteless. Juice has more sugar! **The child associated his preference for juice to taste, and later to sweetness.**	Those who prefer water, why is that? - Because juice makes you more thirsty, and causes obesity. **Children are aware of the bad effects sugar has on their health.**
Eating at home is healthy because food is cleaner **Children perceive food cooked at home as more hygienic**	Boring, when there's beans. - And what would be a fun meal? - Meat! -Why is that? - It's more tasty **Children relate tastes that they like with enjoyment and fun.**	Comfortable because I can eat at a table and the couch - And where do you eat at the school? - Around the classrooms (because they have "guard") **The lack of a proper place to eat affects the children's lunch experience**	Calm, because you're not in a hurry like here (at school). **Children believe they have very little time for eating.**
Boring, because I don't do anything. -What would you like to do? -Play football. -Do you prefer playing than eating? -Yes. (another kid)-We all agree on that! **Children prioritize playing during their breaks.**	Entertaining because I watch TV **Children seek entertaining while eating**	Healthy because I don't eat greasy food. -At school you do? - Yes, because here I eat sweets. **Children seek entertaining while eating**	Chill because you can watch videos -What kind of videos do you like watching? -Tiktok, or comedy **Children seek for entertainment while eating**
Here (at school) it's not that unhealthy and in my house either. I eat fruit and my food and that's all. **Some children decide by themselves not to eat unhealthy food at school.**	At home it's fun because I can watch a movie on my phone or talk with my family. **Children seek for entertainment while eating.**	At home I don't feel observed, how I eat **Home environment makes children feel safe and comfortable compared to school**	I prefer at home because I can prepare my own food and eat whatever I want. **Children prefer having variety in their mealtime.**
It is fast, because they don't give us enough time. **Children consider they time they're given is not enough for eating and playing**	What do you guys do first? Eat or play? - On Thursdays I play first, because I'm assigned to the football court (for supervision). (...) But do you have for eating? -Yes! At the classroom **Some children prioritize play over eating if there's no time**	Loud, and dirty. Where we eat there's a lot of dirt, and kids run by and dirt falls over my food. **Children believe eating at school is not hygienic.**	Amazing because I get to eat with my friends **Children who have company have positive attitudes towards eating at school.**
Interesting because sometimes I try food I had never tried before. **Children like sharing as a way of trying new things and having variety in their lunch.**	Why do you share your lunch, for those who do that? - We share everything! -To try what others bring. **Children like sharing as a way of trying new things and having variety in their lunch.**	What does it mean to you eating at home or eating at school, and why? -At school it's a little junk food because there's juice and biscuits. And at home they give you fruits and vegetables. And where do you think it's more tasty? -At school! **Children know that the food sold at school is unhealthy, but they prefer it anyway.**	Who would like to have more time to eat? - 1 hour! -And what would you do in 1 hour? - Sleep! -15 minutes for eating and the rest, football. **Children like playing football, or activities in which they can run.**


Fruits and veggies
Any time food
Colour them green
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
They provide fiber, vitamins, and minerals to keep you healthy
Tip
Aim to consume them fresh and in season.
Products of animal origin
Sometimes food
Colour them red
1
2
3
4
5
6
7
8
9
10
11
They provide proteins, vitamins, and calcium that help you grow and have strong muscles and bones.
Tip
Choose unprocessed, low-fat, and low-salt products.
POWER RESTORED
Colour them orange
Grains and legumes
Anytime food
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
They provide proteins, fiber, and minerals that give you a healthy tummy and prevent heart diseases.
Tip
Limit the consumption of sugary or highly processed cereals, such as white bread.
Colour them blue
Sugars and oils
Food for every now and then
1
2
3
4
5
6
7
They provide calories for energy, but no nutrients. They are not necessary for a balanced diet.
Tip
Consume every now and then, and in small portions.

¡Let's create something yummy!

The best recipes will be published in a recipe book!

Our heroes need all the children to eat balanced meals to maintain their powers, but many don't know how to do it. Luckily you can help! Now that you now a variety of ingredients, you can create many exciting combinations!

Your mission To create a lunch school that...

- ✓ Includes the secret ingredient
- ✓ Includes ingredients of the different food groups
- ✓ But most importantly, includes ingredients with the tasty factor!

1 The secret ingredient

Write or draw your secret ingredient in this box →

2 What other ingredients does your lunch need?

Imagne you go to the supermarket to buy the ingredients for your recipe. What would you buy? Write or draw them here ↓

Fruits and veggies

(Anytime food)

big portions

Grains and legumes

(Anytime food)

big portions

TIP: Start with ingredients with the tasty factor!

Products of animal origin

(Sometimes food)

medium portions

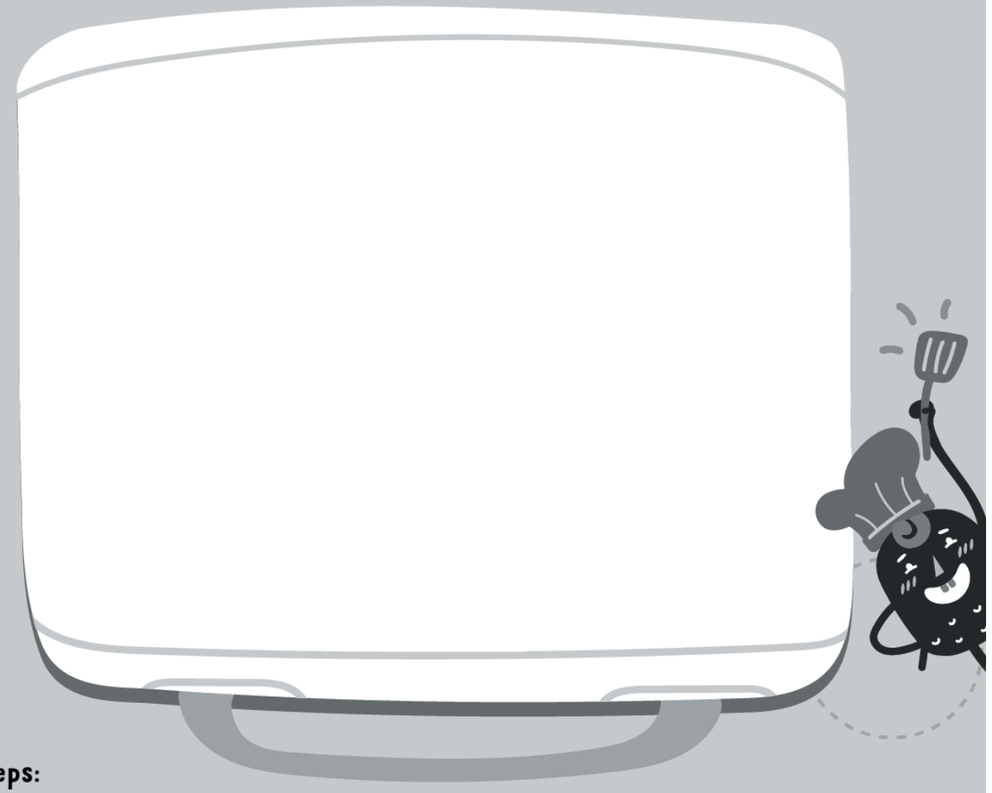
Sugars and fats

(Food for every now and then)

small portions

3 Create your lunch!

In this lunch bag draw the school lunch that you created. Afterwards, describe the steps to prepare it so more children can try it!



Steps: