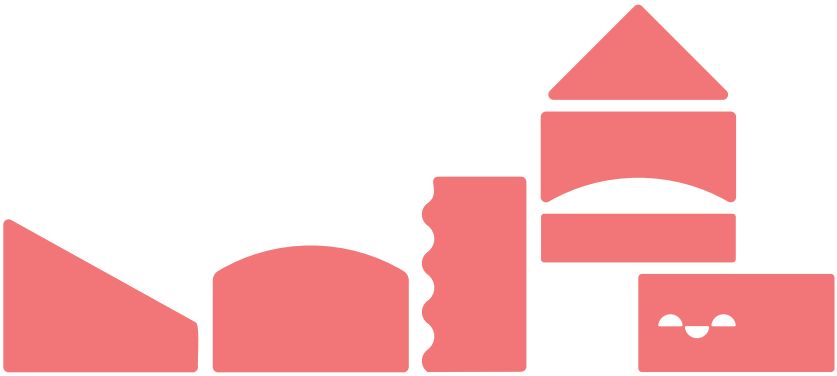
DESIGNING FLEXIBLE LEARNING SPACES FOR A POSITIVE IMPACT: THE CORK CASTLES SYSTEM

Final Work of Master
MBDesign: Master's Degree in Advanced Studies in Design: Contemporary Design
Universitat Politècnica de Catalunya and Universitat de Barcelona
Academic year: 2019-2020

Author: VEGA FERNÁNDEZ, Elena
Director: FORT MIR, Josep Maria



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ABSTRACT EN

Educating children is about providing them with the knowledge, skills and values that we consider they will need when they grow up and become active participants of the "real world". This Thesis explores how design can be used to create a positive impact on learning environments to make the learning experience of children pleasant and adapted to the latest pedagogical needs.

First, research on design's role in creating a positive impact, learning spaces and playfulness has been conducted; followed by the design proposal of Castellets de Suro, a modular open-ended system of cork blocks that invites children to create their own learning spaces.

The outcome of this project proves that Castellets de Suro (the cork castle system) has the potential to facilitate the adaptation of current learning spaces to the ever-evolving pedagogy that requires flexibility and contingency, is a source of fun, imagination and creativity for children and promotes collaboration and empathy. Therefore, this Thesis is an example of how design can improve existing learning environments.

Key Words: Education, Children, Learning Spaces, Design For Education, Design for a Positive Impact

ABSTRACT ES

La educación de los niños consiste en proporcionarles los conocimientos, las aptitudes y los valores que consideramos que necesitarán cuando crezcan y se conviertan en participantes activos del "mundo real". Esta tesis explora cómo el diseño puede utilizarse para crear un impacto positivo en los entornos de aprendizaje para que la experiencia de aprendizaje de los niños sea agradable y se adapte a las últimas necesidades pedagógicas.

En primer lugar, se ha investigado el papel del diseño para generar un impacto positivo y crear espacios de aprendizaje y de diversión. La segunda parte de este Trabajo de Fin de Máster consiste en la propuesta creativa de Castellets de Suro, un sistema modular abierto de bloques de corcho que incita a los niños a crear sus propios espacios de aprendizaje.

El resultado de este proyecto demuestra que Castellets de Suro tiene el potencial de facilitar la adaptación de los espacios de aprendizaje actuales a la pedagogía en constante evolución que requiere flexibilidad y contingencia, es una fuente de diversión, imaginación y creatividad para los niños y promueve la colaboración y la empatía. Por lo tanto, esta tesis es un ejemplo de cómo el diseño puede mejorar los entornos de aprendizaje existentes.

Palabras clave: Educación, Niños, Espacios de aprendizaje, Diseño para la educación, Diseño para un impacto positivo

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I would like to express my sincere gratitude to my Thesis' Director Josep Maria Fort Mir for his guidance and encouragement throughout this project.

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1

INTRODUCTION

This introductory chapter will explain the motivation that led to the planning of this Final Work of Master, as well as the purpose, justification, objectives and methodology followed to develop it.

Figure 1: Conceptual illustration of Castellets de Suro (2020)
Source: Author

1.1. PURPOSE

The purpose of this project is to investigate how design can be a tool to generate positive impact in the Education of children. The possibilities of design in shaping learning and playful environments will be explored to develop an artefact that promotes empathy, collaboration and creativity among children. The proposed system is called Castellets de Suro (cork castle system), a modular open-ended set of cork building blocks to be used by children aged between 3 and 11 years old to create their own learning micro-spaces.

1.2. MOTIVATION

The election of this particular topic is based on my personal interest in the area of design for Education and how it can be used to enhance the learning experience of children. The main motivation of this project is to deepen my knowledge on the value and reach of design strategies in Education and to understand its power to create positive scenarios. Additionally, the intention of this project is to apply the knowledge and skills acquired during the master's degree, as well as to demonstrate the acquisition of new knowledge related to this particular topic relevant to today's design industry; with the final objective of obtaining the degree of Master in Contemporary Design.

1.3. JUSTIFICATION

The relevance of this Thesis for the current design praxis is related to the fact that education is one of the United Nations' sustainable goals: Offering quality education is the basis to achieve sustainable development, as it improves the quality of life of the citizens of the future and offers them the tools for innovative solutions to respond to today's greatest problems (United Nations, 2020).

This project starts with the idea that the work of educational professionals is fundamental to achieve quality education, but it aims to explore this topic within the context of the creative industries and how designing for children can be used to generate positive scenarios in schools; and thereby improve the development of children. As points out María Acaso, teacher and researcher specialized in the area of Artistic Education, furniture and architecture have the potential of creating environments that foster critical thinking, creativity and independence, as opposed to traditional mainstream school design that is based on obedience and compliance (Acaso, 2016).

1.4. HYPOTHESIS

This project is based on the hypothesis that design and designers' skills can be relevant to the children's wellbeing and their academic experience. This Final Work of Master will conduct a research and develop a design proposal to explore how design can assist pedagogy to create a positive impact in schools.

1.5. OBJECTIVES

The intention of this project is to elaborate a holistic project on designing flexible learning spaces for a positive impact. The objectives are:

1. Explore what has already been discussed, researched and written on the topic of design of learning spaces and playful and flexible objects, and to present a clear and summarized overview of the published literature and some of the most relevant examples that have been produced by contemporary designers.

2. Develop primary research in Barcelona to complement the initial secondary research on the topic.

3. Expand this research by developing a design proposal that reflects the main ideas extracted from the investigation.

4. Draw clear conclusions on the influence of design in generating a positive impact on children's education and how Castellets de Suro can achieve that.

1.6. METHODOLOGY

The methodology of this project is to first gather literature and documentation on the intersections between design, education and flexible play, and then to propose a design that satisfies the needs encountered in the research. To this end, recommendations made by Roberts in *The Dissertation Journey : A Practical and Comprehensive Guide to Planning, Writing, and Defending Your Dissertation* and Eco's *How to Write a Thesis* have been followed to design the structure of this project.

A typical scientific method and format has been chosen to organize the study (Roberts, 2012). The chapters have been divided as follows: Introduction, Context, Designing positive impact, Designing learning spaces, Designing fun and play, Designing Castellets de Suro and Conclusions. As the purpose of this Thesis is to analyse the role of designers in an educational project, the most

relevant chapters of this project emphasize the notion of *designing*, and analyse step by step the different elements that form the title of the Final Work of Master: *Designing flexible learning spaces for a positive impact: the cork castles system*.

The first chapters include secondary research on the context and the key concepts of the topic and primary research to obtain a deeper understanding of the local environment in Barcelona. My preliminary ideas included gathering qualitative and quantitative data from children's interests, habits and needs by observing a teacher and their students, as well as organising workshops, co-creation sessions and product testings with them, so children are not only users of my artefact, but also testers, informants and design partners (Druin, 2002). In fact, I contacted several schools but due to the health crisis that started in March, first hand research with children could not be pursued, but obtaining primary data was still fundamental to deeply understand the design context and empathise with children. Fortunately, my tutor Josep María Fort was able to put me in contact with Pilar Ugidos, former director of Escola Miquel Bleach in Barcelona. Ugidos kindly accepted to help me and I interviewed her to collect primary data on the topic. Later in the process, Ugidos helped me again to test and obtain expert feedback on my design proposal. After this, I was able to produce the final design of Castellets de Suro and conclude the project.

1.7. LIMITATIONS

The scope of this project was limited as follows:

- COVID-19: The research was mostly affected by the coronavirus crisis, which led to having to modify several times the planning of the research. For example, the access to children was impossible for the whole duration of the project and for two months I only was able to consult papers and books published in online libraries, mass media and in-community newspapers.

- Time-constraints: This Final Work of Master was completed in 6 months, so this limited the dedication to the project. However, a broad understanding on the topic was obtained and a complete design artefact was conceptualized, pointing out the aspects that could be further developed in a prospective continuation of Castellets de Suro.

- Barcelona-based: Only one educational expert could be contacted in Barcelona. Future projects could aim to replicate this investigation and interview educators from different countries to provide a richer understanding of the topic.

2

CONTEXT

This chapter provides a contextual overview of the economic, cultural and social factors that make the discussion between design and education relevant for children's development and serves to understand the blurry role of design in schools. This will set the scene of this Final Work of Master and explains why it is useful and interesting to explore how design can be a tool to create positive impact for young children within an academic environment. It also includes a small picture on relevant projects developed locally in Barcelona.

Figure 2: Classroom, Feliphe Schiarolli (2017)
Source: Unsplash

2.1. EDUCATION & DESIGN

To understand the possibilities of Design for Education, it is necessary to understand what the current school model is. Traditionally, most educational institutions are shaped following a combination of two main philosophies, explains Bruce A. Jilk, author of the chapter "Place making and change in learning environments" from the book *Children's Spaces*. The first one originated during the Greek civilization, where the teacher, who was the keeper of knowledge, shared it with his students. During the industrial revolution and influenced by the Fordist mentality, this way of teaching aimed for efficiency and mass education (Jilk, 2005). Education was understood as controlling and disciplining children "in order to create pliant citizens who would fit into the new industrialized world; in short, education was to create factory fodder for mass production", explains Mark Dudek, editor of the book (Dudek, 2005).

MASS EDUCATION BASED ON EFFICIENCY

The second philosophy is based on the ideals of Modernist Architecture and Design. Following the concept of "form follows function", schools were built to ensure functional efficiency through great specialization and space definition based on their primary function (e.g. a classroom, a lab, a canteen, etc.) (Dudek, 2005). Each space of a school was (and often still is) designed to satisfy one specific function and therefore it is widely accepted that "learning is defined as something that is married to a 'place'", quoting Herbert Thomas, author of the paper "Learning spaces, learning environments and the dis"placement" (Thomas, 2010).

According to María Acaso, teacher and researcher specialized in the area of Artistic Education, this model is designed to ingest, vomit and forget information; to get bored in class, to deny the children's body and prevent any participatory and collaborative process in the classroom (Acaso, 2016). She argues that it is a model based on the learning of obedience, compliance and against the development of critical thinking, creativity and independence (Acaso, 2016). Rosan Bosch, founder and creative director of Rosan Bosch studio, a company specialized in designing learning environments, also believes that this type of environment has much more to do with discipline than with learning (Bosch, 2016).

During the last decades it has become evident that school buildings also should fit new types of activities, as the ways of learning are expanding. Brown and Long explain in the book *Learning Spaces* that "the emergence of the constructivist learning paradigm has led to a focus on learning rather than teaching." (Brown and Lond, 2020). "I never teach my pupils, I only attempt to provide the conditions in which they can learn" said Albert Einstein already 100 years ago (as quoted by Guayabero and Pérez, 2015). This change of mentality requires a different perspective on the design of schools, classrooms, furniture and other types of educational materials.

Learning environments should offer contingency, "that which is dependent on conditions or occurrences not yet established" (Jilk, 2005); in other words, flexibility to facilitate multiple learning strategies. Jilk highlights that to ensure a good education it not only has to be efficient (quantity measure) but also effective (quality measure). "Efficiency- or 'outcome'-driven learning environments become barriers to expanding the possibilities for learning and the creativity of learning" (Jilk, 2005).

In an interview for *El País*, Bosch explains how the current market is demanding professionals that are capable of thinking independently and can take the initiative without the fear of being wrong (Bosch, 2016). Nowadays, more and more repetitive and automatic jobs are being replaced by robotics and technology (Kelly, 2019) and the most important skills for the future of work are creativity, emotional intelligence, analytical thinking, active learning with a growth mindset, judgement and decision making, communication skills, leadership skills, diversity and cultural intelligence, technology skills and ability to embrace change (Marr, 2019). Bosch highlights the importance of designing learning spaces where this kind of development is possible and that provides children with the right set of skills for the real world (Bosch, 2016). From an economic perspective this implies that an investment in education is an investment to prepare future professionals with the skills that the market is requiring.

In parallel to the understanding that the "discipline and punishment" dynamic of the educational system does not fit the current market's needs, the idea of children slowly transitioned from the concept of "small adults" to "future citizen", strongly marked by the improvements of child labour laws during the last century. This understanding implies that children are different from adults. They are "creatures[s] of terrific potential" that become an inspiring symbol of futurity. (Johnson, 2012).

Indeed, this goes beyond the field of Education, and art and design writer Kimberlie Birks states that "to dismiss design for children as saccharine or frivolous is to overlook its significant potential and power. As children are often the nexus on our views of how to shape the world of tomorrow, the environments and objects that we design for them—and how they shift over time—become powerful markers of our evolving values. In a world that is changing ever more rapidly, how are we preparing our children for a future that we cannot predict?" (Birks, 2019). Birks is the author of *Design for Children: Play, Ride, Learn, Eat, Create, Sit, Sleep*, and she explains in an interview for Design Week that "our children are shaped by the things with which we surround them" (Birks, 2018). To think critically about the objects that shape schools and other learning spaces make us acknowledge its power to build their minds and environments. The collaboration between educators and designers is fundamental. An example of this is the work of the educational design consultancy The Third Teacher, that thanks to their

diversity are able to look at the whole picture: "the whole ecology of learning". They design learning spaces and use design thinking to strategise cultural, pedagogical and organizational change (The Third Teacher, 2020). Therefore, designing for children is a matter of social engagement with the society and our future.

When asked about the significant economic investments that most of the Rosan Bosch projects require, she says that the objective of her studio is not to create beautiful spaces but to contribute to change. For example, low-cost projects can be made by ordering furniture from local carpenters. There's no single formula, each school has to work to find its own. (Bosch, 2016). Regarding this factor, it seems interesting to mention the current "craft revival" phenomenon that we are currently experimenting with. As design critic Alice Rawsthorn explains in her book *Design is an Attitude*: the crafts, self-fabrication, and local production offer a pleasurable and empowering commitment to any cause (Rawsthorn, 2018). Hence the introduction of Design to an academic context can foster the origin of collaboration between schools and local creatives, craftsmen and local manufacturers.

CURRENT POLICIES, TRADITIONS, EDUCATIONAL STANDARDS AND THE INFRASTRUCTURES ARE DIFFICULT TO CHANGE

Reality is that there are many reasons to not expand the possibilities for learning. Current policies, traditions, standards and even the infrastructures are difficult to change, but learning should not be limited to a specific place: "We need to understand why we have put the current limits on our designs of the learning environments. Although learning environments have often been built with some physical flexibility, their basic design concepts are structured around a very narrow interpretation of 'school'. It is possible, however, to design settings for education that do indeed expand the possibilities for learning", explains Dudek (2005).

When talking about design with children, PhD and architect Roger Paez explains how design can help form autonomous, critically thinking children who will, in turn, become responsible and compassionate future citizens and he stresses the importance of playing, as it sets "a framework for radical exploration, celebrating openness, welcoming the unknown, embracing complexity and reacting creatively to chance" (Paez, 2019).

"The reason that I design for children is I am designing for people", says toy designer Cas Holman. She believes that good toys make good people and that designing toys is her tool for activism. Her goal is to "empower thinking outside of the archetype" of what playing is. "If we can give kids the tools to build confidence and have agency and understand how to be creative, empathetic, good people, then I thoroughly believe that they will make a better future for all of us. If we can play together, then we can live together" (Holman, 2019).

DESIGNING FOR CHILDREN IS DESIGNING FOR THE FUTURE

In summary, Design for Education (or generally for children) has the potential to positively impact their personal development but it can also be beneficial for the future of our society and culture. In the following chapter, a deeper research on design for positive impact, for learning and playing will be conducted to explore the concepts introduced in this chapter. Additionally, I would like to point out that within the field of Education the role of designers, architects and other planning professionals is always to assist students and teachers enhance the pedagogical expertise of educators.

2.2. LOCAL ACTION: BARCELONA

This subchapter will present a short collection of interesting projects that take place in Barcelona, showing a local interest in the benefits of Design for Education and some direct links with the topics explored in this Final Work of Master.

The first project is the "Tàndem Schools", an initiative promoted by Catalunya La Pedrera Foundation which encourages the collaboration between schools and institutions to bring innovation to the schools, by exchanging knowledge, experiences and pedagogical material with the institution. One of the main focuses of this project is the creation of learning environments through the transformation of classrooms, common spaces, passing spaces, and outdoor spaces to facilitate interaction and generate knowledge and life learning experiences; in short, make sites learning tools (Fundació Catalunya La Pedrera, 2020).

Escola Miquel Bleach is one of the schools in Barcelona that participates in this project by collaborating with the National Art Museum of Catalonia (MNAC). Together they work on discovering and using the possibilities that Arts offer to deal with any learning process and implement methodologies oriented towards research and project development in the classrooms. My tutor, Josep Maria Fort, was able to put me in contact with Pilar Ugidos, the former director of this school, who was in charge of making this partnership possible. As previously mentioned, she agreed to have an interview with me that you can find in the fourth chapter.

"Educació Demà" (Education Tomorrow) is an initiative from the Jaume Bofill Foundation that also aims to promote innovation with educational institutions in Catalonia. In 2017, they organised the "Hack The School" project in collaboration with ARQUIN-FAD (Asociación Interdisciplinaria de Diseño del Espacio del FAD (Fomento de las Artes y del Diseño), Interdisciplinary Association of Space Design from FAD association (Fostering Arts and Design)), cultural centre Santa Mònica and Architecture association El Globus Vermell. This goal of this collaborative project is to rethink school

spaces to improve learning and school coexistence. Thirty schools from Catalonia joined this initiative to redesign some of their spaces (e.g library, school playground, classroom, corridor, canteen, etc.) through workshops and co-creation sessions (Fundació Jaume Bofill, 2017).

The next project I would like to mention is one of the workshops that the Design Museum of Barcelona organizes for schools. "And why not? Objects, necessities and fantasy" teaches young students how design products have been produced based on specific needs. The goal of this workshop is to show them how design tries to improve our environment and the relationships and well-being of people. It is a fun introduction to design thinking, imaginative thinking and empathy with other people's problems (Museu del Disseny de Barcelona, 2020).

Another example that acknowledges the benefits of design is the "Plan for Play in Barcelona's Public Spaces". The city hall is currently developing a project to move from a city with play areas to a playable city by 2030. Its aim is to improve and diversify opportunities for play and physical activity in public spaces, due to the great benefits these activities have for children's and teenagers' development and well-being and for health and community life (Ecology Urban Planning and Mobility Area - Ajuntament de Barcelona, 2020). The current "superilles" found in different neighbourhoods of the city are part of this plan.

Lastly, I would like to mention that there are more than a hundred schools in Barcelona that opt for alternative pedagogies such as Montessori, Waldorf, Reggio-Emilia or project-based schools. The educational methodologies of these schools tend to be more open to the possibilities of design and architecture to improve the academic experience of students. It is also worth mentioning that most of these institutions are privately funded, as public policies tend to be held back in the traditional school model, explained in the previous subchapter. Nonetheless, this shows a growing interest in new ways of learning and hopefully public schools will be able to incorporate them in the future thanks to the collaboration between designers and educators.

3

DESIGNING POSITIVE IMPACT

The title of this chapter as well as the title of this project states "designing [for a] positive impact". What does this mean? What is to be understood by "positive impact"? Why is one of the objectives of this project to "design positive impact"? Is there such a thing as "positive design"? Through the next pages, these concepts will be analyzed to set a clear view on the role of design within the context of this Final Work of Master.

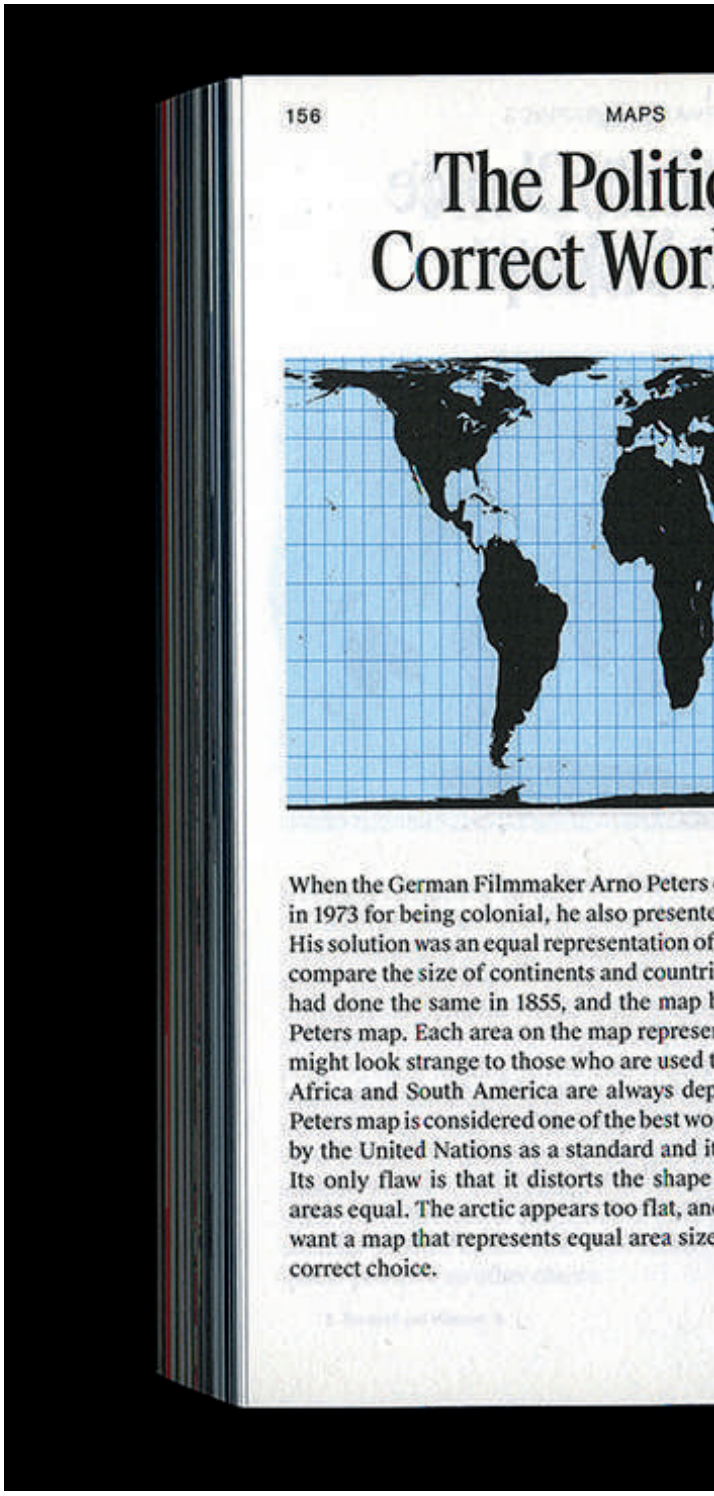
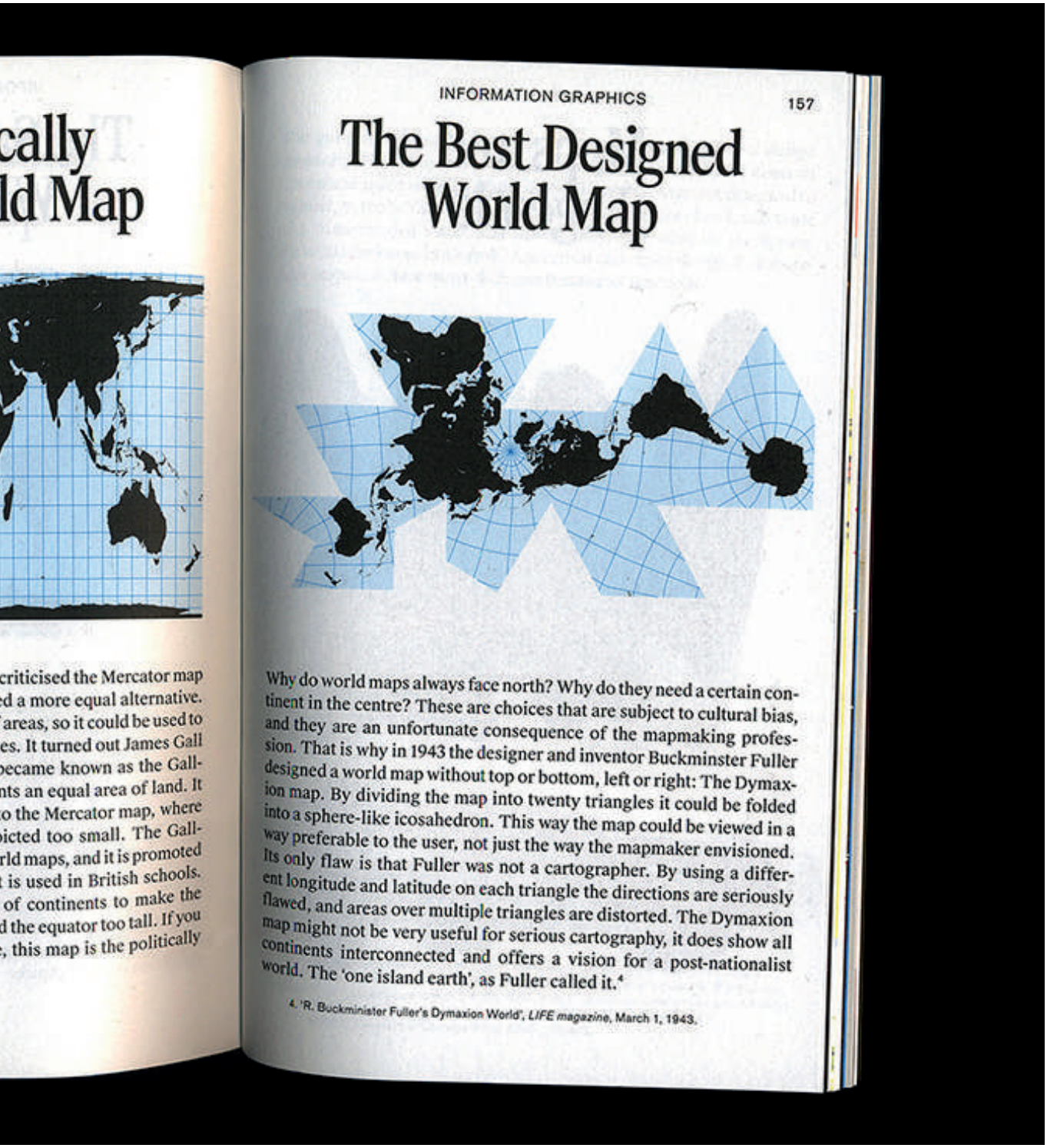


Figure 3: Spread of the book *The Politics of Design*, Ruben Pater (2016)
Source: Fonts in Use



DEFINING DESIGN

The definition and scope of design has been largely discussed by designers and academics since *design became Design*. Victor Margolin, Professor Emeritus of Design History at the University of Illinois, defined two kinds of design: "design with a small "d"—by his definition, what people have always created to satisfy needs and organize their environment—and Design with a big "D"—his word for the official term associated with mass production and mass communication that may be its closest association today". His view on Design as something that affects the "mass", makes it an activity that is central to the creation and development of culture. According to Margolin "design and its history is inextricably linked to past economic, political, and cultural structures" and cannot be understood as an marginalized artistics or aesthetic activity (as quoted by Heller, 2015).

Following this reasoning, designer and design educator Robert L. Peters states "design creates culture. Culture shapes values. Values determine the future." Both Peters and Margolin imply in their definitions that design shapes our sociocultural reality and has the potential to modify the future. Almost 30 years after Peters said his famous quote for the first time, in 2019 he added the following: "Design is therefore responsible for the world our children will live in." (Peters, 2019), highlighting again the potential of designing for children, even when you are not directly designing for them.

Òscar Guayabero, one of the editors of the book *Design for life: 99 projects for the real world*, reflects on how design can be a tool for social change and states that designers have the skills to generate social welfare. He explains that objects are the connecting point between our mind and reality and that designing is creating mediators that soften our relationship with the environment. He rejects the idea of the designer as an individual genius and supports the importance of empathy in the design process. Cooperation and bidirectional collaboration are key elements, as well as Papanek's idea of the "seed project" (Guayabero, 2015). The objective of this book is to show how design can improve the world and our lives.

DESIGN IS AN INSTRUMENT FOR SOCIAL CHANGE AFFECTING ECONOMIC, POLITICAL, SOCIAL AND CULTURAL SPHERES

The idea of design as an instrument for social change was strengthened during the Modern Movement and Bauhaus, when designers looked for simplicity, functionality and efficiency in their products. Decades later it was the Ulm School of Design who continued this endeavour. Otl Aicher, one of the founders of Ulm, wrote in his book *The World as Design* that design is "free of the personality cult of art. design is there for everyone, not for the few and certainly not for individuals." (1991). Aicher believes that design is meant to be copied and reproduced, something that can be accessed by everyone and should not be understood as something élitist. Wolfgang Jean Stock, author of the introduction of this book, says that "design

means relating thinking and doing." It is about connecting the products, its form and aesthetics with ethics and social, cultural and ecological considerations. "The world is defined by its design condition. Modern civilization is one that is made by man, and therefore designed. The quality of the designs is the quality of the world" (1991). Therefore, designers, businesspeople and engineers should work together as they are equally responsible for the design of the world.

Other relevant figures from Ulm like Max Bill, Gui Bonsiepe and Tomás Maldonado also reflected on the social value of design. For example, Bonsiepe believes that design has the potential to abolish the inequalities of the world (Guayabero, 2015). But the greatest exponent of social design is Victor Papanek: In short, he states in his famous book *Design for the Real World* (1985) that design has to satisfy the needs of all people and the planet to be responsible and sensitive with its environment. Without going into further details, this provides us with a broad understanding of social design and the creative responsibility of designers.

DESIGNING POSITIVE IMPACT IS CONNECTED WITH DESIGNERS' CREATIVE RESPONSIBILITY

The cover of this chapter is a spread of the book *Politics of Design* by Ruben Pater, who questions the work and responsability of designers. In this image, two world maps are shown: the first one is the traditional politically correct map of the world and the second one pictures the accurate way of representing the world (Pater, 2016). Why is Europe in the center? Why is the North on top? Design decisions made centuries ago shape how we picture the world today.

As shown, designing positive impact is connected with designers' creative responsibility. Design activism is apparent through diverse approaches to well-being. Alastair Fuad-Luke, designer, researcher and Professor at the Free University of Bozen-Bolzano (Italy), talks about co-design, eco-design, sustainable design, user centred/experience design, universal/inclusive design, slow design, open-source design, service design, empathetic design, cooperative design and metadesign when he defines design as a "giver of well-being" (Fuad-Luke, 2007). It is not the purpose of this chapter to describe the difference between these approaches, but naming them serves to provide a simplified picture on a growing conversation of how design can offer something to society in terms of economical, environmental, socio-cultural and/or individual well-being.

It seems redundant to have to point out that the discipline of design will obviously not solve the world's major problems, but of course designers can put their creative skills into "good use" and "do more than make things pretty. Design is more than perfume, aesthetics and trends", as said by the founder of Architecture for Humanity and the annual conferences *What Design Can Do* (Van der Laken, 2015).

Figure 4: Poster of the What Design Can Do conference (2017)
Source: What Design Can Do

Similarly, Papanek said that "in a world of abject want, a preoccupation with only making things pretty is a crime against humanity". But then he adds "But to design things that work well but fail otherwise is an equally fundamental error [...] Man needs structures and tools that are enriched beyond the severely utilitarian. Delight, balance, and that pleasing harmony of proportions that we project outward into the world (and are told to regard as the eidetic image) are psychological necessities for us" (Papanek 1985). Papanek clarifies that advocating for a design that is socially and ecologically responsible is compatible with the aesthetic and associational enrichment of products, as these considerations provide another type of value. "All designed objects are propaganda for a way of life", would say Alain de Botton (as quoted by Birks, 2018).

Some current examples of designing positive impact or for good are Arquitectura Sin Fronteras, that works to ensure decent habitat for people around the world, circular business design agency Regenerative Design founded by Jan Leyssens, product design studio Better Future Factory, AIGA's Design for Good

initiative; Anthropocene.Design, an NGO offering design solutions for public problems; IDEO, a design company that focused on offering positive impact through design; or the Utrecht Manifest, a biennial cultural event focusing on social design. This event was launched in 2005 and was concluded in 2015 with the publication of *Design for a Good Society* (by Victor Margolin, Bart Lootsma, Ed van Hinte and Max Bruisma), a collection of interviews and essays urging the design community to use their skills for good and follow the visionary ideas of William Morris, Walter Gropius and Richard Buckminster-Fuller. And this goes without mentioning the boom of open-source design initiatives risen during these last months to produce 3D printed masks, gowns and healthcare equipment to fight the COVID-19 crisis

With these ideas in mind, the purpose of this Final Work of Master is to use design as a way of thinking and to develop new opportunities within the field of Education. It will explore how design can be used as a tool to improve learning spaces and enhance the Education of children and develop a design proposal with simple good intentions to start a conversation on the role possibilities of designers in learning environments.

4

DESIGNING LEARNING SPACES

This chapter has the objective of summarising an extensive body of existing knowledge that academics, designers and other professionals have discussed with the aim of understanding the purpose of design within learning environments and the requirements that products and spaces should cover to ensure a positive learning experience. Designing learning spaces can be understood as the spatial design of schools, classrooms, playgrounds, but it also includes the products and tools that generate the correct environments where children can feel safe and ready to learn.

Figures 5: Sant Elia Nursery School, Giuseppe Terragni (1937). Source: Ellen Harris

Figure 6: Liceo Europa, Rosan Bosch (2016). Source: Rosan Bosch Studio

4.1. INTRODUCTION TO LEARNING SPACES

As analysed in the Context chapter, the current educational model is swifting from a *teaching* perspective to a model where *learning* is the core activity of schools. This change of paradigm questions the role of the teacher as well as the role of the traditional classroom, but still views learning as something that is linked to a specific place. This place includes the "indoor and outdoor areas, buildings, the architectural design of landscapes, buildings and rooms, fixed installations, furniture and other removable artefacts, as well as elements that contribute to the aesthetic design of the institutions" (Løkken and Moser, 2012). This definition comprises the concept of materiality, the physical qualities of these spaces, but also the people's experience, adding an individual and subjective dimension to the term that refers to the sensory and experiential dimension of things. Considering that "learning always happens within emotions and moods", the materiality of the space shapes these emotions and moods, through "light and shade, sounds, temperature, breezes, distances, proportions, routes, transitions, and so on", explains Jorge Raedó, researcher and art teacher (2019).

LEARNING SPACES ARE NOT LIMITED TO THE WALLS OF A CLASSROOM

Herbert Thomas argues that "if 'learnings' are emergent properties of learning spaces and learning ecologies, then the position of learning space planners becomes invidious" (Thomas, 2010). This idea offers the possibility to designers and architects to reconsider classrooms as spaces for learning, says Brown and Long, authors of the chapter "Trends in learning space design" from the book *Learning Spaces* (edited by Oblinger), but also to view informal spaces as potential learning environments. Their perspective is that learning spaces provide environments for people. As nowadays we have more access to new technologies, content and resources, this has led to a growing interest in "active learning, formative assessment, social engagement, mobility, and multiple paths through content" (Brown and Long, 2020). Students are now participants, instead of receivers and spaces can act as catalysts of learnings based on interactivity, multiple roles (as a participant, the student can be listener, critic, mentor, presenter, etc.) and social engagement (collaboration, group work, debates, etc.) (Brown and Long, 2020).

The school's environment is fundamental to complement "the educational and social support of pedagogy". Design values children's needs and "forms a lasting impression on the users" (Dudek, 2005). The chapter "The school building as third teacher" by Eleanor Nicholson from *Children's Spaces* explains how children are conscious of the symbolic messages that school spaces can transmit: from big, old and damaged buildings to small and cozy spaces. She believes that "fine child-centred programmes can exist in less than wonderful buildings. Conversely, rigid, unjust, cold and insensitive programmes can take place in state- of-the art buildings. [...] the school building is,

THE SCHOOL BUILDING: "THIRD TEACHER"

and should be a player." Formal and informal learning spaces are the "third teacher" and observing these spaces allows us to reflect how students learn, what they learn and how they are taught, but it also shows what is considered important and deserving of respect: Nicholson states that schools also have impact in the children's life experiences and that any decision on how a school is implies "someone's judgement about what's important for children" (Nicholson, 2005). "Good spaces tell us where we are. Sometimes they even whisper where we have come from and where we are going. They are the symbol of something that transcends our daily lives" (Raedó, 2019).

Sant'Elia Nursery School in Como, designed by Giuseppe Terragni in 1937, is one of the first examples of schools designed considering the learning needs of children from a Rationalist perspective. Crow Island School in Chicago, built by Eliel and Eero Saarinen and Wheeler and Will Perkins (1940), with furniture by Saarinen and the Eames, also incorporated modern ideas to its design: the spaces were envisioned as flexible, multiple activities can be performed in the same room and the teacher can be the "choreographer" of these activities, as explains Lange in an interview for *Bloomberg* (as quoted by Kolson Hurley, 2018).

Figures 7 and 8: Sant Elia Nursery School, Giuseppe Terragni (1937). Source: Ellen Harris & Platform Blog

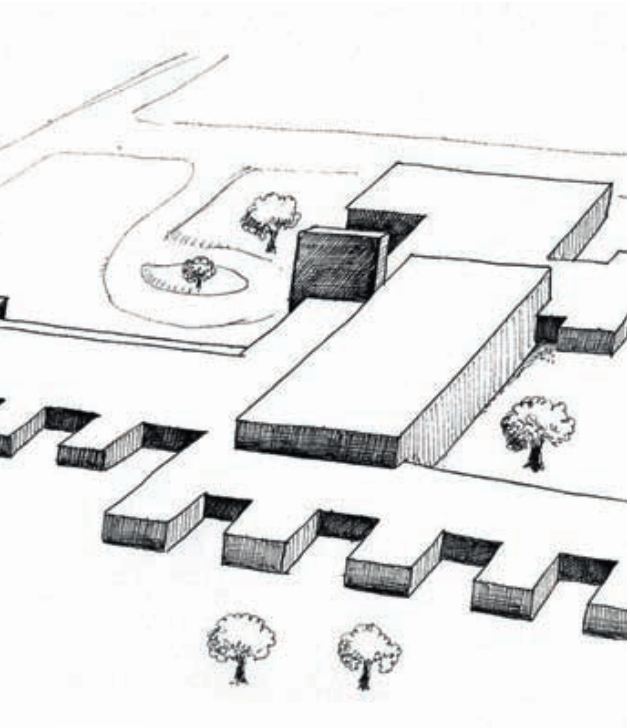


Figure 9 and 10 Crow Island School, Saarinen and Perkins (1940). Source: Classhaus & Neil Gislason

With this in mind, it is clear that how we design and furnish the spaces where children will learn will have a direct impact on their learning experience, in terms of academic success but also reflected in the students' wellbeing, motivation and comfort in these places.

4.2. CHARACTERISTICS OF LEARNING SPACES

After understanding the value of a proper implication of designers and architects, this subchapter aims to gather a series of recommendations and key concepts on how Design for Education should be according to experienced designers, researchers and academics.

It seems evident that designs for children need to be durable, cleanable and safe, as Birks explains, but she equally highlights the importance to be an invitation for imagination, where children can create their own worlds. Her experience showed her that designs should be open-ended, adaptable and not entirely prescriptive, they should engage and exercise their bodies and minds through motion (Birks, 2018).

DURABLE, CLEANABLE, SAFE, IMAGINATIVE, OPEN-ENDED, FLEXIBLE, INCLUSIVE SPACES

This idea of open-ended designs is closely related with the previously explained concept of "contingency". Designing with flexibility and versatility in mind allows the users (students and teachers) to re-use learning spaces while the activities and learning strategies advance, as Jilk points out. Contingent design is sustainable by

increasing the longevity and flexibility of the products (Jilk, 2005).

David Thornburg defines that every school should include four ideal spaces: the Campfire, a space meant for collective reading; the Watering Holes, where children can discuss and debate; the Caves, a quiet area to foster reflection; and the Life, where students can share their learnings with others (Torres Menárguez, 2016). His research findings are used by Rosan Bosch as design principles. It seems interesting to mention that her studio recently produced a *Wonder DIY* cardboard kit to recreate these elements at home while children cannot attend school due to the current health crisis.

The involvement of educators in designing learning spaces is very important as they are the ones that will be daily in contact with the spaces and children. Autens, a Danish education consultancy, has ideated Learning Space Design Labs for educators, which allows them to co-create learning spaces with architects and designers. They invite teachers and students to a series of workshops to develop a collaborative design project. Autens believes that "one innovative teacher might improve their classroom layout and culture, but this is unlikely to have a long term impact on the learning culture of the school. For lasting impact and meaningful change, the whole school community needs to play an active role in changing the culture and design of learning spaces" (2020). It is a very interesting proposal as the intention is to co-create a purposeful, joyful and unique learning culture. The results of these Labs are fluid designs where spaces are "dynamic tools for pedagogy, didactics, learning and well-being" (HundrED, 2020). Autens is aware that not every school can (re)design their facilities, so they have also developed Design Lab LITE, a solution for small-scale spaces (one classroom or area for up to 50 students) that teachers can use with smaller budgets.

Figure 11: Cave at Liceo Europa, Rosan Bosch (2016). Source: Rosan Bosch Studio

Figure 12: *Wonder DIY* Cave, Rosan Bosch (2020). Source: Stykka

This is an excellent example that illustrates the importance of being able to re-imagine existing spaces and that shows as well that the impact will be different if a teacher or the whole school staff is involved in it.

JISC's (British not-for-profit company supporting institutions of higher education and research) suggest that these spaces should be flexible, future-proofed, bold, creative, supportive to all learners and enterprising (as quoted by Thomas, 2010). The author adds that learning spaces should be malleable and almost fluid and make sure that the skills envisaged for the workforce of the future, such as critical thinking, are included in the design strategy; but he also mentions the importance of mystery, to make learning spaces enchanting or "the perception that entering the setting would lead to increased learning, interaction or interest" (Thomas, 2010).

Another remarkable design consideration is *metacognition*, where the learner can actively assess his/her own learning, by creating places that "encourage and enable this self-assessment with the instructor's guidance" (Brown and Long, 2020). This philosophy gives students and teachers direct ownership of their learning spaces and the role of designers and architects is to assist them by offering them the right tools to be able to build their own environments. Indeed, "one size may be adequate for all, but it's not particularly good for any given learning activity. Learning spaces in the 21st century need to foster discovery, innovation, and scholarship, not simply contain them" (Brown and Long, 2020). Students and teachers should be engaged and be capable of adapting the space to their needs.

4.3. ALTERNATIVE PEDAGOGIES' VIEW OF DESIGN

While it is clear that the role of Design within learning spaces is changing and offering more adapted solutions to the current pedagogical needs, most traditional educational institutions still perform their functions in outdated buildings, with inflexible designs. On the other hand, alternative pedagogies embrace design as a powerful tool of the learning development of children, from small toddlers to teenagers.

For example, Montessori is a scientific pedagogy created by Maria Montessori in the 20th century based on an education that focuses on the stimulation of the autonomy, self-esteem and self-confidence of children. It is an individual-oriented education. Audrey Migliani, architect, urbanist and researcher on spaces design for children at the Universidade São Judas Tadeu (Brazil), explains that the schools that follow this educational model are designed with a philosophy based in simplicity, minimalism, organization, accessibility, security, silence, soft materials, ergonomy and decoration inspired

Figure 13: Montessori pedagogy - Preescolar Beelieve, 3Arquitectura. Source: ArchDaily

Figure 14: Montessori pedagogy - Montessori Kindergarten, ArKa. Source: ArchDaily

Figure 15: Waldorf pedagogy - Yellow Train School, Biome Environmental Solutions. Source: ArchDaily

Figure 16: Waldorf pedagogy - Escola El Til·ler / Eduard Balcells + Tigges Architekt + Ignasi Rius Architecture. Source: ArchDaily

SPATIAL STIMULATION TRIGGERS MENTAL STIMULATION

in nature, animals and people (Migliani, 2020). Montessori schools acknowledge that spatial stimulation triggers mental stimulation.

Another example is the Waldorf pedagogy, introduced also in the last century by Rudolf Steiner. This model embraces an anthroposophical philosophy. Briefly, it is an "holistic approach to the human being: feelings, imagination, spirit, and intellect are considered unique to every individual, and thoughts, feelings, and actions are understood to always be linked" (Migliani, 2020). Waldorf schools ensure the freedom of movement and exploration of the environment through its design. Warm tones are used for spaces where active and festive activities take place and cold tones for concentration and focus areas. The geometry of the space and elements shift from organic shapes to firmer, angular lines over the years: e.g classrooms for older students where abstract concepts are taught require stronger contrasts. The sense of community and home is very important, as schools are understood as an extension of it. Flexibility is also very important as most of the learning is very dynamic. Find in the previous page visual examples of Montessori and Waldorf schools.

These alternative pedagogies were pioneers in moving from traditional unarticulated classrooms (rectangular room, rows of desks facing the blackboard, where the teacher is static and always the focus of attention, unidirectional transfer of knowledge) to articulated, versatile classrooms, with nooks and niches to work in, spaces for individual concentration and shared collaborative areas, explains Herman Hertzberg in *Spaces and Learning* (2008). We are increasingly seeing traditional schools follow suit and try to flexibilize their classrooms to accommodate different types of activities. This can be achieved by making the classrooms more articulated through its design, for example by creating non rectangular spaces or including furniture that can build multiple centers of attention; or by colonizing corridors or domesticating exteriors, in other words by decentralizing "the hegemony of the classroom as an autonomous bastion" (Hertzberg, 2008). For that reason it makes sense to talk about "learning spaces" as something inclusive and not restrictive to the boundaries of a classroom.

In the next page there are two examples of non-alternative schools embracing the benefits of design: The first image is from a kindergarten in Nagasaki (Japan) designed by HIBINOSEKKEI + youji no shiro. A variety of niches can be found in the premises with the objective of integrating learning and playing in different environments. The second image is the SolBe Learning Center in Boston (USA); the architects from Supernormal designed the school by combining two types of spaces: Dwelling (classroom) and Yard (open area). These pairs of spaces offer particular spatial characteristics appropriate for the quality and level of the activities performed within them. Soft lightning and colours are used to create a sense of calm and wonder in the classrooms. The Dwellings

are like quiet islands in an open-floor plan of playful and lively Yards. "This oscillation between focused learning and free-play territory reflects the innovative curriculum, creating space that is sensitive to the needs of children as they transition through growth stages and times of the day," explains the studio to Dezeen magazine (as quoted by McKight, 2019).

Figure 17: OB Kindergarten, HIBINOSEKKEI + youji no shiro (2015). Source: Designboom

Figure 18: SoCal Learning Center, Supernormal (2019). Source: Dezeen

4.4. CONVERSATION WITH EDUCATION EXPERT: PILAR UGIDOS

INTERVIEWEE

Pilar Ugidos is the former director of the Miquel Bleach public school in Sants (Barcelona). She has a large experience working in the field of education and cultural inclusion and while working at the Miquel Bleach school she started the "Tàndem Schools" project together with the Catalunya La Pedrera Foundation in 2013, in which the school partnered with the National Art Museum of Catalonia (MNAC).

This collaboration brought art and artistic heritage closer to children to achieve educational success. Together they discovered the possibilities of learning through art and how to implement it through classroom methodologies based on research and project-based learning (Fundació Catalunya La Pedrera, 2020).

The school joined this project because a large number of their students have foreign origins and the "Tàndem Schools" initiative facilitated them a contextualised learning strategy which is ideal for newcomers with comprehension difficulties, she explained to *El Periódico* (Benavides, 2016). As a consequence, the students improved their academic performance and the school was awarded in 2015 with the prize "Ciutat de Barcelona" in the Education category.

Check Annex A: Pilar Ugidos' Profile for more information on her experience and the importance of her interview for this project.

Figure 19: "Tàndem Schools" activity at the MNAC museum (2016). Source: Blog MNAC

INTERVIEW

Our interview was held via video-call, for which I prepared a series of open questions about learning spaces and her expertise in managing the Miquel Bleach School. The contribution of Pilar Ugidos to this Thesis was extremelly valuable as interviewing her provided direct insight into the experience of educators and first hand qualitative information to understand how spaces shapes the learning experience of children. The interview diversified the type of data collected, enriching and corroborating the research of this Thesis (Davies and Hughes, 2014).

LEARNING SPACES ARE PSYCHOLOGICAL AND PHYSICAL

Pilar Ugidos explained that a learning space can be understood from two perspectives: The first one is the psychological, where emotional and affective wellbeing needs to be covered to create an optimal personal situation where children can feel safe and ready to learn. For Ugidos, the coverage of the children' psychological needs is fundamental. The second perspective views learning spaces as something physical and tangible: in most cases, it is the classroom or the whole school, but it can also be understood as any territory where some kind of learning takes place. Covering the physical and emotional needs of children generates the proper environment where they can focus on learning. Therefore, these two perspectives of space are interdependent. Ugidos pointed out that usually they are better overseen in private schools.

She mentioned how during her work as school director she was able to observe the importance of the physical component of learning spaces and particularly the aesthetics of schools. In her opinion, the aesthetics of the whole educational experience/ service can influence children's happiness. At school, she witnessed how often children lack contact with beauty and this indirectly influences how they play, relax, learn and reflect. Ugidos stressed how everyone has eyes and hands to feel their surroundings. Accustoming children to the broken and deteriorated implies that their identities will be conformed to that.

Her job also involved managing budgets and she explained that many times, when she was finally able to get money to improve the school, she encountered teachers that didn't know what to do with it. She thinks this is due to a mentality of conformism and inertia. Teachers accept that what they already have is everything they can get and she adds that the ones that requested new equipment were unambitious, only capable of asking for little things. Accustomed to having little money, they are scared to ask for big improvements. Therefore, the teachers' lack of interest in improving the learning spaces directly affects the children's wellbeing in the school.

Ugidos said "spaces define our minds" and children need physical emptiness to be able to fill it with their own experiences. She observed that often teachers stored everything in their classroom

CHILDREN NEED PHYSICAL EMPTINESS TO BE ABLE TO FILL IT WITH THEIR OWN EXPERIENCES AND LEARNINGS

(e.g. old material from the previous teacher that taught in the same classroom) and did not leave any room for the needs of upcoming students. Giving students the freedom to build their personal environment is imperative. The protagonists of the school should be the students and space should stimulate their curiosity.

Ugidos stresses that homogeneous classrooms do not exist and she suggested that to take into account the invisibilized students is fundamental. To include the children with fewer possibilities ensures a global education that anyone can benefit from, giving the same opportunities to everyone.

At the end of our interview, we talked about my ideas for my design proposal and she agreed that versatile, inclusive and flexible elements offer a lot of great possibilities to build learning spaces based on collaboration and teamwork. She highlighted the importance of investing in high-quality products and long-lasting materials that can be reused and preserved. Indeed, a few years ago she organized the remodelling of the school's playground, she developed deep research on good companies specialised in playgrounds and now that the school will be relocated to another building, one of the few things that they will be able to reuse is this equipment.

In conclusion, our conversation gave me a deeper comprehension on this topic and made me understand the role of aesthetics in generating meaningful emotional and physical learning spaces. It showed me the social potential of including all children in creative activities, from artistic initiatives such as their collaboration with MNAC to my design project. Finally, I would like to add one of her reflections from her participation in "Debats d'Educació" that sums up very well what I have learned from her: "Tomorrow's school must be joyful, creative, beautiful. It has to be bright and always open. Few walls and many spaces to meet, to dialogue and to "do" together" (Ugidos, 2013).

"TOMORROW'S SCHOOL MUST BE JOYFUL, CREATIVE, BEAUTIFUL. IT HAS TO BE BRIGHT AND ALWAYS OPEN. FEW WALLS AND MANY SPACES TO MEET, TO DIALOGUE AND TO "DO" TOGETHER"

(UGIDOS, 2013).

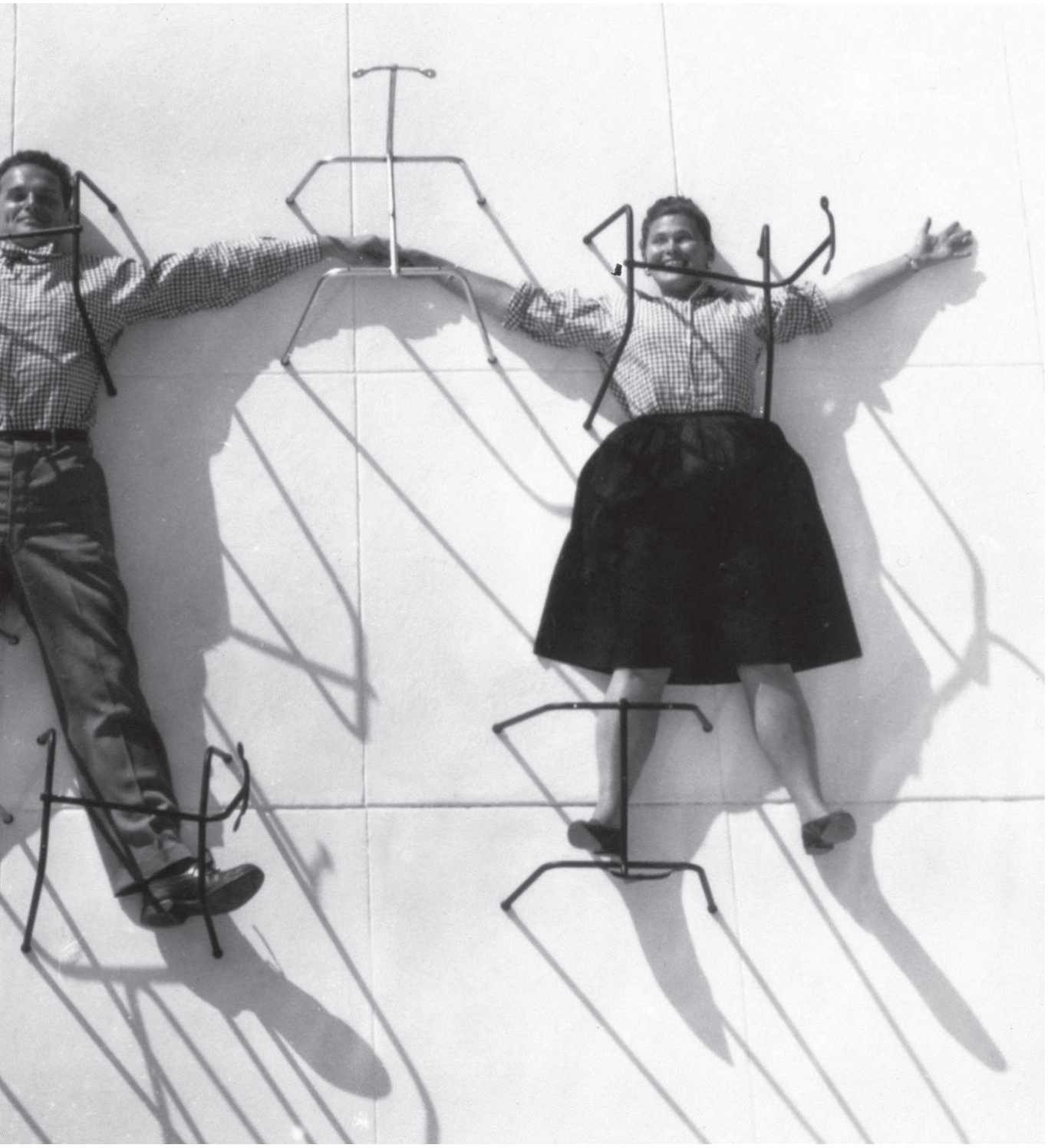
5

DESIGNING FUN AND PLAY

Even if the design of children's toys, products and spaces is often overlooked in the design history books, a quick overlook on the work of many renowned designers and architects shows that they were deeply interested in this area of design. Gerrit Rietveld, Marcel Wanders, The Eames, Marcel Breuer, Kengo Kuma, Jean Prouvé, Alvar Aalto, and Philippe Starck, among many others, were attracted to the design for children not only because its playful and imaginative nature, but also because children design was (and is) a "testing ground for prototypes and technological advancements, albeit at a smaller scale" (Birks, 2019). Their experimentation with children products paved the way for some of their most iconic designs, as we will see in the following pages.

This chapter aims to present a broad overview on playful design, educational toy design, contestatory design and popular materials for children.

Figure 20: Ray and Charles Eames with chair bases.
Source: Emes Office LCC



5.1. CONTESTATORY DESIGN

Before entering into the topics of playfulness and educational design, the term of contestatory design will be explained to provide a general understanding of the idea of designing with the purpose of flexibility and with the intention of offering fun open-ended products to the users. Indeed, this term was firstly used to describe a children's chair, another example of how the design of children's products is used as a prelude of bigger design explorations.

Contestatory design is a term coined by Emilio Ambasz referring to objects with the potential to create environments that were "flexible in function and [permitting] multiple modes of use and arrangement" (as quoted by MoMa, 2012). Ambasz uses this concept to explain the *Chica Chair* (also called *Junior*) designed by Jonathan De Pas, Donato D'Urbino, Paolo Lomazzi and Giorgio DeCurso. This chair is "a modular system of plastic components that can be fitted together in a variety of ways to create seats, tables, and play structures. The elements, made in four bright colours, are light enough for older children to play with and reconfigure, in a product that exemplifies the fun, flexible spirit of Italian postwar design" (MoMa, 2012).

Prototypes of the chair were displayed in *Italy: The New Domestic Landscape* exhibition (curated by Ambasz) in MoMa in 1972 as an example of "objects selected for their formal and technical means", characterized by the experimentation of new synthetic materials and production techniques, such as molding (Ambasz, 1972). A similar chair was also part of this exhibition: the *K4999* children's chair by Marco Zanuso and Ricchard Sapper, manufactured by Kartell. This chair originated as the result of an experimentation with polyethylene plastic and stacking needs for school chairs. "We had created a chair that was also a toy, which would stimulate a child's fantasy in his construction of castles, towers, trains, and slides. At the same time, it was indestructible, and soft enough that it could not harm anyone, yet too heavy to be thrown" explains Zanuso (as quoted by Carpenter, 2020).

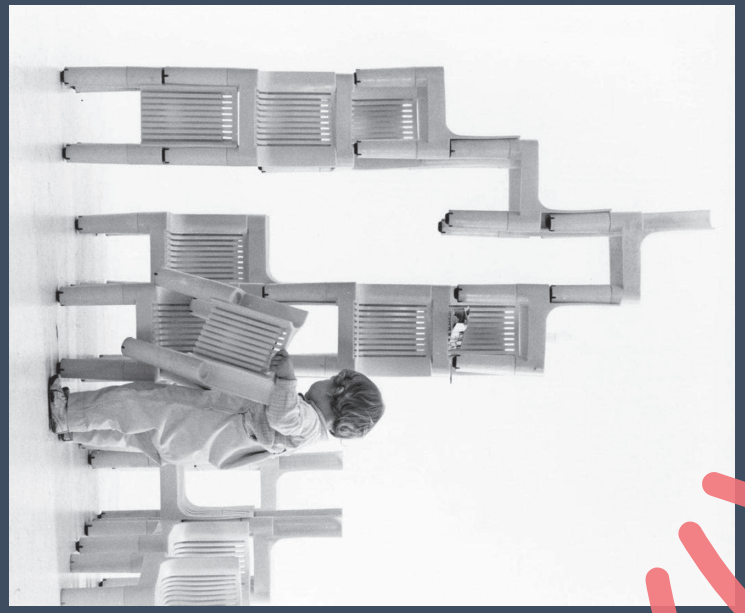
These two chairs are excellent examples of modularity, flexibility and playfulness through design, as they allow children to play and reconfigure the elements to build fun and flexible spaces. While these designs mostly arise from researching the possibilities of plastic and post-war necessities (durable, affordable and resistant products), they are also some of the first products that deal with the idea of objects as games and interactive experiences.

During the sixties, similar plastic chairs were designed, such as the *4860 Universale Chair* by Joe Colombo (Kartell, 1067) or the *Panton Chair* by Verner Panton (Vitra, 1960), portraying the characteristics of postmodernist, pop-inspired design. By that time, designers were rejecting the german "good design" hegemony and eagerly experimenting with cheap, fun, clever, playful designs and

Figure 21: Chica chair, De Pas, D'Urbino, Lomazzi and DeCurso (1972). Source: MoMA

Figure 22: K4999 Chair, Sapper and Zanusso (1964) Source: Sapper

Figures 23 and 24: Superonda sofa, Archizoom (1966) Source: Poltronova



flexible and modular systems. The groups Memphis, Archizoom and Superstudio are outstanding examples of this movement.

Indeed, *Italy's* exhibition also includes Archizoom's *Superonda* (designed by Andrea Branzi, Gilberto Corretti, Dario and Lucia Bartolini, Massimo Morozzi, Paolo Deganelloas for Poltronova in 1966) an example of reformist design, being "motivated by a profound concern for the designer's role in a society that fosters consumption as one means of inducing individual happiness, thereby ensuring social stability" (Ambasz, 1972).

Contestatory design implies offering to the consumers an "open-ended manner of use", products are created as "environmental ensembles and permit different modes of social interaction, while at the same time they allow the user to make his own statement about both privacy and communality", states Ambasz (1972). Acknowledging this as part of the intention of the design is related to the idea of experience and involving the users in the creation process, as they will be responsible for the final shape of the product.

In a broader sense, this can even be understood as a handcrafting activity: the users will "design" individual and unique environments by arranging the modules created by the designers. Within an academic context, designing becomes an educational tool, fostering a mental approach to creativity, problem solving and innovation. The "platform-block" and "sitting-hollow" (images below) from the Delft Montessori School designed by Herman Hertzberger between 1960 and 1966 show how simple modular blocks permit a variety of interpretations and roles: the blocks work as structural and seating elements that children can put together or take apart by themselves and sit on, lay materials during classes, gather to read a story in group, play, etc. They are activity islands in the middle of a sea of floor-space and are opposites and complementary at the same time: The elevated "platform-block" can act as a scenario, pedestal, table or space that attracts the attention from far away and the "sitting-hollow" offers intimacy, a space where children can hide from the view (Hertzberger, 2008).

Designing contestatory products and spaces is closely related with the key concepts that were explored in the previous chapter: flexibility, contingency, metacognition, etc. to meet the requirements of current pedagogical trends. Indeed, some of the examples shown in the previous pages were conceived for children, so this design philosophy has the potential of integrating pedagogical needs into the design process. Therefore, the next subchapters focus on playful and educational design, to gain a deeper knowledge of applying these ideas to the design of learning environments.

Figure 25: Platform-block, Herztberg (1966) Source: AHH

Figures 26: Sitting-hollow, Herztberg (2011) Source: Dezeen

5.2. PLAYFULNESS

Why is playful design so popular? "Play is the 'rocket fuel' of child development" states a study from IKEA, the LEGO Foundation, National Geographic and Unilever. In 2018, these companies joined to form the Real Play Coalition (RPC) with the intention of promoting the benefits of playing. In the Value of Play Report, it is explained that we are instinctively curious beings with an urge for exploration and discovery. Playing empowers children to learn how to control their bodies, unleash their imagination and develop cognitive, emotional and social skills. A childhood rich in play enhances the creativity, self-expression, collaboration, risk-taking, exploration, adaptability, stress-management and problem-solving of children (Real Play Coalition, 2018).

According to a research by the Lego Foundation, there are five types of play with different forms of enhancing learning (Whitebread, D. et al., 2017):

- **Play with objects:** When children manipulate objects playfully they can learn representational abilities, reasoning and problem-solving strategies that enhance the development of language, maths, spatial and fine-motor skills.

- **Games with rules:** Physical games with rules (e.g. hide and seek, chasing games and organised sports) help children adapt to formal schooling and board games help improve numeracy.

- **Physical play:** Active body movement, such as climbing, running, dancing or ball play, is linked with academic progress, self-regulation and social competence.

- **Symbolic play:** Games where children include spoken language, mark making, numbers and music help language development, self-regulation, academic achievement and higher cognitive functioning.

- **Pretend play:** When children pretend to be movie characters or professionals it helps develop their reasoning skills and enhance their learning-to-learn skills, with direct benefit on social development, language, narrative skills and emotion regulation.

PLAYING IS FUN, IMAGINATION, LAUGHTER, LIBERATION AND MAKES LEARNING EASIER

Vytaute Staponkute explains in the introduction of the chapter dedicated to Education of *Design for life: 99 projects for the real world* (Guayabero and Pérez, 2015), that "good design should provide clues (not answers!), be interesting and engaging, but also leave plenty of room for exploration, for error and, above all, for play". Playing is fun, imagination, laughter and liberation and makes learning easier. The author also argues that when a designed product or experience contemplates failure as part of the learning process, it motivates the

creativity, ability to take risks and critical thinking of children. Making mistakes should be fun and challenging, not punishing or frustrating (Staponkute, 2015). Similar ideas are revealed when the architects responsible for the renovation of the Children's Museum of Pittsburgh talk about their project: "designing for kids means engaging them, not controlling them." (Blum, 2005).

Designing for play requires the need for flexibility, so kids can use their imagination to play (Dudek, 2005). For example, landscape architect Isamu Noguchi designs playscapes that would "provoke a desire to play instead of dictating how you play", says Sharmacharja, curator of the Play Well exhibition at the Wellcome Collection in London (as quoted by Smith, 2020). Noguchi's playgrounds are complex and attractive environments that trigger children's curiosity. The abstract shapes of his playgrounds facilitate the free interpretation of uses. Obviously, this shouldn't ignore safety concerns. As Alexandra Lange explains, the design philosophy of these landscapes is "non-directive play" (Lange, 2019).

Cas Holman and David Rockwell Group designed the *Imagination Playground*, a set of "loose parts" that transforms the traditional idea of a playground into a "pop-up" architecture (Holman, 2010). This design invites children to create their own playgrounds and increases social interaction and collaboration as they have to work together to move the parts around. It took them five years to develop this project as it required a deep research on playgrounds, the benefits of play and open-ended activities. The portable nature of the set facilitates a wider distribution and storage. UNICEF and Disney's P.L.A.Y. project has brought it to more than 13.000 children in Bangladesh and Haiti (Rockwell Group, 2010). The foam is a very practical material, as it is light and soft, which makes it safe for children to play with. It is also easy to clean, but unfortunately it is not a sustainable material.The design of these big blue blocks was inspired by Caroline Pratt's Unit Block, explains Holman in her Netflix documentary (2019). Caroline Pratt was an American educator who invented the Unit Blocks (1913), in turn inspired by her contemporary Patty Hill who developed a larger set of building blocks to incentivise free-play (Wellhousen and Kieff, 2001).

The design of these big blue blocks was inspired by Caroline Pratt's Unit Block, explains Holman in her Netflix documentary (2019). Caroline Pratt was an American educator who invented the Unit Blocks (1913), in turn inspired by her contemporary Patty Hill who developed a larger set of building blocks to incentivise free-play (Wellhousen and Kieff, 2001)..

Holman explains that she designs *for play* and does not *design play*: She highlights the importance of designing for the circumstances of play to arise rather than the play itself. In her opinion, the goal of designing for play is to facilitate an environment where children can create from their imagination rather than following instructions (2019).

Figure X: Playground at Piedmont Park, Isamu Noguchi (2014) Source: Herman Miller

Figure 27: Playground at Piedmont Park, Isamu Noguchi (2014) Source: Herman Miller

Figure 28: Imagination Playground (2010) Source: Imagination Playground

Figure 29: Architecture against death: Reversible Destiny Lofts, Shusaku Arakawa and Madeline Gins (2005) Source: Metropolis

For her, "easy is boring", understanding easy as something that does not engage our thinking. This premise goes against the design presumption that "easy is great", similar to Robert Venturi's "less is a bore". To explain her point of view, Holman shares the example of Architecture against Death, a project by Shusaku Arakawa and Madeline Gins, who believed in the possibilities of design to force people to think. When architecture is unpredictable, people are more alert and active, and therefore can stay young and continue thinking. They designed colourful buildings with uneven or bumpy floors and walls that continuously stimulate our minds and bodies.

House of Cards designed by Charles and Ray Eames is another great example of playful design. It is "a deck of playing cards, printed with graphic motifs or photographs, that fit together with six slots to form several three-dimensional structures" (Fernández Villalobos, 2019). *House of Cards* is a modular, flexible construction game that everyone can use to build endless structures.

Playing is a concept present in the whole trajectory of the Eames: one of their most famous quotes is indeed "Take your pleasure seriously", which perfectly sums up their work-play philosophy. As Charles Eames said, "toys are not really innocent as they look. Toys and games are the prelude to serious ideas" (as quoted by Fernández Villalobos, 2019). Their deck of cards is meant to be arranged in multiple combinations with a single and "unique building piece": the card.

Playful experimentation is visible through their whole architectural and design activity: none of their compositions was fixed, all of their designs always led to another and the objects they created were always reconsidered (Fernández Villalobos, 2019). Indeed, Holman points out a similar idea in her Netflix documentary (2019): she explains that design is very similar to play, as designers are constantly testing with new ideas, concepts and objects in space, or simply put, playing with things.

PLAYFUL EXPERIMENTATION IS PART OF ANY DESIGN PROCESS

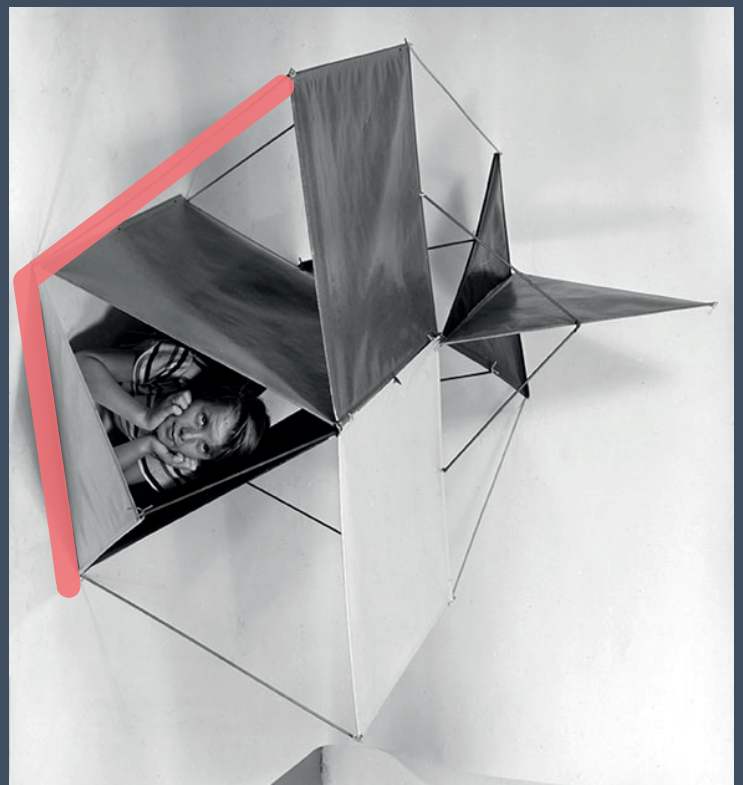
The Toy, also designed by them in 1951, is a large-scale construction game created so children could play with the interior and adults could use it for amateur theatrical sets. They perceived playing as an essential activity of humans and not as something exclusively for children (Fernández Villalobos, 2019). It is interesting to mention that they also designed *The Little Toy* (1952), a small version of *The Toy* meant for playing with puppets and *Giant* (1953) a set of 18 × 27 cm *House of Cards* to build bigger compositions.

Another interesting playful design by the Eames is *Carton City*: Ray and Charles designed in the 50s packaging boxes of Herman Miller's products and converted them into playful spaces for children. The packaging included a leaflet offering instructions on "How to Make a Playhouse". Together with dotted lines and illustrations this facilitated the creation of a *Carton City*. The Eames saw the potential of cardboard to create imaginative worlds (Lange, 2020).

Figure 30: *House of Cards*, Charles and Ray Eames (1952) Source: Emaes Office LCC

Figures 31 and 32: Different configurations of *The Toy*, Ray and Charles Eames (1951) Source: The Culture Trip

Figure 33: *Carton City*, Charles and Ray Eames (1952) Source: Herman Miller



5.3. EDUCATIONAL PLAY

It was the pedagogue Friedrich Fröbel who discovered the educational benefits of construction toys back in the 19th century. He inspired many designers and architects to create toys that allowed spatial experimentation and reflection on shapes, lights, materials, textures, etc from a young age, explains PhD architect Nieves Fernández Villalobos (2019).

It is interesting to mention that Fröbel would not consider his blocks toys but he would rather refer to them as *gifts* or *Fröbelgaben* in German. His pedagogical intention was to use them as tools for learning, as his experience showed him the benefits of physical activity and active learning in early education. He also invented the idea of the kindergarten, a special school for younger children, merging the concepts of kids and outdoor spaces and gardens. He opened the first one in 1837 in Bad Blankenburg, Germany (Kohlstedt, 2019).

The blocks would be used in a very structured way. First, children were given soft and simple balls that later would be replaced by more complex materials and shapes. The gifts were designed with a clear educational intention, encouraging children to think abstractly and learn counting and mathematics, for example (Kohlstedt, 2019).

Fröbel's ideas influenced the work of many Expressionism and Cubist artists such as Paul Klee and Wassily Kandinsky, and Modernist architects and designers like Le Corbusier and Frank Lloyd Wright. Indeed, one of the first teachers that Walter Gropius hired at the Bauhaus used to work as a kindergarten teacher. A quick look through their designs will remind us of the work of children (Kohlstedt, 2019). His work also inspired the designs of Caroline Pratt and Patty Hill, introduced in the previous subchapter. As a matter of fact, the hand-scale unit blocks of Pratt are still used to teach mathematical relationships to children (Wellhousen and Kieff, 2001).

Educator Elizabeth Peabody, who founded the first English-language kindergarten in the USA (previously another one existed, but taught in German). Peabody decided to find support to mass-produce Fröbel's Gifts, so they could be accessible to everyone, but quickly were miss-understood as an incredible business opportunity and started to be found in many shapes, colours and materials, corrupting their original simplicity and purely educational purposes (Kohlstedt, 2019).

Bauhaus's alumna Alma Siedhoff-Buscher believed in the benefits of "free-play" toys and designed versatile and colourful sets of geometrical shapes that allow children to freely unfold their creativity in opposition to the educational ideas of Fröbel (Fernández Villalobos (2019). Her toys are sculptural toys that stimulate children's minds through balance and movement (Birks, 2018). Frank and John Lloyd Wright, Ladislav Sutnar, Enzo Mari and

19th Century

1923

1949

2009

2016

Figure 34: The Cube construction toy, Friedrich Fröbel (19th Century). Source: The Kinder Journal

Figure 35: Toys, Alma Siedhoff-Buscher (1923). Source: El Periódico

Figure 36: Ziggurat, Enzo Mari (2009). Source: Archiexpo

Figure 37: Wright Blocks, John Lloyd Wright (1949). Source: Blog Arquitectura y Educación

Figure 38: Oddblocks, Pupilpeople (2016) Source: Eye on Design Magazine

Maria Montessori among many others also designed construction toys inspired by Fröbel.

Nowadays, thousands of different types of construction blocks can be found in the market in all imaginable shapes, colours and materials. An interesting example is *Oddblocks*, a set of play-objects with odd shapes made out of granulated cork. In an interview for AIGA'S *Eye on Design* magazine, the design studio Pupilpeople explains that they came up with the idea of *Oddblocks* when they noticed how often in the market toys had become educational tools used to teach maths, physics, etc. (Zhuang, 2016). Holman agrees by stating that goal oriented toys tend to look like something, offering only one way to play with it and shutting down the pleasure, engagement and enjoyment open-ended games offer (2019).

Oddblocks is a less prescriptive, open-ended game that stimulates the discovery of shapes and proportions and nurtures children's creativity. It encourages curiosity and playful interactions such as small sculptures, printmaking and 3D puzzles (Pupilpeople Design, 2019).

In summary, the intersections between contestatory, flexible, playful and educational design are wide. The examples shown provide a complete picture of the potential of Design to create the spaces of tomorrow's Education. The following subchapter will complement these findings by exploring the materiality of children's design.

5.4. MATERIALS FOR CHILDREN

This subchapter provides a short reflection on common materials used for children products or spaces and children's appreciation of materials and aesthetics.

Most children's products in the market show a tendency of over-exploiting animated cartoons and vibrant bright colours to be more attractive to the eye of the young consumer. Often, cheap materials are used. As children grow up fast, it seems obvious that there's no point in using good durable materials. Indeed, with the discovery of plastics in the sixties, it became extremely popular to produce affordable, colourful amenable plastic furniture and toys for children (Vigna, 2016). Fortunately, during the last decades a growing number of designers and researchers are working to question this mainstream consumist model and offer more well-though, sustainable solutions by acknowledging children's appreciation to other forms and types of materials. Additionally, the playful nature of children and toy design has always facilitated a great experimentation with technological advancements and the designer's imagination.

For example, Jordi Queralt, Spanish architect with experience designing schools and playgrounds such as *La Ballena de Nou Barris* explains that children have much more taste than we acknowledge and that designing for them doesn't require using saturated colours or hyper-stimulant elements. In his opinion, experimenting with materiality and lightning can be a great way to design children's spaces (*Elástica Magazine*, 2020). Similarly, Holman says in her Netflix documentary that "kids are actually pretty sophisticated, they can play with a white toy and appreciate that the colour isn't telling them what it is" (Holman, 2019).

SENSORY-RICH MATERIALS EXPAND LEARNING POSSIBILITIES

Louisa Penfold, Post-Doctoral Researcher in Early Childhood Education from Harvard University explains how materials and a materialist approach to Education can facilitate "expansive possibilities for children's creative learning" (2019). She explains that children can manipulate materials to self-express, but materials can also be "active and participatory forces that open up new and divergent learning processes". As previously explained, Friedrich Fröbel did not only discover the pedagogical benefits of construction toys, he also invented the kindergarten. This paved the way for the Steiner, Montessori and Reggio-Emilia education approaches to explore the importance of sensory-rich material resources to incentivise the imagination and play in children (Penfold, 2019). These alternative pedagogies tend to use soft and natural materials to create special and comforting relationships with children.

The mood and ambience a space or product creates is largely defined by the materials and colours used, explain Feinberg and Keller, authors of the book *Designing space for children and teens in libraries and public places*. A colour is perceived differently depending on the colours that surround it or by the source of light that enlightens it. Colours and colour compositions can moderate the physical space by creating the illusion of big or small spaces and can also create the impression of warmth, scale and excitement with a strong cultural correlation (Feinberg and Keller, 2010).

The colour palette used in a design project for children and teens can take different perspectives: While some professionals use vibrant primary colours, others prefer subdued secondary colours or mixes of green and blues. Selecting properly the colours (and its nuances or hues) can intensify the harmony and continuity in the design. Feinberg and Keller quote Josef Albers' (Bauhaus alumnus, artist and art educator) colour theory: "any color (shade or tint) always has 2 decisive characteristics: color intensity (brightness) and light intensity (lightness). Therefore, color intervals also have this double-sidedness, this duality" (as quoted by Feinberg and Keller, 2010).

Colour can also be understood in quantitative units: the amount of colour, saturation level, scale and volume of the space, and sources and amount of light. Finally, let's not forget that colour depends on cultural sensitivities. So when deciding on a colour for a space or object, we should consider the local connotations (Feinberg and Keller, 2010).

"A material's sensory and aesthetic properties may also transform as a child plays with it, generating opportunities for further experimentation. These transformations then allow children to extend and make their learning more complex over time" (Penfold, 2019). Materials should be inspiring, honest by showing its purpose, use and possibilities, and their beauty should suggest action by children (Dudek, 2005).

Abraham Maslow, American psychologist and author of the "Hierarchy of Needs", developed a study in the 50's that showed that physical environments can determine wellbeing. He developed a research that consisted in showing students "beautiful, average and ugly rooms" and the results proved that the beautiful room was better ranked on his rating scale (Russell, 2019). Originally, the "Hierarchy of Needs" was included: physiological, safety, belonging, self-esteem and cognitive needs. This study along with extensive research made him later include three more basic human needs: aesthetic, self-actualization and self-transcendence needs. "Maslow describes aesthetic needs as those that are met by finding appreciation and beauty within our environments, leading to a higher sense of connection to all things beautiful" (as quoted by Russell, 2019).

As Pilar Ugidos explains in the subchapter 4.4, the aesthetics of the spaces and products that surround children is important. She explained that being in contact with beauty influences the self-esteem of children. This is one of the reasons why the collaboration of her school with the MNAC museum was such a success. The collaboration with the museum made it easier to bring art and beauty closer to the students and had direct consequences on their academic performance.

BEAUTY ENHANCES THE LEARNING EXPERIENCE OF CHILDREN

MATERIALS

Plastics

The Eames, Zanuso and Sapper, among many other designers, quickly started to experiment and design inventive designs with plastics. This material was a great revolution as it allowed to produce new products with shapes that were not possible with other materials in a very economical way, such as the *Panton Junior* chair by Verner Panton (Vitra, 1960).

Nowadays, plastic products are still extremely popular as the latest technologies, such as computer-modelling and rapid-prototyping, increase the number of possible shapes that can be mass produced. However, a growing consumer concern on sustainability and plastic waste together with the rising cost of petroleum is forcing designers to re-think their material selection to better alternatives, such as sustainable plastics or natural recyclable materials (Vigna, 2016).

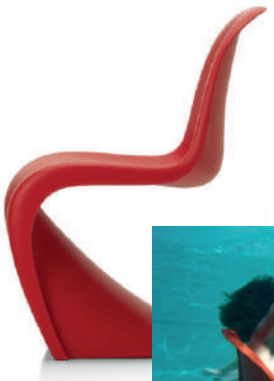
Wood

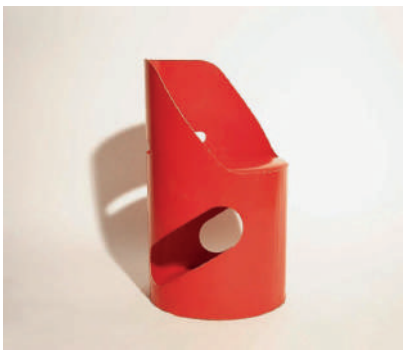
The second most popular product for children toys is wood. In particular, plywood is an incredibly attractive material as it is inexpensive, easy to mold and strong (Appleton, 2014). Horse wooden rockers or construction educational blocks are good examples of durable wood toys, but also chairs like the *Elephant* chair by the Eames (1940). Traditionally, wood has been used to develop long lasting designs, but with the plastic boom this material became less interesting to manufacturers. Current eco-design trends have influenced the resurgence of wood as an eco-friendly alternative, for instance El Pájaro Jocs is a local example of a toy company focused on using wood to build game constructions and exploring the benefits of wood as a teaching material (Rigol, 2019).

Cardboard

As seen through the designs of Ray and Charles Eames, cardboard is another remarkable material for children: Every child has played with discarded boxes to build their own cardboard castles, but the greatest benefits of this material is that it is eco-friendly, accessible, ephemeral (can be easily disposed) yet durable (used to protect other objects) and cheap.

This humble material was popularized in the 60's and 70's when designers like Frank Gehry, Jean Louis Avril and Peter Murdoch designed innovative cardboard furniture pieces. After them, paper furniture and toys became popular as they were inexpensive and disposable, but it has not been until recently when designers have started to benefit from the small ecological footprint of this natural material (Vigna, 2016). Contemporary products show how cardboard can offer infinite possibilities: fiberboard, heavy-duty corrugated board, etc.





Textiles

The use of textiles and soft materials is very common in children's designs as it offers a particular tactile experience that cannot be achieved with other elements. Carpets for children often offer playful experiences by including illustrations or patterns that trigger children's creativity.

The textile playgrounds by Toshiko MacAdam are a unique example of the possibilities of textiles. This artist is able to create incredible colourful architectures by exploring the relationship between knitting, crochet and spaces (Quirk, 2012). The properties of the textiles, and the fact that they are hand-made generate special interactive situations where children can play and have fun in groups.

Cork

Some of the most relevant contemporary designers like Ilsa Crawford, Tom Dixon, Jasper Morrison or Hella Jongerius have been exploring the possibilities of cork due to its versatile, attractive and sustainable properties. Cork is a very interesting material for children's design because of its lightness, soft texture and insulation properties.

Oddblocks by Pupilpeople (shown in the previous chapter) is a great example of using cork for construction toys. Hory, a local company from Barcelona, Korxx (Germany) and Elou (UK) also produce construction blocks made out of cork. *Toronto* stool by In-Tenta (picture below) and *SIT'ABIT* stool by PlyEco are other examples of self-assembly designs for children.

Another interesting use of cork is the production of flooring for playgrounds thanks to its sound absorbent, fireproof and water resistant qualities. Portugal is the largest producer of cork. Amorim is one of the biggest cork companies for Portugal and partnered with BASF and A-Road (a Korean flooring company) to develop a cork composite for the playground at Jayang's nursery in Seoul (Amorim, 2020).

Figures 39 and 40: Panton Junior, Verner Pantone (1960) Source: Vitra

Figure 41: Elephant, Ray and Charles Eames (1940) Source: Vitra

Figure 42: Standard Chair, Jean Louis Avril (1967) Source: The Kinder Journal

Figure 43: Textile playground , Toshiko MacAdam (2012) Source: ArchDaily

Figure 44: Toronto Stool , In-Tenta (2014) Source: In-Tenta

6

DESIGNING
Castellets de Suro

This chapter explains the design proposal developed based on the research conducted on learning spaces for children. First, a design brief is presented based on the conclusions extracted from the research. Secondly, the design process will be explained, showing the first sketches and drafts and how the concept of this design proposal was created based on the opportunities and needs encountered in the brief. Even if now the design process is explained in a linear way, it was an itinerant development and often it was necessary to extend the secondary research to obtain a broad vision on the context of this project, as shown in the diagram of the next page. Lastly, the identity and usage of the product will be described, as well as the technical details and viability of the design.

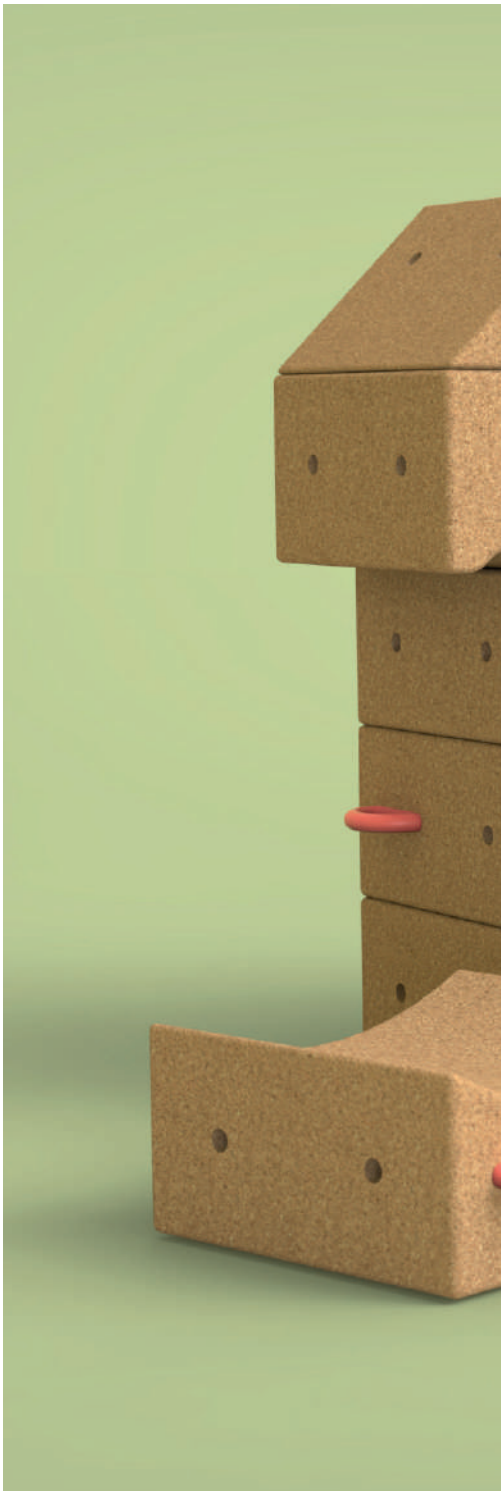
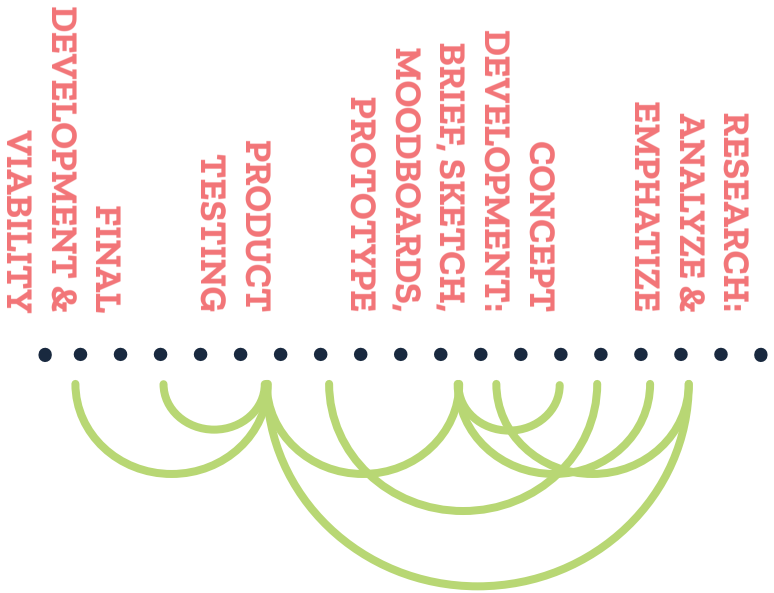


Figure 45: Render (2020)
Source: Author

Figure 46: Design process diagram (2020)
Source: Author



6.1. DESIGN BRIEF

The extensive secondary research from the previous chapters and the interview with education expert Pilar Ugidos lead to the following conclusions:

1. Design complements the pedagogical mission because it builds the physical side of learning spaces. As education is a lively discipline, constantly evolving, design should ensure contingency, in other words, offer adaptability to new learning scenarios, rather than teaching spaces.

2. While educators and designers acknowledge the importance of space in learning, these are often not easy to change, as schools are located in old inflexible buildings, budgets are limited and public policies are slow. Hence, the design proposal should be directed into trying to adapt existing spaces to evolving pedagogical activities by using other elements as space configurators, that can require smaller budgets and its implementation is easier in pre-established schools.

3. Play facilitates learning and promotes creative skills which are extremely valuable for the future. Different forms of play have different children's educational benefits but free-play is also extremely valuable just for the sake of playing. Pleasure and enjoyment should be given its own importance. Contestatory and flexible solutions are key to unleash children's imagination and let them enjoy play in non-prescriptive ways.

4. Our minds are shaped by the things that surround us and accustoming children to broken, old objects and spaces influences how they will grow up. Design is a tool to provide beauty with thought and care to improve their self-esteem and relationship with their environment.

5. Involving the teachers in the design of learning spaces is fundamental. As Ugidos explained, they tend to "accept" the environment as it is. If design incentives their creativity they can be more confident to promote innovative teaching strategies.

With these ideas in mind, a design opportunity (my creative contribution to this final work of master) was written to begin the design phase of this project:

DESIGN OPPORTUNITY

A flexible product that ensures contingency and flexibility so existing learning spaces can easily be adapted to different ways of teaching and that can contribute to creating a positive impact in schools, by promoting collaboration, empathy and openness.

6.2. USERS

The users of the design are children from primary and nursery schools from Barcelona, as it is where the research was conducted. This location is understood as the base of the pilot project, later on it will be explained how this user group is targeted through the identity of the proposal and how the proposed system can be escalated to other contexts.

The teachers of the students should find the proposal interesting as they are in charge of the material available in their classrooms. The product developed should make them interested in using it, so it has to be attractive and practical for them.

KEY DETAILS

Location
Barcelona (Spain)

Age range
3 to 11 years old

Interests
Playing and learning

Occupation
Students

Language
Spanish and Catalan. As previously mentioned, at the Miguel Bleach school (as many others in Barcelona) a great percentage of children have foreign origins, so the product should facilitate collaboration, empathy and openness without strong verbal communication. Its use should be intuitive.

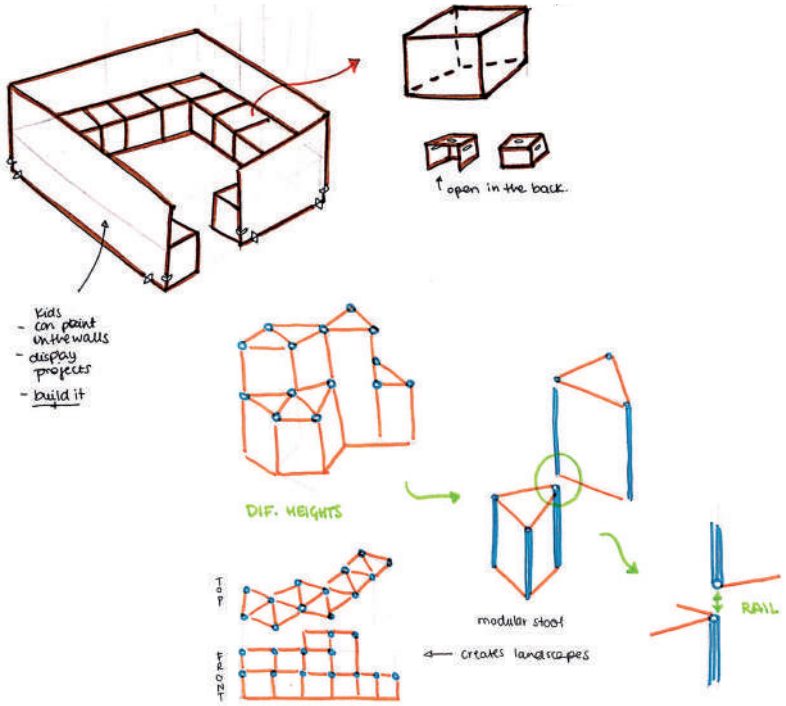
Figure 47: Children, CDC (2020)
Source: Unsplash

6.3. DESIGN PROCESS

Once the design opportunity and user group were defined, the first ideas were sketched, exploring different possibilities, from modular chairs or furniture that can be arranged in different ways to big playful objects. The objective of this sketching phase together with the creation of the following inspirational moodboard was to narrow down the possible ways this project could be developed and to analyse how different material solutions can lead to different scenarios and interactions between children and how products can be used to alter existing classrooms.

For example, designing furniture could be an interesting challenge, but due to the current context it seems less viable, as it would require to get rid of the current chairs and desks of a classroom. Therefore, I decided to explore ideas that could be integrated into already existing spaces, yet not be limited to work in this particular place. As seen through the research, a trend towards flexible and informal spaces is growing within the educational community.

During this first phase, I was curious by the use of cardboard to provide ephemeral scenarios that can easily be built by children and do not take much space as it can be stored flat. Inspired by *Carton City* from Ray and Charles Eames, I was intrigued by this humble material with thousands of possibilities, how the packaging of a toy can sometimes be more interesting than the toy itself as its use is less restrictive and motivates the child's curiosity in fascinating ways. I sketched different concepts to re-use packaging cardboard to create furniture, room dividers or playful scenarios, but after my first conversation with Pilar Ugidos, I decided to discard this idea. She pointed out the benefits of surrounding children with beauty



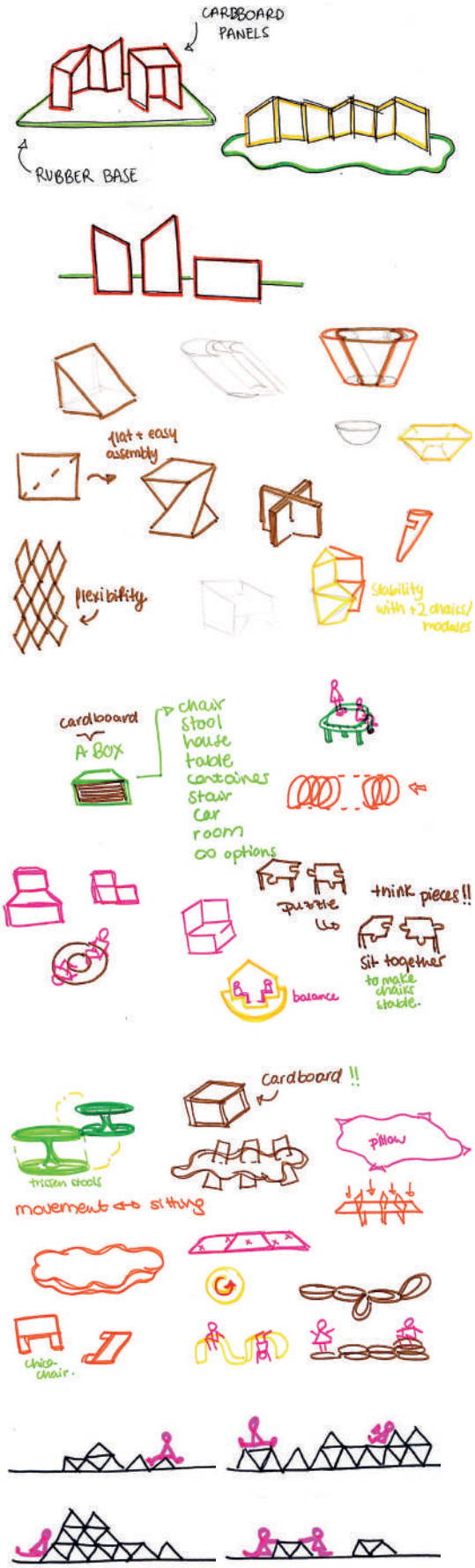


Figure 48: Initial sketches (2020)
Source: Author

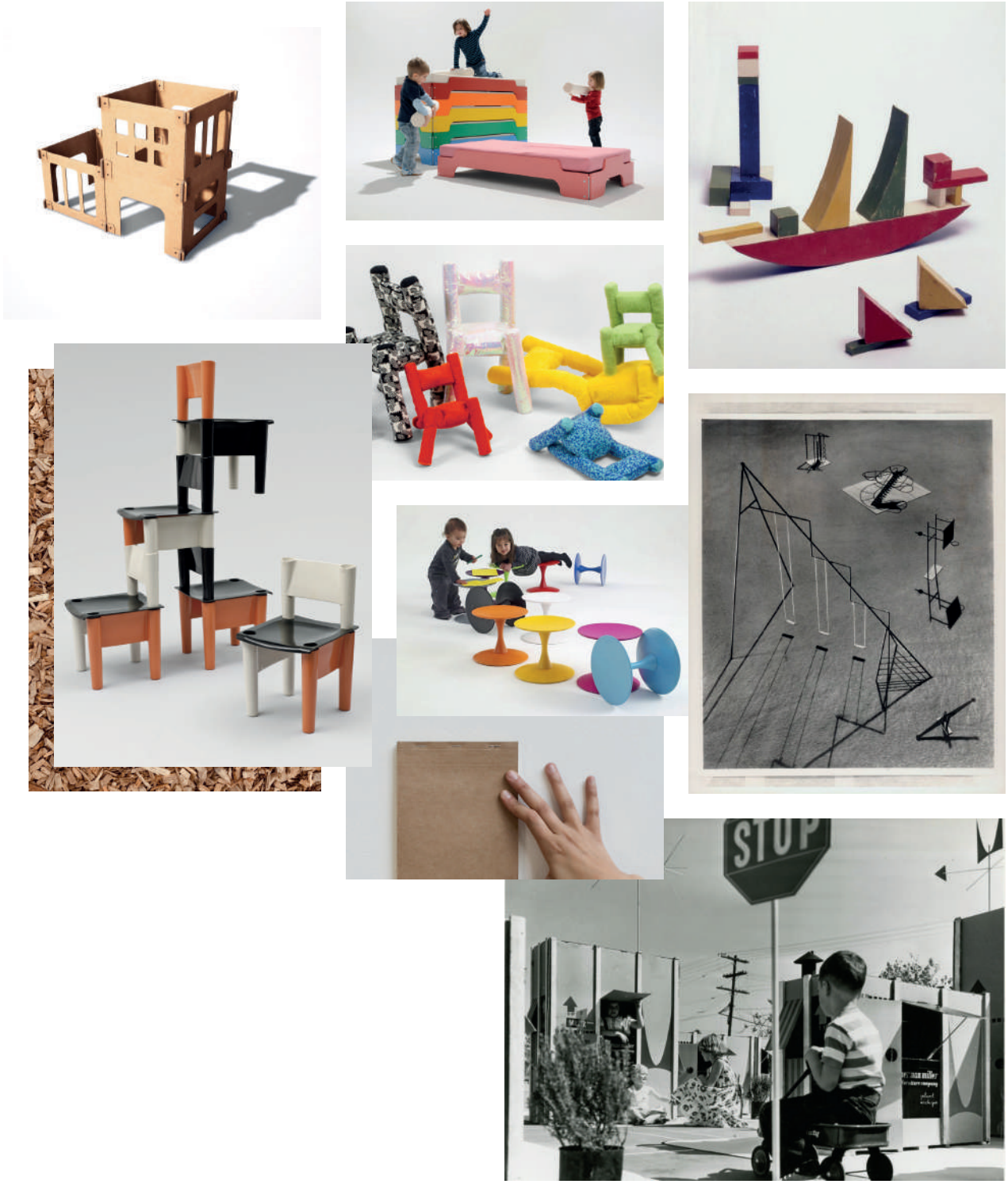


Figure 49: Moodboard composition (2020) : Carton structure - CartonLab, Stacking bed - Rolf Heide, Blocks - Alma Siedhoff-Buscher, Chica chair - D'Urbino, De Pas, Lomazzi and DeCurso, Stuffed chairs - Katie Stout, Playground - Noguchi, Cork texture - Rob Evel, Cardboard texture - Laika Notebooks, Carton City - The Eames
Source: Cartonlab, Herman Miller, Design week, Artishock, Unsplash

SYSTEM OF BLOCKS THAT CAN CREATE DIVERSE SMALL SCALE LEARNING SPACES

and durable materials. While cardboard is a remarkable material, due to its limited durability, I preferred to focus on other materials.

The research and brainstorming of ideas led to the conclusion that a solution that can be integrated in the current context was to design a product that could be many things at the same time. Consequently, designing a "chair" or a "desk", an object with a clear functionality was not a possibility. Instead, I pursued the idea of developing a system of elements that can form small-scale architectures, so children and teachers can hack their classrooms and schools to build their own landscapes, adapted to their current pedagogical needs. For example, they could build reading nests, sets and scenarios for group activities, room dividers to create different atmospheres where children can work on different exercises, intimacy nooks to relax individually, etc.

While exploring the different shapes that these elements could have, I realized that they should be interesting as single elements and not dictate a specific functionality while facilitating the construction of diverse structures. The users should be able to assign different functions and meanings to these elements and make them their own creations. Geometric blocks offer the possibility to create complex outcomes by combining simple forms. Designing very organic shapes would be attractive in terms of exploration, but it wouldn't be suitable to construct bigger structures. Blocks encourage creative and spatial thinking and foster social collaboration to build larger structures.

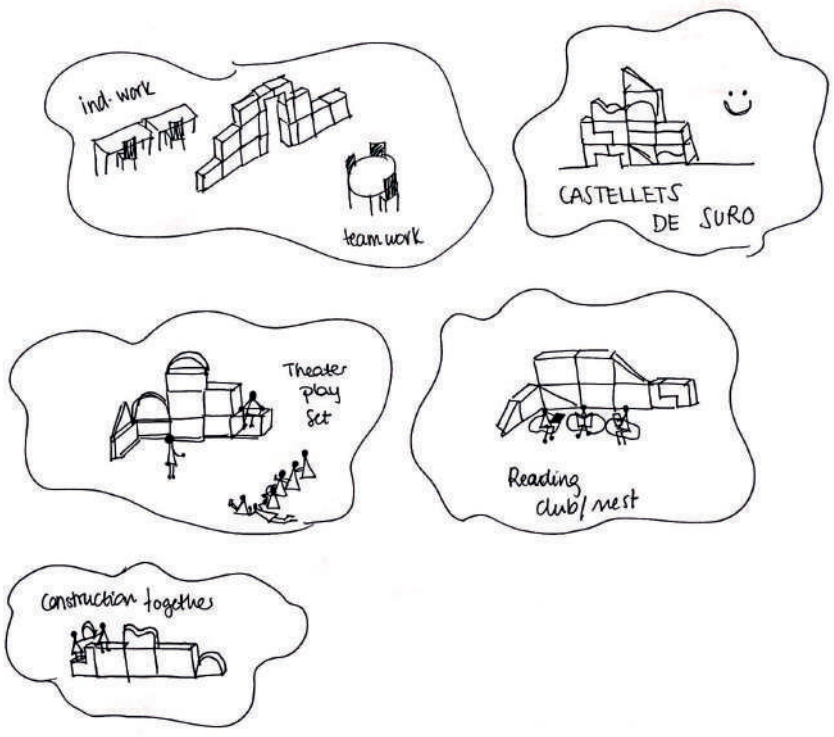


Figure 50: System sketches (2020)
Source: Author

BLOCKS BASED ON GEONS: VOLUMETRIC PRIMITIVES

The final shapes of the blocks are based on abstract geometric primitives: Geons. This term was coined by Irving Biederman, who developed the Recognition-by-components theory. According to his theory, our minds recognise objects by dividing them into geons, simple geometric components such as blocks, cylinders, wedges and cones. For example, a briefcase can be recognised by combining a rectangular block and an arc; and a mug is a cylinder and an arc (Biederman, 1987). As users we can assign functional meaning to these shapes and build our own forms, objects, scenarios, uses with our own meanings based on our experience and socio-cultural knowledge.

Biederman used these ideas to recognize objects by the geons they are formed with, but last year a student at the Royal College of Arts (UK) applied this theory with a reverse philosophy. Alessandra Fumagalli Romario created "Imaginary language", a set of geon-objects that children and artists can use to build their own objects and languages by assembling these primitive shapes (Calum, 2019). My proposed modular system aims to trigger the same situations but adds a spatial component, by increasing the shape of the blocks and offering the possibility to create spaces as well as objects, as illustrated in the image below.

I combined the basic geons to create a set of 7 geon-blocks, that can be arranged by following a modular grid, to facilitate the storage and packaging of the blocks. Each pair of blocks form

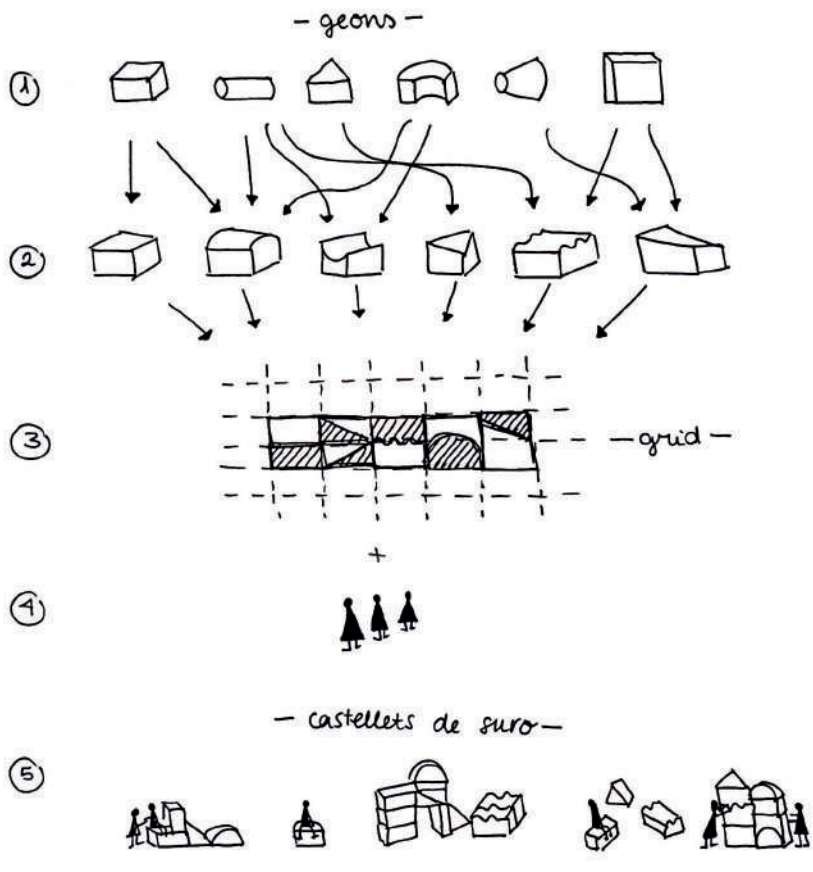


Figure 51: Geon sketches (2020)
Source: Author

72x72x36 cm rectangular modules and satisfy ergonomic principles. The measures of the blocks were carefully thought to be conveniently used by children from different ages. For example, three different seating combinations can be created to accommodate children of different heights. (Check the subchapter 6.9. Technical details that gathers all the relevant information related to the ergonomy of the system).

CORK: LIGHTWEIGHT, SOFT, DURABLE, SUSTAINABLE, CHILD-FRIENDLY

After I developed the first sketches and models, I came across this quote from Charlotte and Peter Fiell, renowned design historians and critics, which conveniently justifies the design of the modules: "a monoblock construction will always be the best for children's furniture, as it does not have dirt-trap seams and its structural integrity is generally more durable" (as quoted by Vigna, 2016).

In parallel, I was researching popular children materials (see 5.4. Materials for children) to evaluate which material could be more appropriate with my design. Cork seems to be a perfect fit, as it is lightweight, soft, durable and sustainable (see subchapter 6.9. Technical details for a deeper analysis of the benefits of using cork). With the prototype models, I was able to explore the tactility of the material and I observed practical benefits of round corners: besides being safer for children with a soft material such as cork, corners get less deteriorated without pointy finishings. The prototypes also allowed me to experiment with possible uses of the blocks, as seen in the images below.

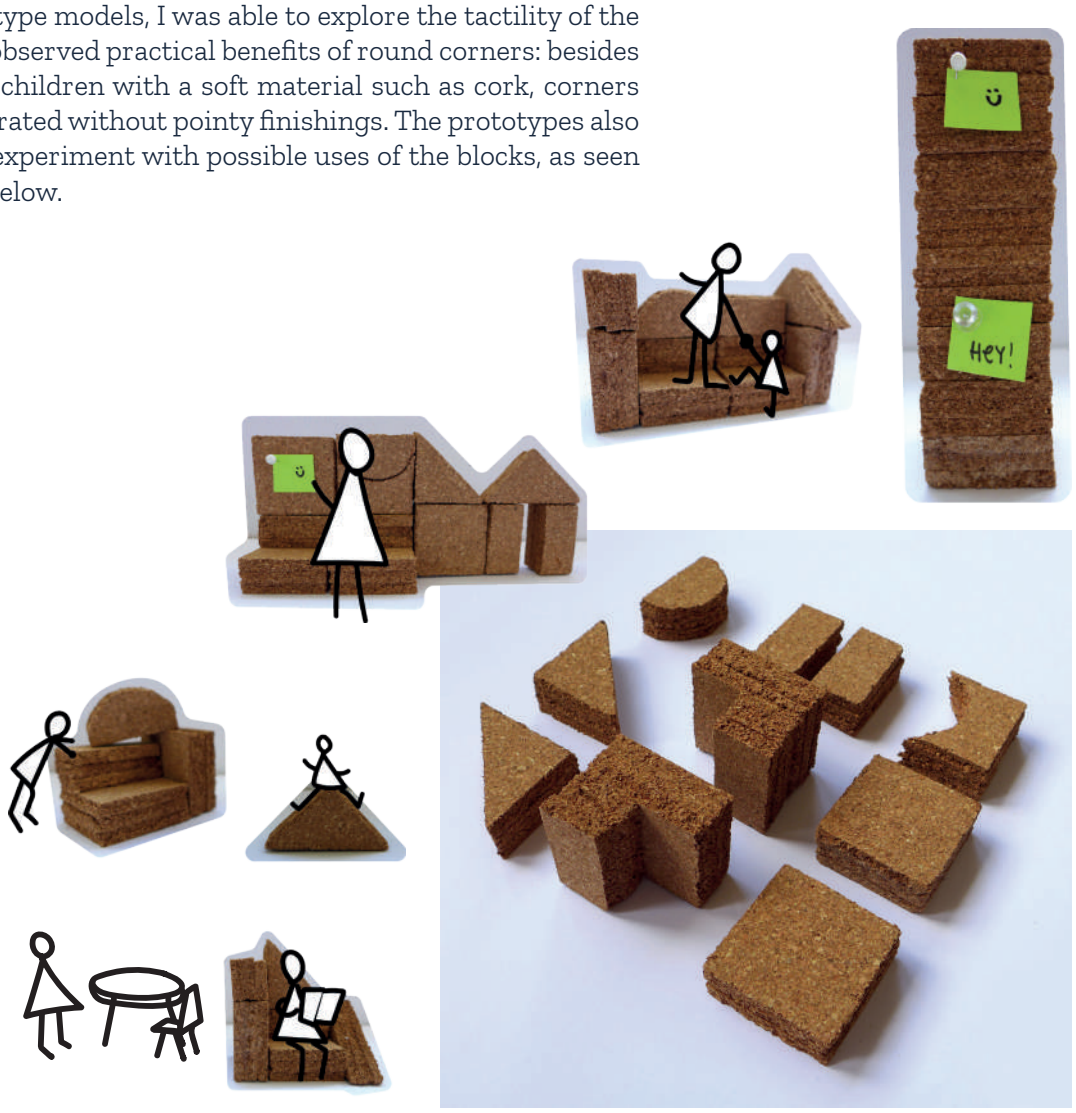
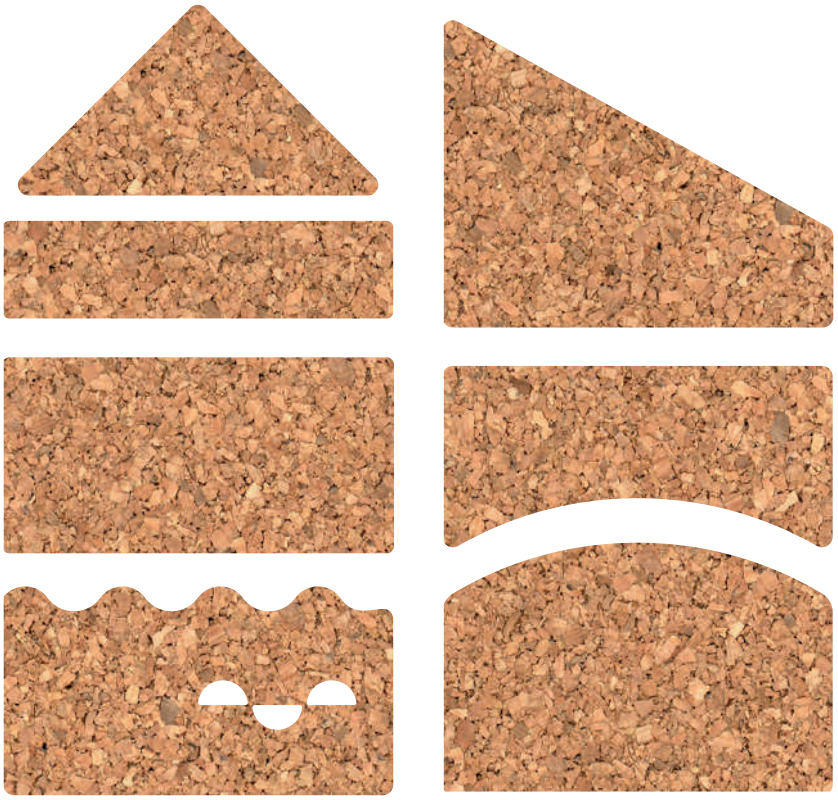


Figure 52: Models E=1:10 (2020)
Source: Author

After the material and shapes were decided, the next challenge was to solve the union between blocks. The natural adherence of cork makes the blocks stable: when putting the blocks in piles, their surfaces do not slide. Nevertheless, a union system was required to ensure the stability of bigger constructions. As it is a product for children between 3-11, not any kind of joints is suitable. For further information on this technical challenge, see the short study on several types of unions, assessing the pros and cons of each alternative, in Annex B: Study: Union solutions. The joints explored were: magnets, tongue and groove joints, velcro stickers, knots and rubber plugs. The results and prototypes showed that the plugs are the most convenient solution, because it allows the creation of more combinations (the other options work in pairs), easy manufacturing and that they can be used or not according to the needs of the students (e.g they can create constructions without plugs for ephemeral activities or they can use them for long-lasting activities).

Anyhow, the other types of joints should not be discarded for future designs: it could be beneficial to offer a larger set of blocks with different union systems targeted to more specific age ranges and different psychomotricity levels. This also could be applied to the experimentation with more shapes and materials. For instance, including textiles like felt could give broader opportunities and create different interactions with children.

Figure 53: Models E=1:2,5;10 (2020)
Source: Author



CastelletsdeSuro

Figure 54: Blocks (2020)
Source: Author

6.4. CONCEPT

Castellets de Suro is an open-ended modular system with simple yet curious shapes that invites children and teachers to create ever-evolving learning scenarios.

The starter pack version consists of 32 geon-based blocks (7 different designs) and 70 plugs (3 types: connector, button and handle), but pieces can also be acquired individually, so teachers can decide which shapes they find more interesting to work with. In future stages of this project, new blocks based on geons will be designed and the research on new ways of unions and materials will continue to satisfy user's needs.

The blocks form a grid of double-pieces rectangular modules (72x72x36 cm) to facilitate the storage and packaging of blocks, as seen in the following image. Thus the blocks can easily be stacked in pairs when not in use and its packaging is a big rectangular box that optimises the cost and transport of the blocks.

The main characteristics of Castellets de Suro are:

- **Facilitator:** The functionality of the system is designed by the users, who by elaborating on the design make the outcome theirs. Children and teachers become the designers of their own spaces, as they create their own experiences. The modules can create infinite possibilities: a wall to divide different areas of the classroom, a nest for group reading, a relaxation corner, a scenario, a playground or any other architectural structure the users imagine. Individual pieces can also be re-interpreted as sitting blocks or furniture. Pieces can be replaced and none is indispensable to keep the system working.

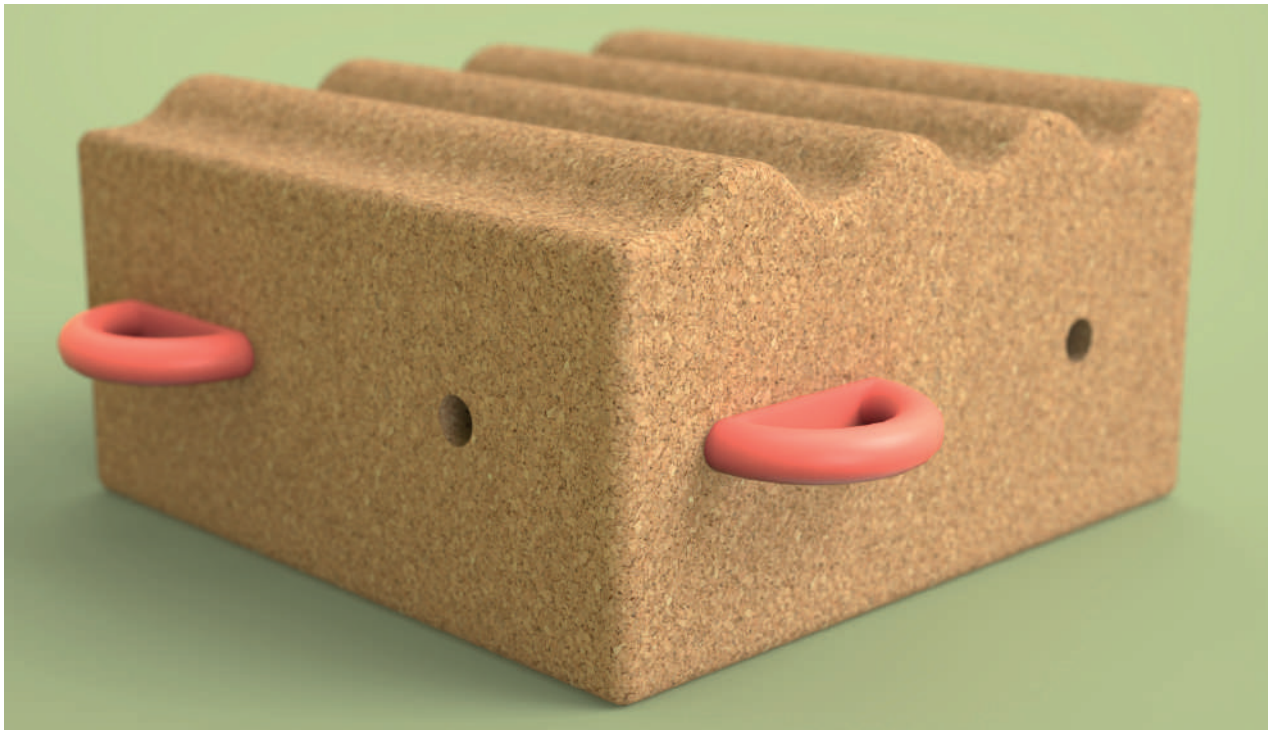
- **Positive impact:** It is achieved by promoting collaboration, empathy and openness. The building pieces are intentionally big so children need to work together to create their own learning spaces, making it interactive and inclusive. It promotes their creativity and imagination as all pieces are simple and don't dictate which one is the wall, the chair, the door,... It encourages playful and dynamic learning. Bringing a beautiful natural and tactile pleasant material to the classroom gives a new materiality to the spaces they will create, the users will be responsible of arranging the system to create spaces according to their personal aesthetic and functional needs.

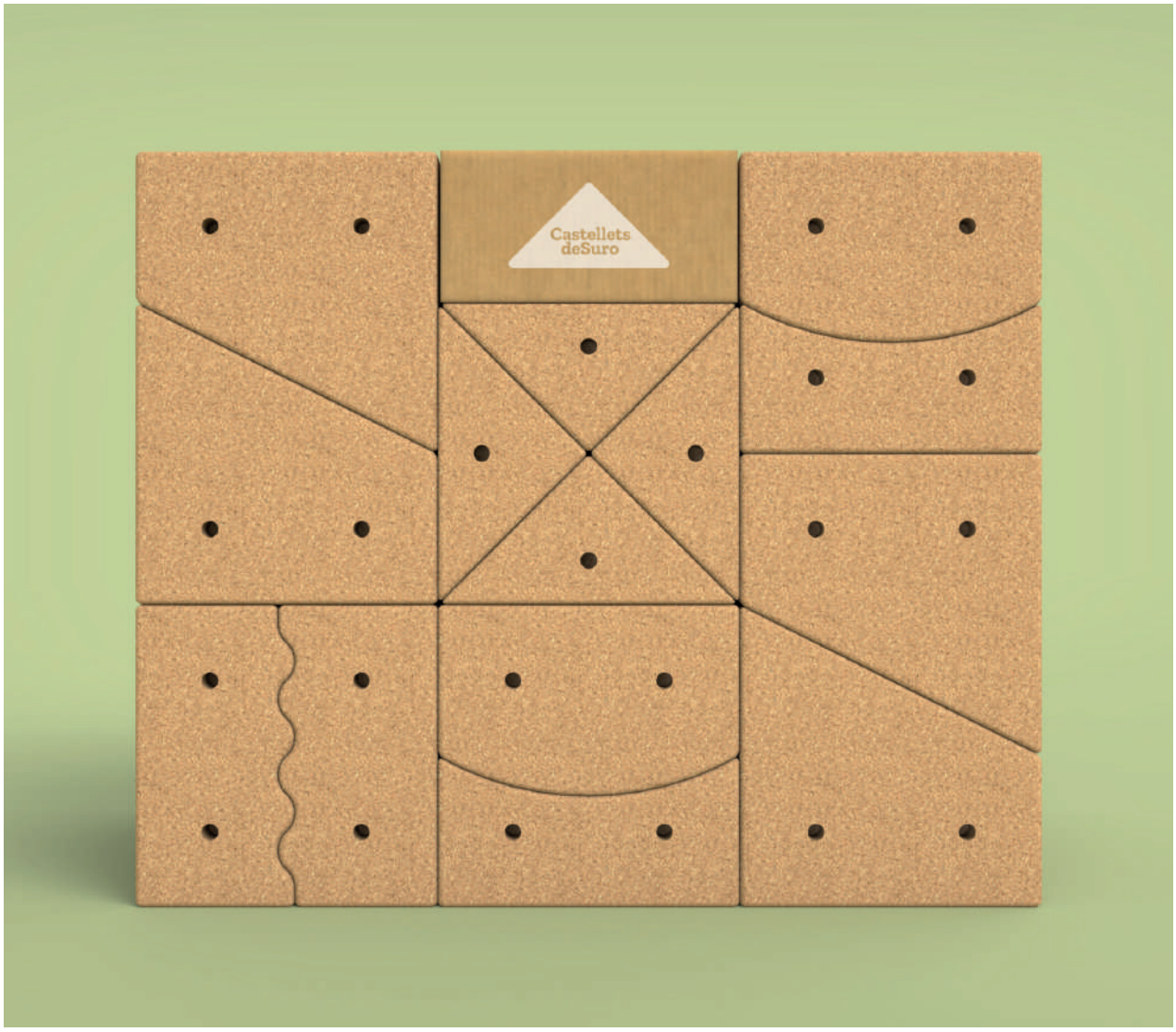
- **Non-static:** The system can be easily built and disassembled. It can be used for both permanent and ephemeral designs. For example it can create a space that fosters a recurring activity, such as a reading club; but it can also build a scenario for specific activities (e.g theater scenario, artistic happenings) or display-wall of drawings, science projects, etc.

Figure 55: Render (2020)
Source: Author

- **Future-oriented:** As pedagogical strategies are constantly being improved, this system facilitates the creation of new spaces that can accommodate these new learning strategies. The construction can be guided by the teacher's educational expertise (e.g. building a specific scenario for a particular teaching activity) or can be used as a free-play scenario. It is a tool to transform and articulate existing spaces to current needs.

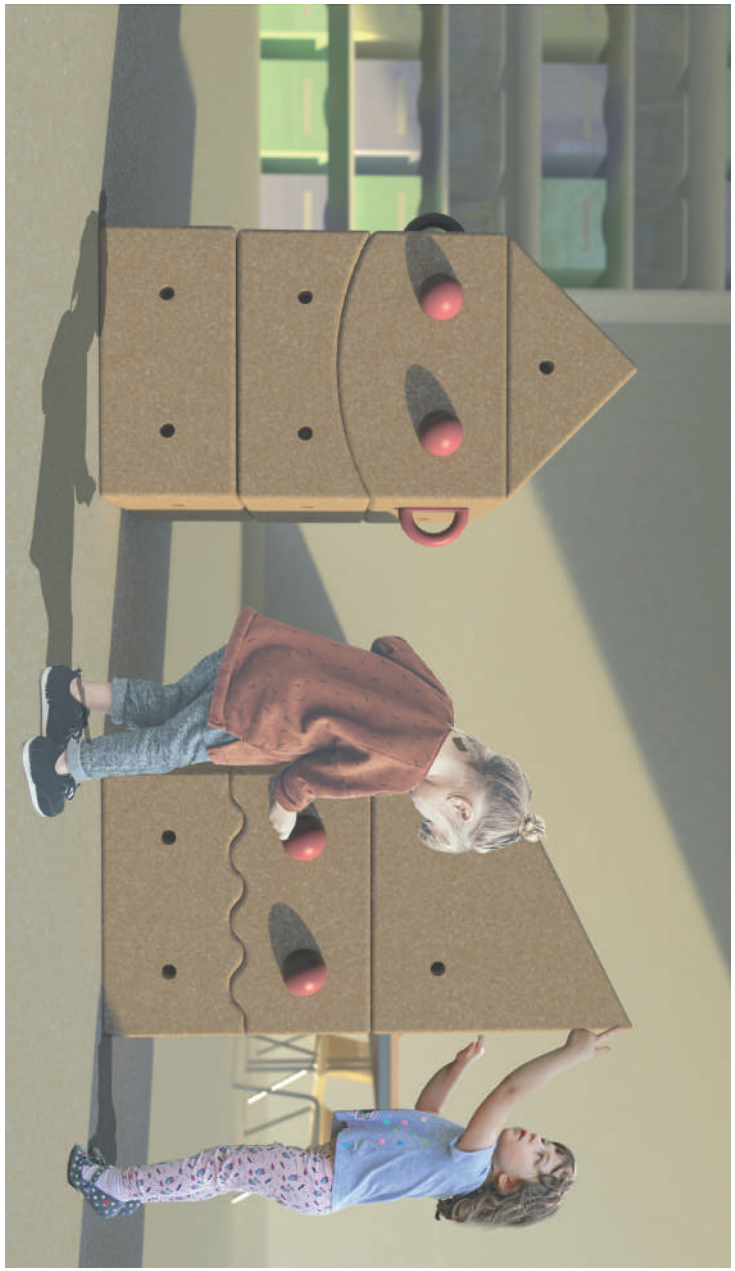
- **Eco-friendly:** Cork is a humble, yet beautiful natural material produced locally. Surrounding children from an early age with sustainable and recyclable materials will promote awareness of the importance of taking care of our environment.




Castellets
deSuro

Figures 56, 57 and 58: Renders (2020)
Source: Author

Figures 59 and 60: Classroom renders (2020) Source: Author



Figures 61 and 62: Renders (2020)
Source: Author

6.5. PRODUCT TESTING:

Due to the circumstances related to COVID-19, it was not possible to perform a prototype testing session nor to co-design with real students. Therefore, I organised a second interview with education expert Pilar Ugidos to share with her the concept of my design. I could draw valuable qualitative data from her large experience as teacher and school director that support and validate the benefits of Castellets de Suro.

This interview consisted in two main parts: At first, I prepared a short presentation with sketches and renders of my design that I used to explain my idea. I presented her the overall concept of my design, I showed her what the modules would look like, a few examples of possible scenarios built with them and then I briefly explained the benefits of its design and the material selected. The second part consisted of the following 6 questions:

1. Do you think teachers would be interested in this proposal?
2. Do you think it would be attractive to students?
3. What age range do you think would make the most use of the blocks?
4. Do you think it would require constant supervision from a teacher?
5. In your experience, what type of construction would be more frequent?
6. Do you think it is essential that the blocks can be fixed?

Our conversation was dynamic, so some of the questions were indirectly answered through her interventions during my presentation.

In summary, her answers stated that both primary and kindergarten teachers would be interested in this proposal. She validated the hypothesis that the target users would be children aged between 3 and 11. She explained that it would be great to have a small set of pieces in each classroom and teachers could share them when children would need to build bigger constructions. She explained that teachers always need to be in the classroom with their children, so she does not believe that the use of the blocks would require more supervision than that. She was very positive on the social potential of Castellets de Suro and she pointed out that

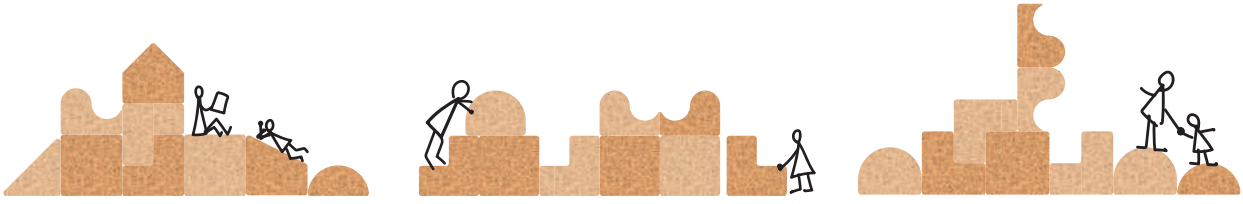


Figure 63: Sketches (2020)
Source: Author

it could be also used as individual pieces: she explained that often nervous children want to change seats or move when the teacher is explaining a new subject, so individual pieces could be used as dynamic seating solutions. She was quickly capable of picturing other uses of the system, such as building spaces to express emotions or moods.

At the end, I asked Pilar Ugidos about the union between blocks, as at that moment the design was not finished. I wanted to offer the possibility to easily fix and unfix the pieces and I shared with her several of my ideas (plastic plugs, tongue-and-groove joints, velcro, magnets, etc.). She noted that magnets would be a great option, as it can add a playful component to the system as children need to discover the polarity of the blocks to join them. She also suggested that if a more permanent fixation is required, it is something that the teacher could do to improve the security of the constructed architecture.

The interview was very useful and given the current circumstances related to COVID-19 it will be considered as a validation of the hypothesis that Castellets de Suro can generate positive impact for children in an academic environment, but this does not mean that a real focus group with children would not be required for future steps of this design project. Ugidos's comments were incorporated to the project and used to develop the final design of the blocks. At the end of our conversation, she even said that she saw a great learning opportunity in this system and educational companies could be interested in the idea.

6.6. DISCOVERABILITY

To complement the validation of Pilar Ugidos, I decided to auto-evaluate my concept with the six fundamental psychological concepts of Discoverability proposed by Don Norman, author of The Design of Everyday Things.

Norman explains that when we interact with a product, we have to be able to discover how it works, what it does and the different possibilities that it offers (Norman, 2013). These concepts that ensure discoverability are: affordances, signifiers, constraints, mapping, feedback and conceptual model.

In the following table, you will find a brief explanation of each concept and a reflection on how it is present in Castellets de Suro.

Discoverability (Norman, 2013)	Castellets de Suro
Affordances Indicates the possible actions, how we can interact with them.	The simple shapes of the blocks suggest they are construction elements. According to the Recognition-by-components theory by Irving Biederman, our mind recognises objects by dividing them into geons (primordial geometrical shapes). As users we can assign functional meanings to these shapes and build up our own forms, scenarios, uses.
Signifiers Indicates where the action should take place: "any perceivable indicator that communicates appropriate behavior to a person".	The plugs and different faces of the blocks suggest the kind of combinations possible between blocks.
Constraints "Serve to simplify what must be retained in memory" "The constraints by themselves are often not sufficient to determine the proper reassembly of the device—mistakes do get made—but the constraints reduce the amount that must be learned to a reasonable quantity." Can be **physical** (a piece that can only fit into one spot), **cultural** (tightening things clockwise), **semantic** (sit facing forward on a bike) or **logical** (when you build something and you have one piece left over)	The shapes act as physical constraints on the system. After a few uses, children will remember how the plugs can be used and which combinations of shapes work better for their constructions, but the design of the blocks ensures that these physical constraints are minimal to simulate the creativity of the users. The product does not have semantic, cultural nor logical constraints.

Mapping Indicates the controls and display of the product, "the relationship between the elements of two sets of things". A product is easy to use when the set of possible actions is visible.	The playful nature of Castellets de Suro invites users to be curious to understand the physical possibilities of the blocks.
Feedback How the product communicates the results of an action, how the user is aware that the system is working properly.	As it is an open-ended system, there is no right composition that proves that it is working correctly. It is not a puzzle where pieces only fit in one manner. Therefore, we rely on the polarity of the blocks to confirm that the blocks are united to make sure that the construction will hold together.
Conceptual model A manual or an "explanation, usually highly simplified, of how something works".	A usage poster is included in the packaging of the product showing visual examples of how the blocks can be configured to create different interesting learning spaces inside the classroom. It also includes a series of recommendations for cleaning and storage and re-directs teachers to a virtual online community where they can post the creations of their students, share advice and check how other educators are using it.

6.7. IDENTITY

The name Castellets de Suro, meaning little cork castles, comes from the local tradition of "castell" or "castellets", human towers that are built in Catalan festivities. It is a cultural tradition that dates back to the 18th Century, when colles (groups of "castellers", the castle makers) began to compete to prove who could erect the bigger castles (Castellers de Barcelona, 2020). To build a castle three main elements are needed: a pinya (the horizontal base of the construction formed a big number of people that bring stability and strength to the structure), a tronc (vertical trunk divided into various stores with a decreasing number of people as the levels rise) and a pom de dalt (the crown of the castle built by the youngsters of the group as they are more agile and light to climb to the top). The motto of the castellers is "strength, balance, courage and common sense" as these are the skills required to be able to build such big human structures.

As previously explained, the percentage of foreigners in Barcelona is very big and often schools have many students that are new to the city and do not know the local traditions or languages. Using the name of Castellets de Suro, besides describing easily the functional and playful possibilities of this build-upon modular system, also offers a connection to a local tradition and enhances inclusiveness and empathy with the Catalan culture.

The visual identity of Castellets de Suro captures the simplicity and modularity of the system and strengthens the joyfulness, creativity and openness values of this educational tool to build human relationships.

CastelletsdeSuro

Figure 64: Different logos possibilities, (2020) Source: Author

Colours

#FF7477 Pink

#252D40 Blue

#EEDCD0 Beige

#C5D86D Green

Typeface

Zilla Slab Bold
Zilla Slab Light

Figure 65: Castell in Barcelona, Angela Compagnone (2019) Source: Unsplash

6.8. USAGE: THE STARTER PACK

The starter pack of Castellets de Suro comes in a big cardboard box and includes 32 blocks plus a set of plugs. The packaging also includes a folded leaflet/poster that shows different illustrated examples of possible compositions through the flexibility and playfulness of the product and how the plugs can be used to bring the blocks together. As previously explained, the limits of this system are set by the imagination of its users, so students and teachers will be the designers of their personal learning spaces. The blocks can be used when developing multiple activities in the same space, the acoustic properties of cork ensure minimal noise when manipulating them so other children don't get disturbed while doing high concentration activities. The storage is simple and quick, as the blocks have practical shapes based on a grid structure.

POSTER: This poster is meant as a source of inspiration and will direct teachers to the product's website, a space where they can join the Castellers de Suro community and share with other teachers the creations of their students and examples of learning activities that can be done with the blocks. It also includes basic advice on how to take care of the blocks.

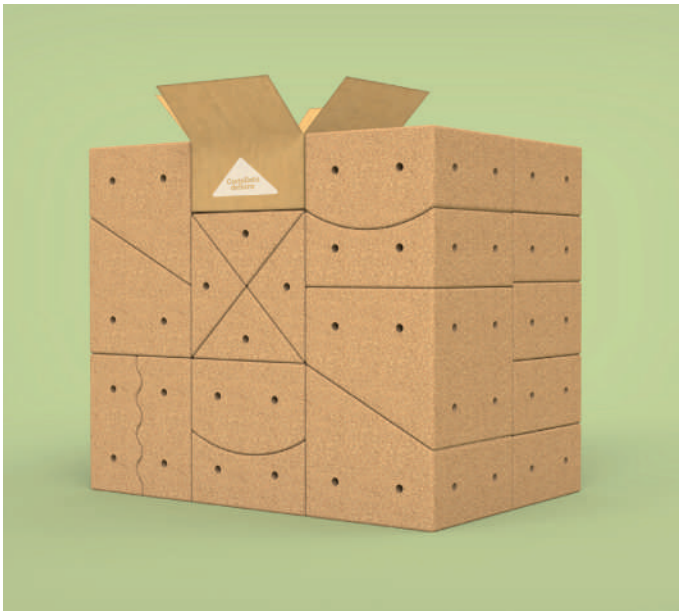
USES: Children can build any kind structure, architecture or object, such as: reading nests, nooks, relax corners, room dividers, display walls, platforms, playgrounds, stages for theatre plays or artistic activities, seats, large scale puzzles, sculptures, forts, houses, furniture, landscapes, etc. The three types of plugs enlarge the possibilities of the system by offering the possibility to unite the blocks and adding buttons and handles to them.

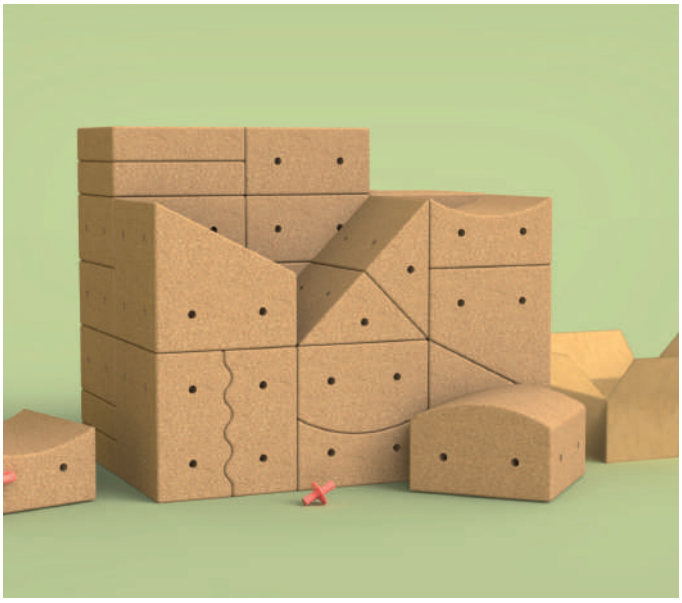
Figures 66, 67 and 68: Poster-leaflet, (2020) Source: Author

Castellets deSuro

Building blocks for learning spaces

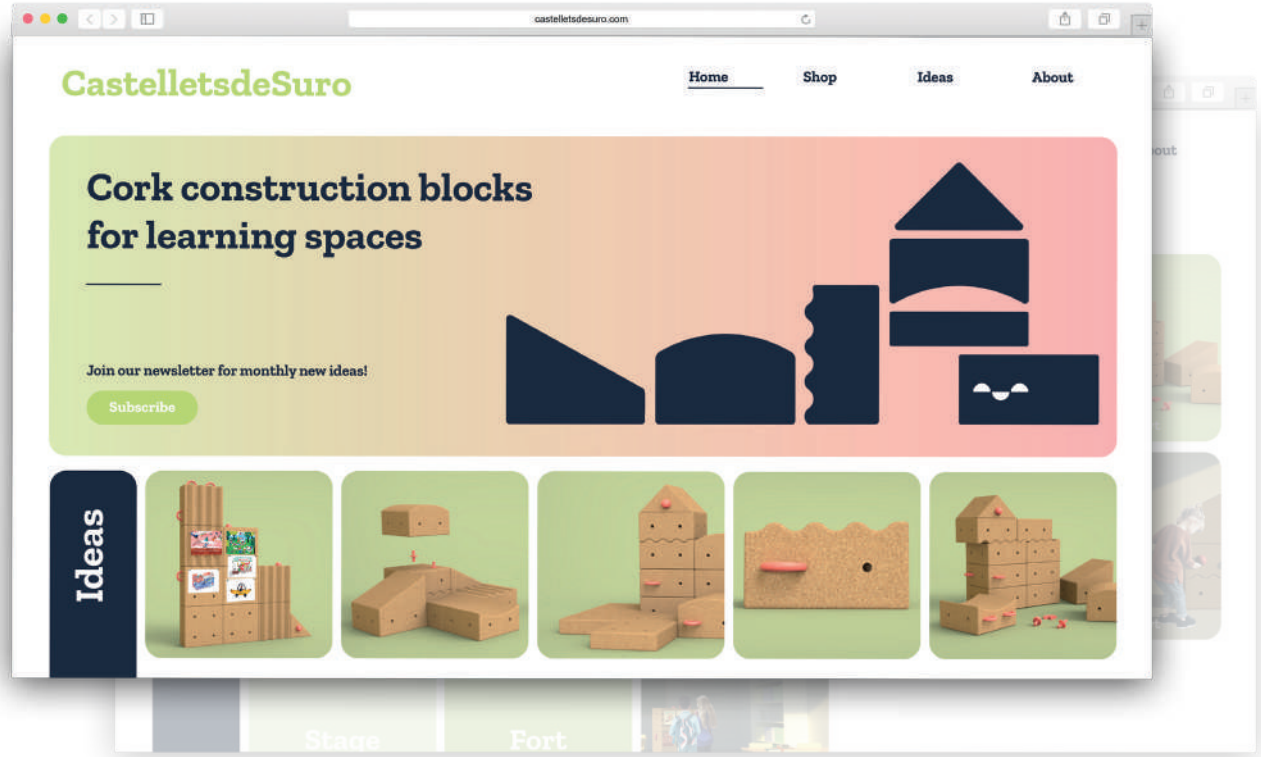
walls, stands, nooks, space dividers, platforms, sculptures, nests, forts, houses, stages, puzzles, playgrounds, chairs, furniture, learning tools.





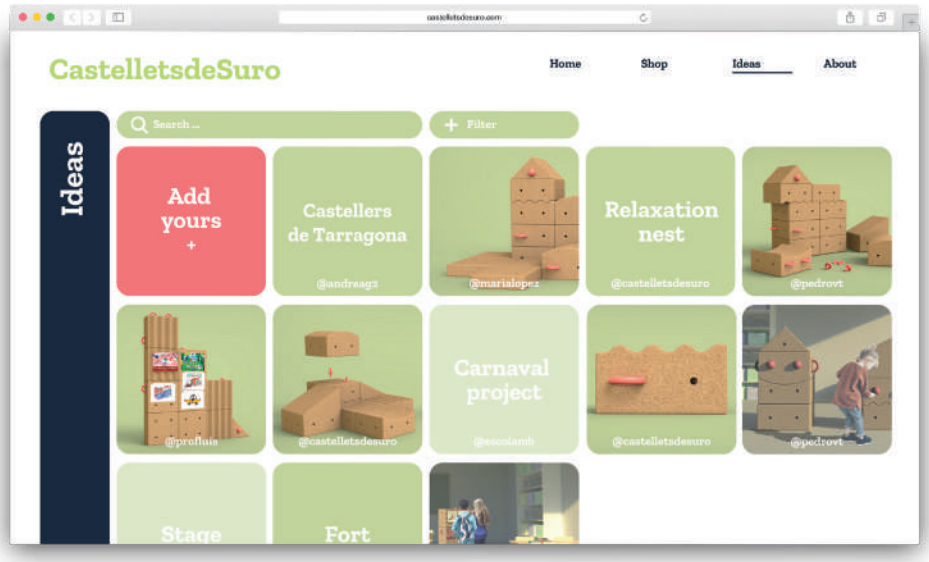
PACKAGING:

The set of 32 blocks, 70 plugs and poster comes in a big cardboard box that can be reused as part on an ephemeral construction.

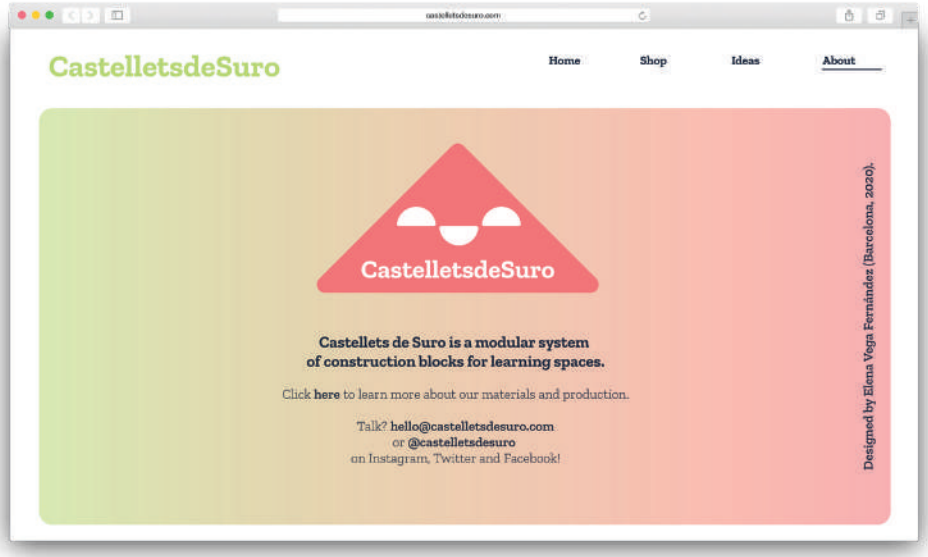


WEBSITE: The website of Castellets de Suro is not only a space where educators can purchase sets of blocks, but mainly works as a hub where a community of teachers can share posts with pictures and articles about the activities and micro-architectures they develop with the blocks. In this manner, the website will create a conversation among teachers and reach more people interested in the pedagogical benefits of this system.

Figures 73, 74, 75 and 76: Website, (2020) Source: Author


CastelletsdeSuro
Home
Shop
Ideas
About
Ideas
Search ...
Filter
Add yours
+
Castellers de Tarragona
@andreag3
@marialopez
Relaxation nest
@castelletsdesuro
@pedrovt
@profluis
@castelletsdesuro
Carnaval project
@escolamb
@castelletsdesuro
@pedrovt
Stage
Fort


CastelletsdeSuro
Home
Shop
Ideas
About
Starter pack Set
32 blocks (7 types)
70 plugs (3 types)
Add to cart
Construction blocks to create learning scenarios: walls, stands, nooks, space dividers, platforms, sculptures, nests, forts, houses, stages, puzzles, playgrounds, chairs, furniture, learning tools.
Suitable from 3 to 11 years old.
Size of blocks: approx. 36x36x18 cm, 1-3 kg/each.
Size of set: 72x108x90 cm.
Agglomerate of natural cork + bioplastic
Made in Spain


CastelletsdeSuro
Home
Shop
Ideas
About
CastelletsdeSuro
Castellets de Suro is a modular system of construction blocks for learning spaces.
Click here to learn more about our materials and production.
Talk? hello@castelletsdesuro.com
or @castelletsdesuro
on Instagram, Twitter and Facebook!
Designed by Elena Vega Fernández (Barcelona, 2020).

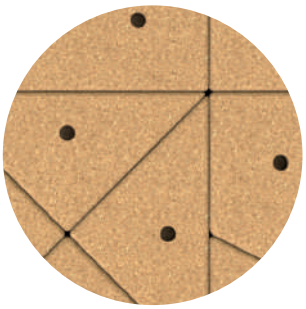
6.9. TECHNICAL DETAILS

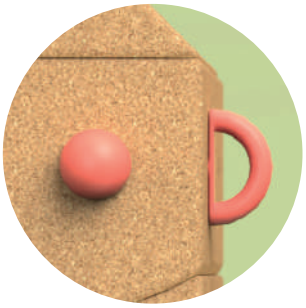
MATERIALS:

CORK

As previously mentioned, cork is the main material of the blocks. This material was selected because of its great physical properties (Institut Catalá del Suro, 2020):

1. Low density and lightness.
2. Impermeability mould resistant.
3. Low heat transmission and good thermal insulation.
4. Acoustic insulation and low sound transmission.
5. High resistance to movement or high coefficient of friction.
6. Damping capacity.
7. Compressibility, elasticity and flexibility.
8. Durability, stability and rigidity.
9. Hygroscopic.
10. 100% natural, recyclable and renewable.





Figures 77 and 78: Textures, (2020)
Source: Author

"Cork is the quintessential 21st-century material, allying outstanding technical performance, unparalleled sustainability, premium features that enable myriad applications in the most diverse areas" (Amorim, 2020). Cork comes from the bark of the Cork Oak tree, which is stripped from the trunk of the tree every nine years without damaging it. Each tree can be stripped around 17 times, so cork trees are often harvested for 150 years. This type of tree is an evergreen tree from the Fagaceaue family (Quercus suber) mainly found in Western Mediterranean Countries, such as Portugal, Spain, Italy, France, Morocco, Tunisia and Algeria. "Cork consists of suberin cells in the shape of tiny pentagonal or hexagonal honeycombs, a complex fatty acid and is filled with an air-like gas, which makes up 90% of its volume", hence it is a very light and compressible material. (Amorim, 2020).

Cork is a humble natural material with an incredible "capacity for renewal and for adapting to new technological demands". Therefore it is used for "state-of-the-art engineering solutions", architecture, construction, fashion, product design and even for the spacecraft industry (Amorim, 2020). It is light, soft and flexible so it is easy and safe for children to manipulate. It is water resistant and easy to clean. It is a silent material, so children can be constructing new micro-architectures while others are nearby doing activities that require silence and concentration. Children can pin paper and drawings to display their work without damaging the product. The texture and beauty of cork creates an interesting tactile experience for children and gives dignity to a humble and natural material. Lastly, but not least it is a 100% natural and recyclable material. Environmental awareness comes in hand with designing positive impact.

Local harvesting and production

Another great benefit of using cork is that it is a material available locally. In Spain, there are 506,000 hectares of cork oak groves that represent 25% of the world's total. Each year more than 88,000 tons of cork are extracted (30% of the world's production). After Portugal, Spain is the second biggest producer of cork in the world. The Spanish cork sector is mainly located in Extremadura, Andalucia, and Catalonia, where there are 150 companies concentrated, generating around 2,000 jobs and rising to 3,000 during the cork extraction season. (López Corralo, 2017). Catalonia has 83,000 hectares of land in the south (Palafrugell) and it is estimated that its production is 3-4 tons of cork/hectare per year. (Institut Catalá del Suro, 2020).

Type of cork

Cork can be found in various forms such as natural plates, granulated, agglomerated and composites. The type of cork for this project is agglomerate of natural cork "flex" (coarse grain). The choice of the type of cork was made in consultation with the company Barnacork. Based on their expertise with cork manufacturing, this cork was selected as the most appropriate for Castellets de Suro. Material details (Barnacork, 2020):

2-5 mm	170-210 kg/m³	+ 400 kPa	+ 75 %
Particle size	Density	Breaking strain	Recovery

BIOPLASTIC

The material of the plugs should also be environmentally-friendly, such as a bioplastic: a bio-based elastomer (e.g. BioTPU or BioTPE) that is flexible and strong. The natural adherence of plastic and cork ensures a stable union by pressure that is easily manipulated by children.

For example, the French company NaturePlast manufactures these types of plastics from thermoplastic resins produced from renewable biomass (NaturePlast, 2020). In future stages of the implementation of Castellets de Suro, further analysis of these materials and a Life Cycle Assessment (LCA) would be required to be able to provide a value proposal following a circular economy model.

up to 80 %		50 Sh A - 55 Sh D	
Biological origin	Biodegradable in industrial composting	Hardness	Suitable for children: non toxic

ERGONOMY

The pioneer work of Henry Dreyfuss on ergonomics and anthropometrics (picture in the following page) entailed a great improvement on the history of Industrial Design, as it influenced the minds of posterior designers on the importance of including ergonomic studies in design processes and in fact, nowadays it seems unthinkable to design without putting people in the center of our designs.

The dimensions of the blocks have been established based on anthropometric measures extracted from *Guía de diseño ergonómico de productos para la infancia (Ergonomic Design Guide for Children's Products)* developed by the Instituto de Biomecánica de Valencia and the Instituto Tecnológico de Producto Infantil y Ocio (Alemany and Busó, 2015). This study was chosen as reference as the target group of the pilot proposal of Castellets de Suro are children from Barcelona, but the high level of flexibility of the system should be adaptable for children from other places of the world.

The blocks have to be easily manipulated by children from 3 to 11 years old, so they have to be light: the weights of the blocks oscillate from 1 to 3 kg (some of the blocks are empty inside to ensure that the cork is not too heavy). The plugs are big, so there no possibility of choking.

"A chair is a chair, is a chair, is a chair ... but a seat does not necessarily have to be a chair" said Eerno Arnio from one of his most well-known designs *Puppy* (as quoted by Herman Miller, 2020). Similarly, the blocks have been devised so that they can be transformed into seats in a comfortable way. The modularity of the system offers the possibility to use one block for smaller children, one block plus the flat rectangle for children between 6 to 9 years old and two blocks for bigger children. The dimensions also took into consideration the recommendations for school chairs (IBV, 2015):

Measures (based on children's heights)	1.05 m	1.35 m	1.80 m
Minimal seat width	25 cm	29 cm	36 cm
Seat height	26 cm	34 cm	46 cm
Seat depth	26 cm	33 cm	40 cm

Figure 79: Children's antropometric data, Henry Dreyfuss (1967) Source: The measures of man

Figure 80: Sitting blocks render (2020) Source: Author

ANTHROPOMETRIC DATA – MALE AND FEMALE CHILDREN

top figure in box is data for boys, lower figure is for girls, and one figure applies to both.

Age	Ht.	Wt.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	Θ	Φ
17	68.2 63.6	138. 119.	12.2 11.5	20.7 19.7	16.3 15.1	15.6 14.4	3.4 3.	31.7 28.9	15.7 14.4	6. 5.8		13.2 12.1	12.9		3.7	12.3 11.5	10. 9.1	7.6 7.		35.3 33.5	31.3 29.5	17. 16.	7.3 7.6	5.2 5.	7.6 6.7		2.9 2.8	10.1 9.5	16"	27"
16	67.3 63.5	132. 118.	11.8 11.3	20.5 19.8	16.2 14.9	15.5 14.5	3.3 3.	31.5 28.9	15.2 14.3	6. 5.8		12.9 12.1	12.7 12.8		3.7	12.2 11.7	9.9 9.1	7.6 7.		34.5 33.4	30.5 29.4	17. 15.5	7.6 7.3	5.2 5.	7.4 6.9		2.8 2.7	9.8 9.4		
15	65.6 63.2	122. 115.	11.1	20.1 19.7	15.9 14.9	15.2 14.5	3.3 3.	31. 28.9	14.7 14.2	5.9 5.8		12.4 11.9	12.3 12.7		3.7	11.9 11.5	9.7 9.	7.5 7.		33.4 33.	29.4 29.	16. 15.5	7.5 7.3	5.1 5.	7.2 6.8	2.3	2.7	9.5 9.3	15	25
14	63. 62.3	109. 108.	10.9 11.	19.2 18.8	15.1 15.2	14.6 14.3	3.2 3.	29.7 28.5	14.1 14.	5.9 5.7	11.	11.6 11.4	11.6 12.3	5.6	3.6	11.4	9.3 9.	7.2 6.9	3.	32.1 32.4	28.1 28.4	16. 15.	7.4 7.3	5.1 5.	6.9 6.7	2.2 2.3	2.6	9.1		
13	60.5 60.6	96. 100.	10. 10.2	17.9 19.	15.5 14.3	13.9 14.1	3.2 3.	28.5 28.2	13.5 13.6	5.8 5.7		11. 11.1	11. 11.8		3.5	10.7 11.	8.8	6.8		30.9 31.5	26.9 27.5	15.5 15.	7.4 7.2	5.1 5.	6.6 6.5	2.2	2.5	8.9	14	24
12	58.2 59.	86. 90.	10.8 10.6	17.1 17.9	13.9 14.3	13.3 13.5	3.1	27.3 27.4	13.	5.8 5.7		10.6 10.7	10.6 11.2		3.4	10.3 10.6	8.4 8.5	6.6		29.9 30.3	25.9 26.3	14.5 14.7	7.3 7.2	5.1 4.9	6.4 6.3	2.2	2.5	8.6 8.5		
11	56.2 56.5	77. 79.	10.6 10.4	16.6 16.8	13.3 13.4	12.7 12.9	3.	26.1 26.3	12.6 12.4	5.8 5.7	10.5	10.2 10.3	10.1 10.5	5.	3.3	9.9 10.	8.1	6.3 6.4	2.8	29.2 29.1	25.2 25.1	14. 14.4	7.3 7.1	5. 4.9	6.2 6.	2.2	2.5 2.4	8.4	13	22
10	54.3 54.2	71. 70.	10.6 10.4	15.9	12.7	12.2 12.3	2.9	25.1 25.	12.3 12.	5.8 5.6		9.9	9.8 10.		3.2	9.5	7.8 7.7	6.1		28.5 28.2	24.5 24.2	14. 13.	7.3 7.1	5. 4.9	6. 5.7	2.2 2.1	2.5 2.4	8.3		
9	52.4 52.	64. 63.	10.7 10.3	15.1	12.2 12.1	11.6 11.7	2.8	23.9 23.8	11.8 11.5	5.7 5.6		9.5	9.1 9.5		3.1	9.1	7.4 7.3	5.9 5.8		27.7 27.4	23.7 23.4	13.5 13.	7.2 7.	5. 4.9	5.8 5.5	2.1	2.4 2.5	7.9 8.	12.5	20.5
8	50.4 50.	58. 57.	10.6 10.2	14.5 14.4	11.5	11.1	2.7	22.7	11.4 11.1	5.7 5.6	9.2	9.2	9. 9.1	4.4	3.	8.7	7.1 6.9	5.7 5.6	2.5	27. 26.6	23. 22.6	13. 12.5	7.2 7.	5. 4.9	5.7 5.4	2.1	2.4 2.5	7.7		
7	48.2 47.9	53. 51.	10.7 10.3	13.6	10.8 10.9	10.5	2.6	21.5 21.4	10.9 10.7	5.7 5.5		8.8	8.7 8.8		2.9	8.2	6.8 6.6	5.4 5.3		26.1 25.7	22.1 21.7	12. 11.5	7.1 6.9	5. 4.8	5.5 5.4	2.1	2.4	7.4	11	18.5
6	46.1 45.8	48. 46.	10.8 10.4	12.7	10.3	9.8 9.9	2.5	20.2	10.4 10.2	5.6 5.5	8.5	8.5	8.3 8.4	4.1	2.8	7.6	6.1 6.2	5.1	2.3	25.4 25.	21.4 21.	11.6 11.	7.1 6.8	4.9 4.8	5.5 5.3	2.	2.4	7.		
5	43.9 43.6	43. 42.	10. 9.7	12.7	9.6	9.2	2.4	18.9 18.8	10.1 9.8	5.6 5.4		8.2	8. 8.1		2.7	7.	6. 5.9	4.9 4.8		24.5 24.3	20.5 20.3	11. 10.	7. 6.8	4.9 4.8	5.4 5.2	2. 1.9	2.3 2.4	6.8 6.6	10	17.5
4	40.9	38. 37.	10.4 10.5	11.1 10.9	8.8	8.4 8.5	2.2	17.2	9.7 9.4	5.6 5.4		7.9	7.4 7.7		2.7	6.4	5.6 5.4	4.7 4.6		23.5 23.1	19.5 19.1	9.5 10.	6.9 6.7	4.9 4.8	52	1.9 1.8	2.3 2.2	6.6 6.5		
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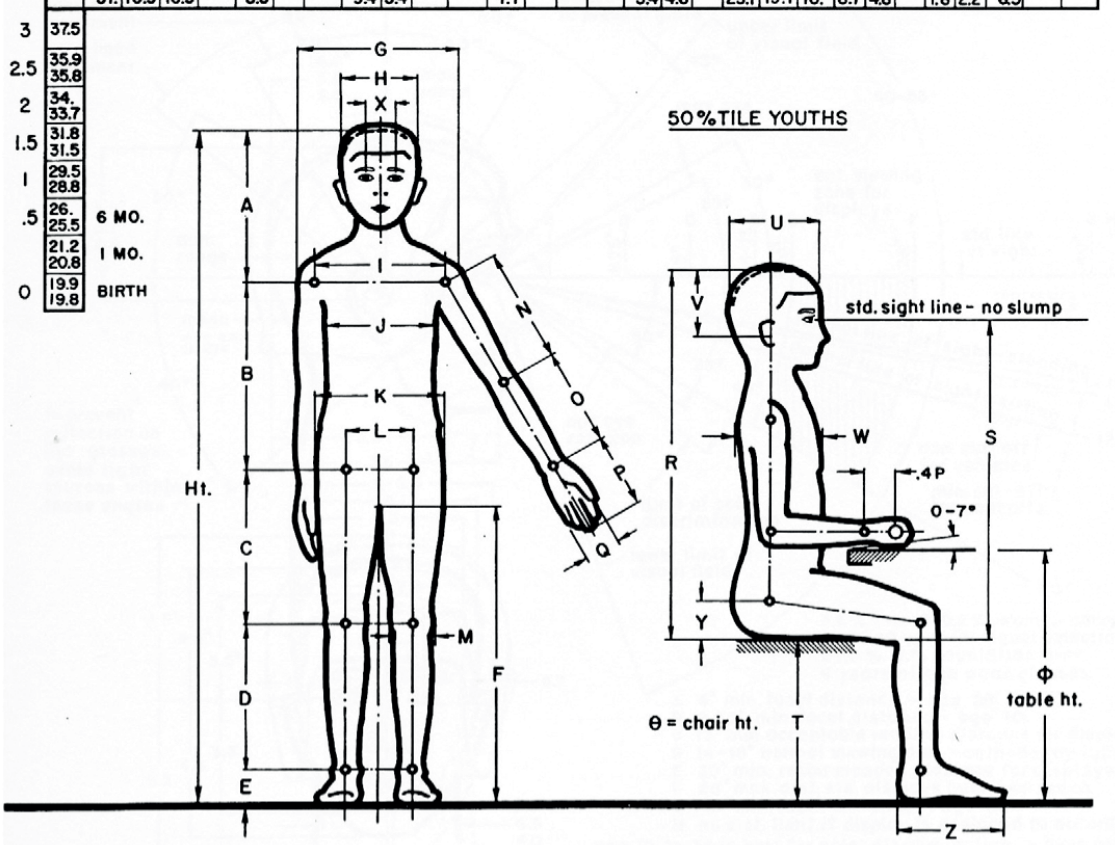
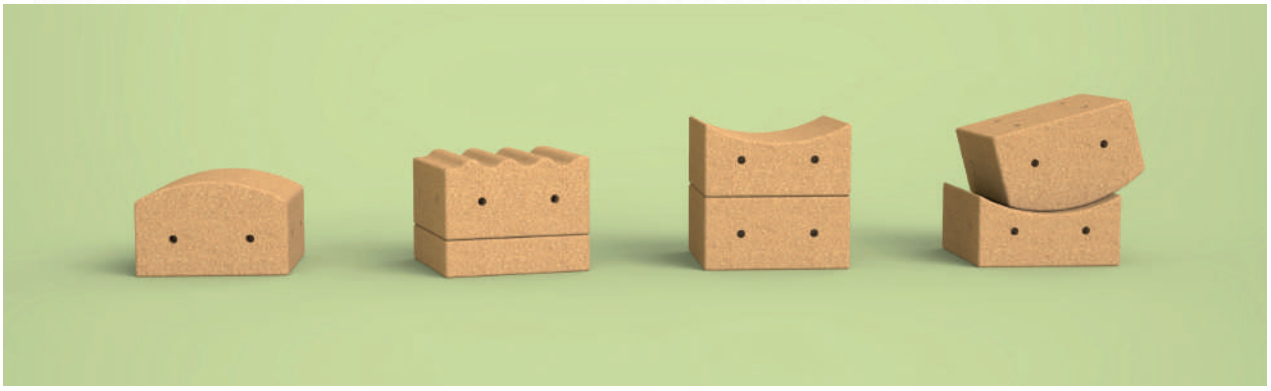




PRODUCTION

As previously mentioned, Catalonia is one the main places in Spain where there are Cork Oak trees and its cork industry is strongly focused on the manufacturing of cork products. Most of the companies are specialized in producing wine cork stoppers or construction solutions. Barnacork is one of these companies that also manufactures other types of cork products, such as furniture. Its factory is located in Polinya, near Sabadell, province of Barcelona. I contacted the company and talked to Jaume Palet, one of the owners and commercial director. He kindly gave me advice on the production of these blocks, recommended the most convenient type of cork and gave me an estimated budget for the blocks. He confirmed that the manufacturing of the blocks could be done by two options: The first option would be to start from big cork blocks and then mill the shapes with a CNC (computer numerical control) milling machine, make the holes for the magnets, cover them, round the edges and polish the surface. The second option is similar but instead of using big chunks of cork it starts from thinner cork sheets glued together.

Other manufacturing opportunities could be reached with Cork2000 (Palafrugell, Girona), another Catalan cork company that also produced cork furniture and stationery. Alternatively, the cork could be purchased directly from cork extracting companies and a CNC manufacturing workshop could be hired, such as CrearLab (Taradell, Barcelona) or Indawood (Torellò, Barcelona), to produce the blocks. During the research on production options, I interviewed Ovidi Alum Gelabert, architect and designer of HORY, a local firm of cork toys and he gave me great tips on this topic.

The plugs would be manufactured by a transformation process of injection moulding.

CastelletsdeSuro

PLANS

Elements	Weight (kg)	Quantity
Blocks		
1 - rectangle	3	6
2 - flat rectangle	1	6
3 - triangle	1	4
4 - convex	3	4
5 - concave	3	4
6 - waves	3	4
7 - wedge	3,8	4
Total		32
Plugs		
1 - connector	0,02	40
2 - button	0,06	15
3- handle	0,04	15
Total		70

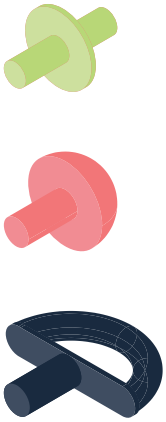
Plug 1 - Connector

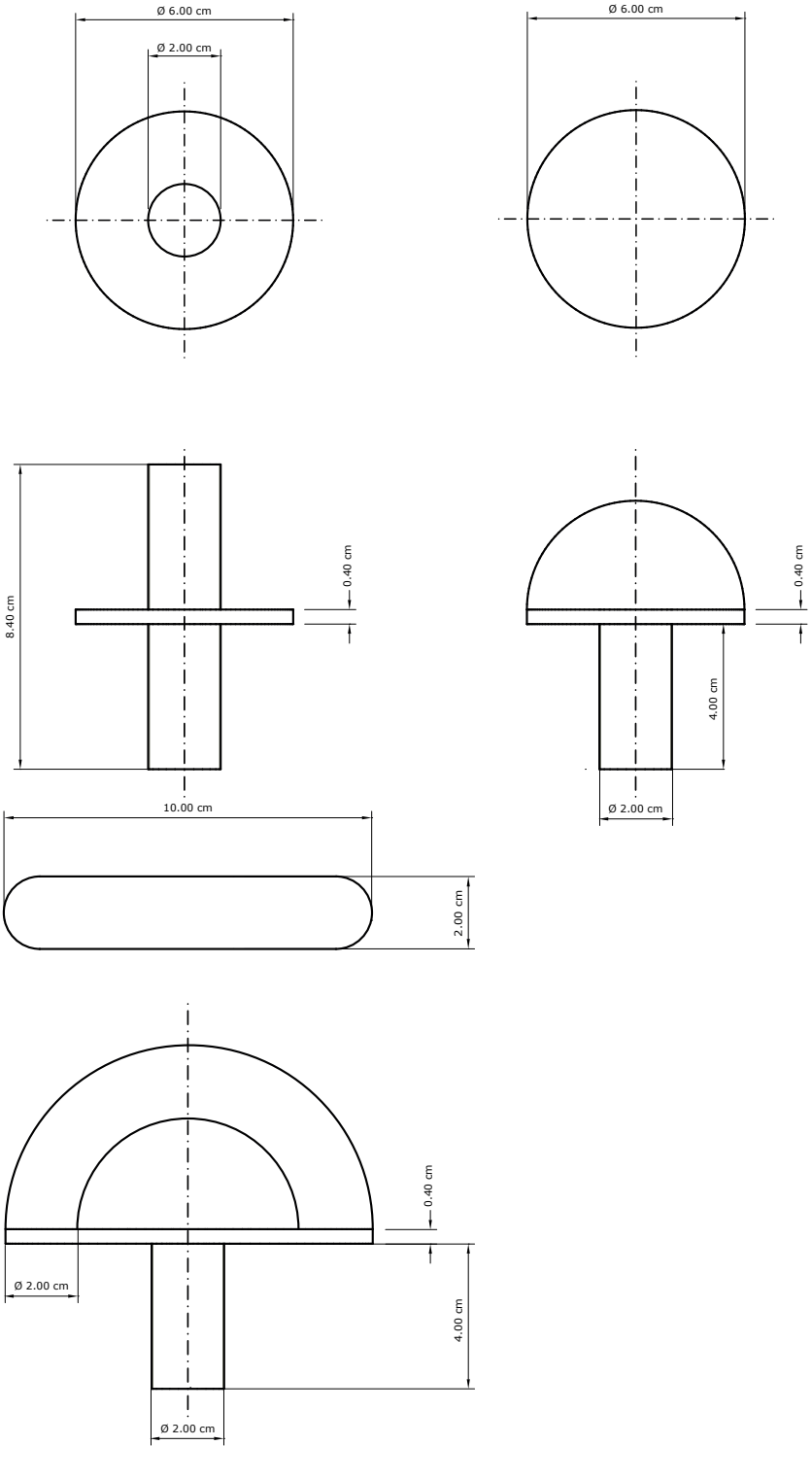
Plug 2 - Button

Plug 3 - Handle

PLANS

PLUGS E=1:2

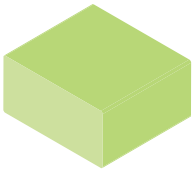


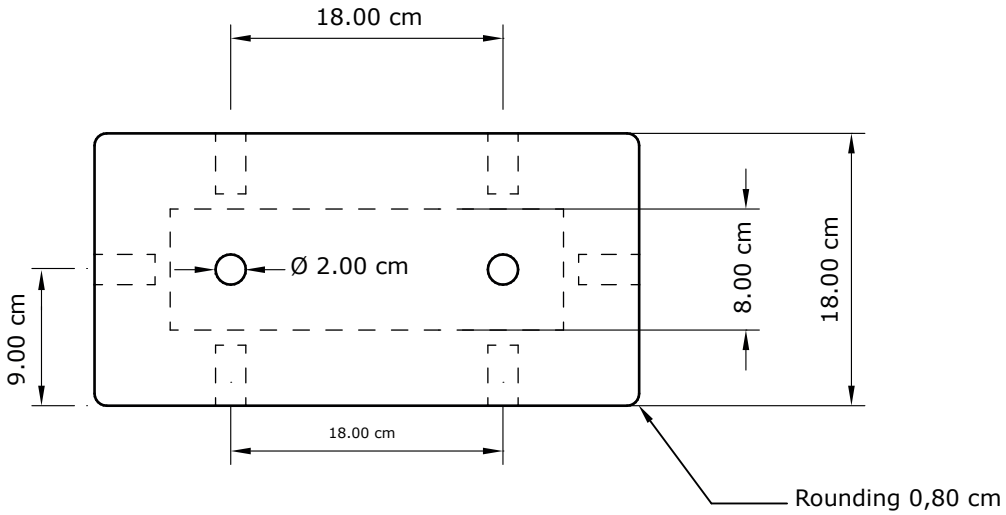


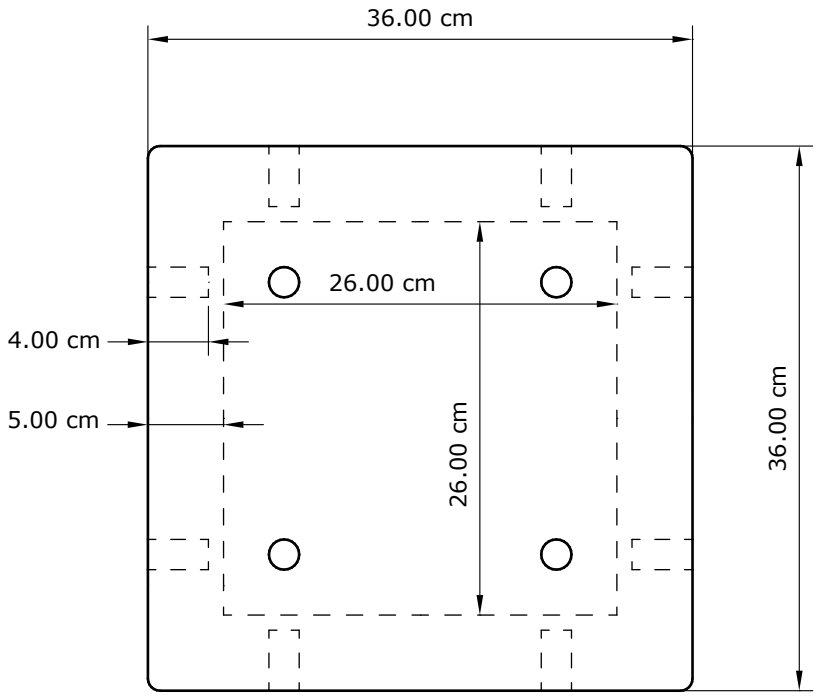
PLANS

Block 1 - rectangle

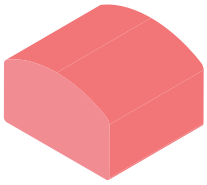
BLOCKS E=1:5

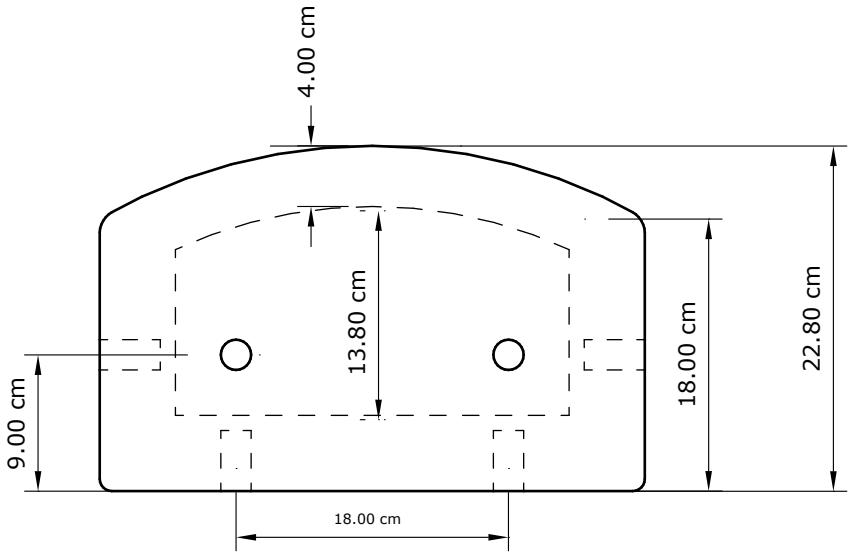


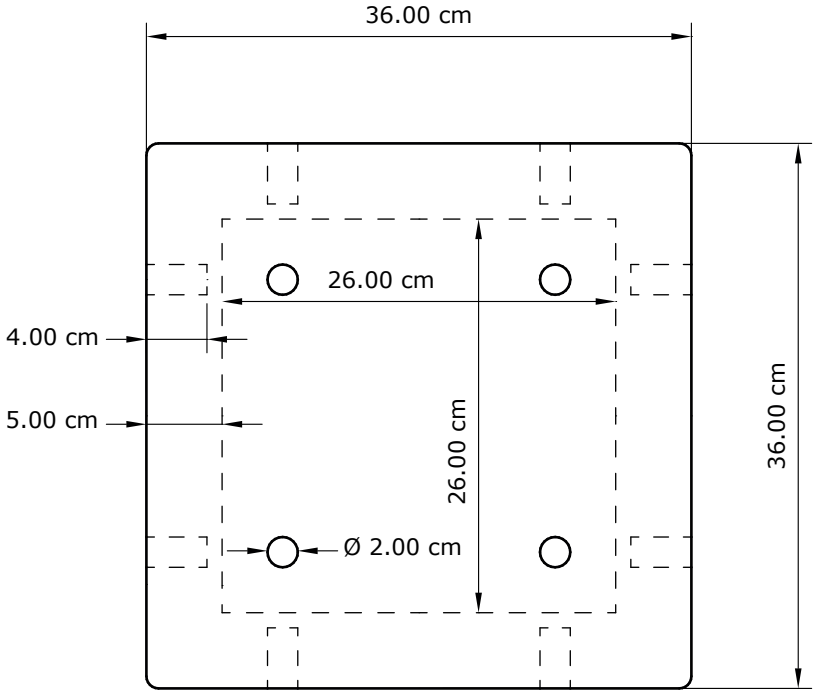




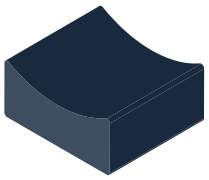
Block 2 - convex

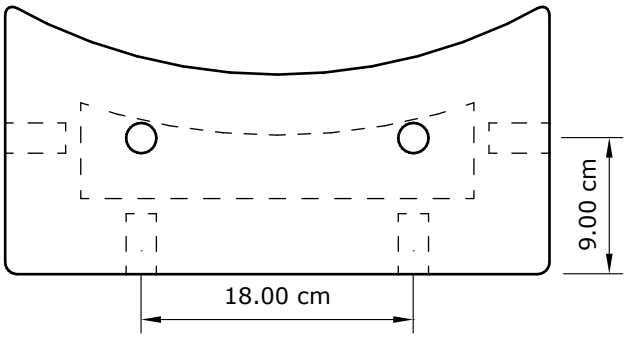


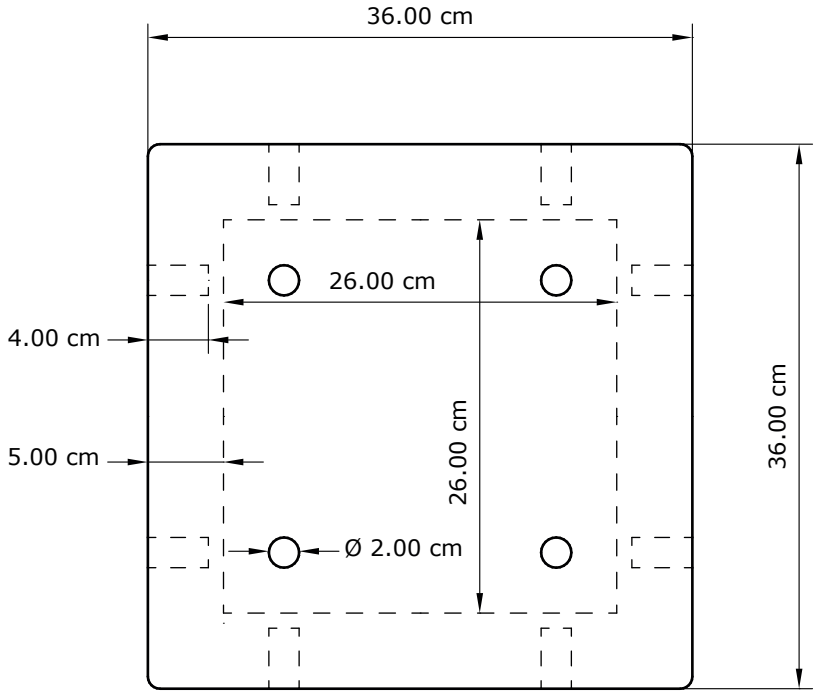




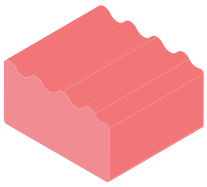
Block 3 - concave

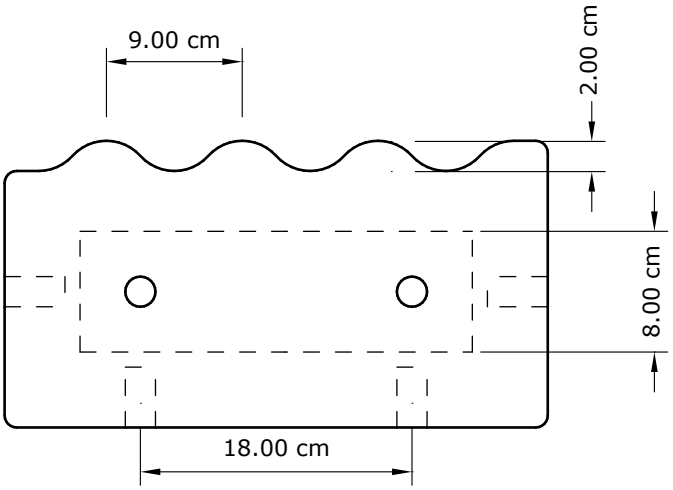


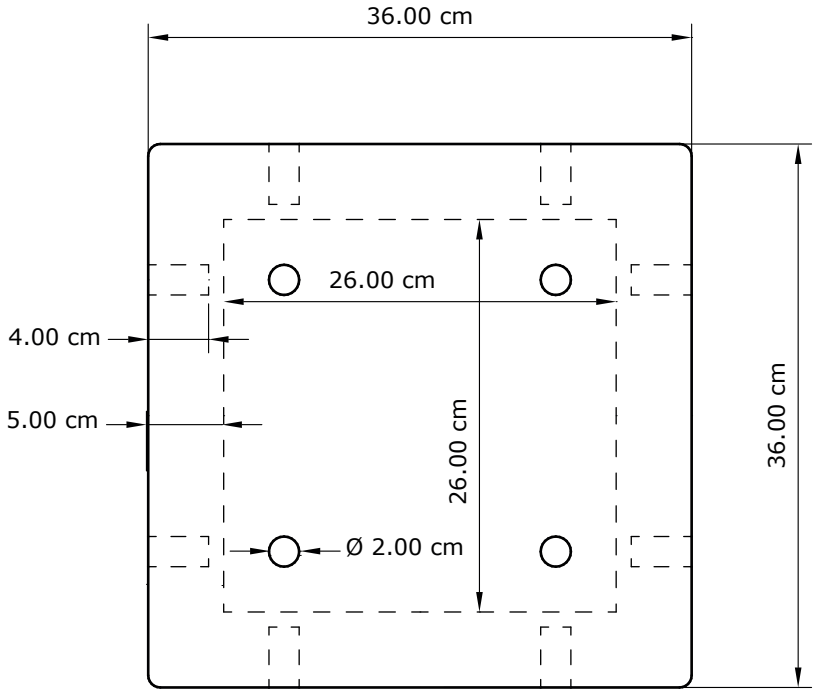




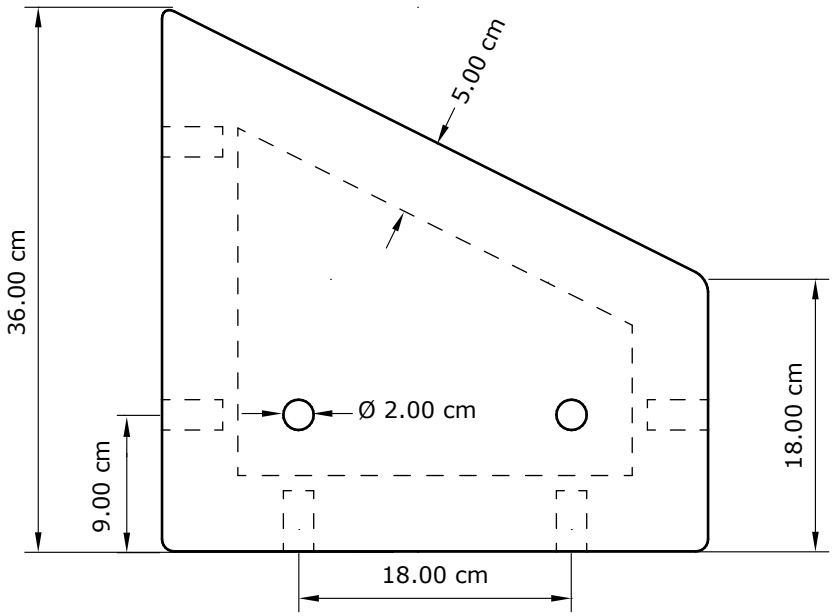
Block 4 - wavy

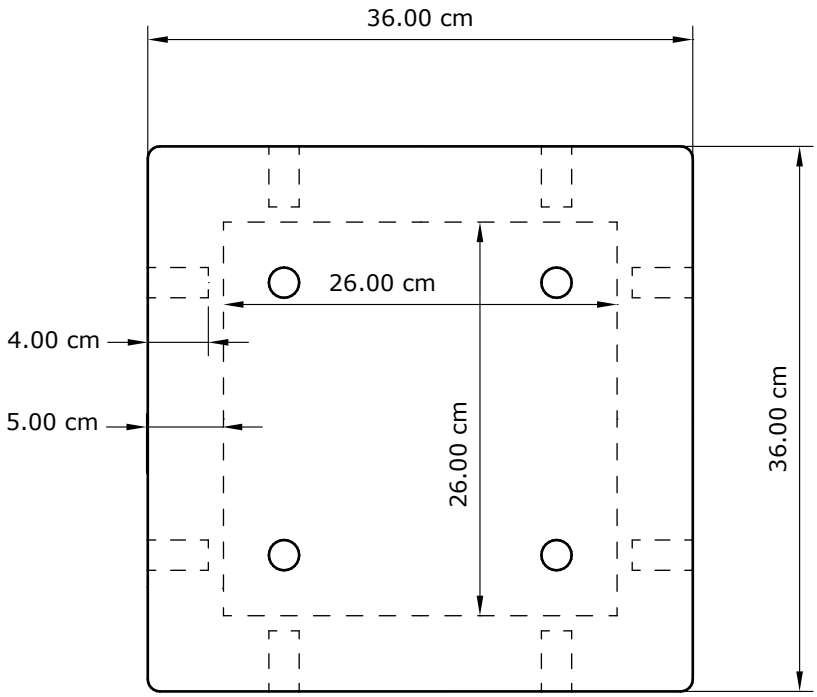



9.00 cm
2.00 cm
8.00 cm
18.00 cm

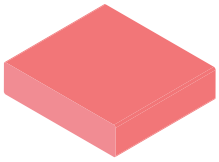

36.00 cm
26.00 cm
4.00 cm
5.00 cm
26.00 cm
Ø 2.00 cm
36.00 cm

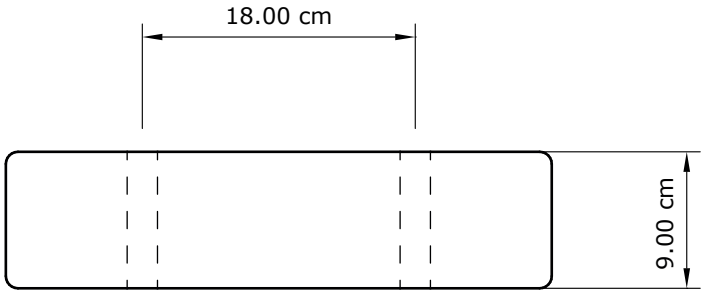
Block 5 - wedge

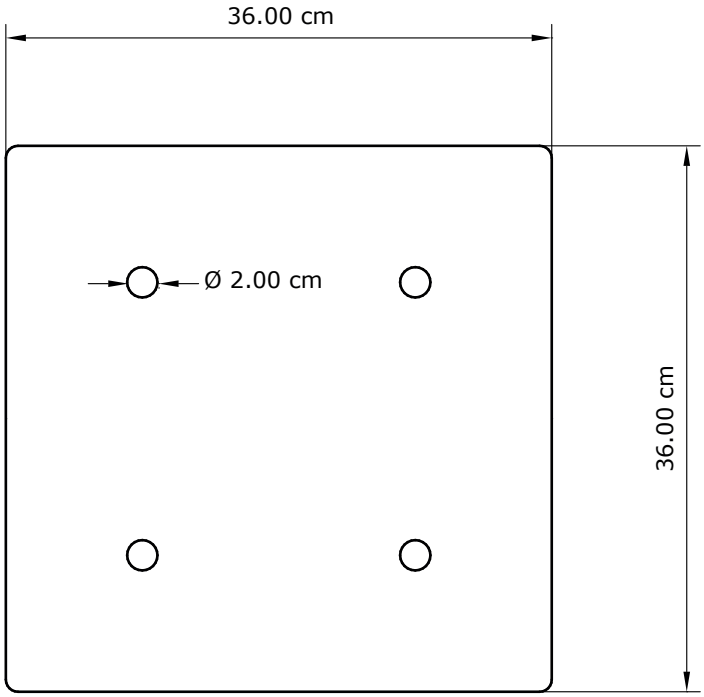




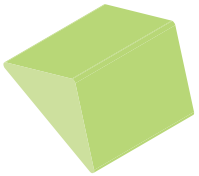
Block 6 -flat rectangle

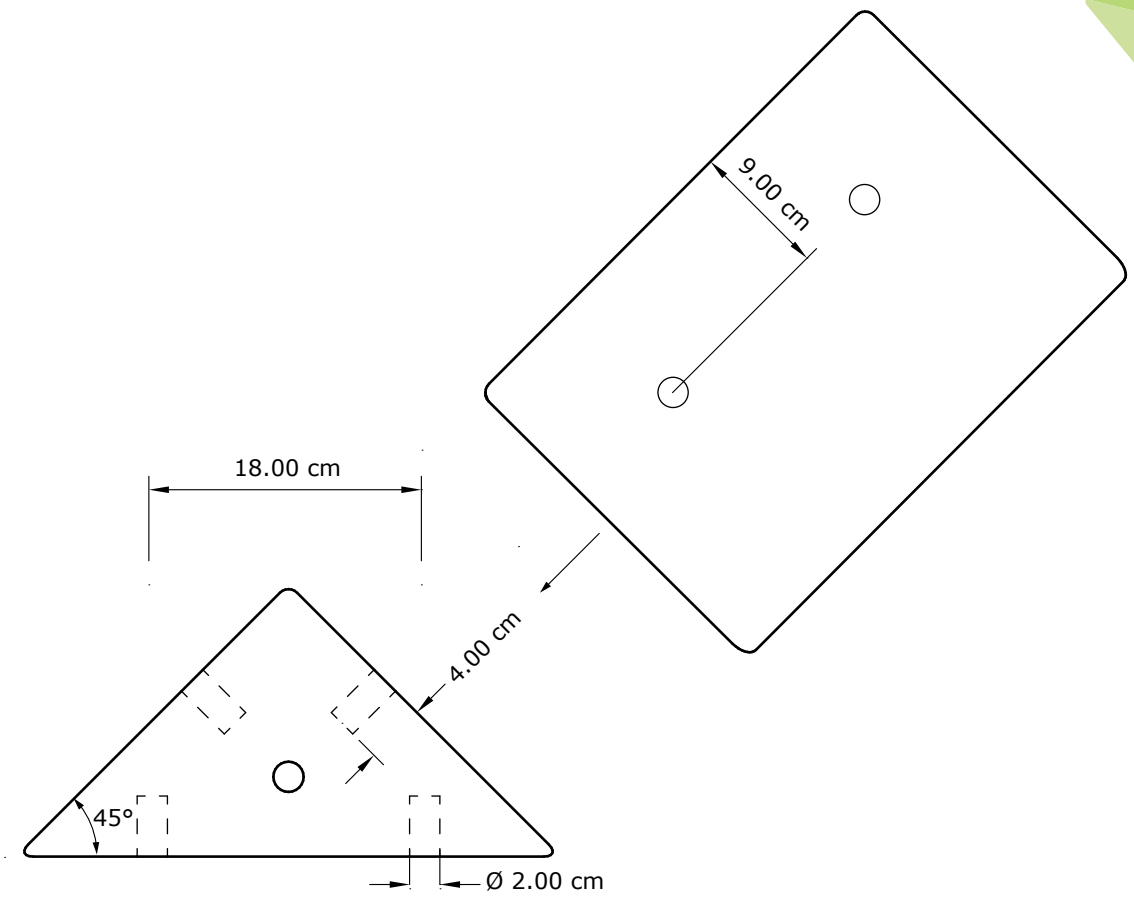


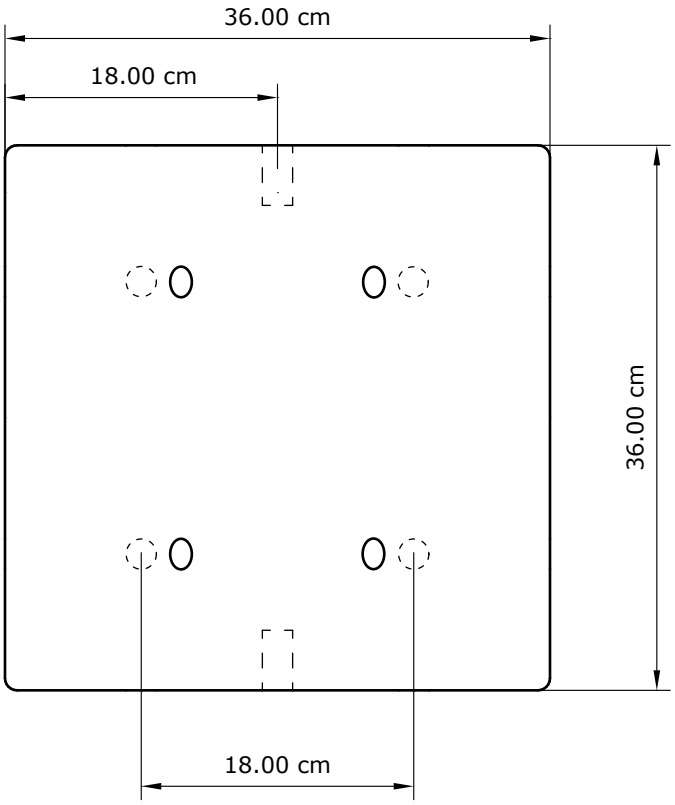




Block 7 - triangle







6.10. VIABILITY

COSTS

At Barnacork they were able to give me the estimated cost of manufacturing Castellets de Suro: producing one block would cost around 30-40 €/unit (material: cost cork plate 15-16€ to make 6 blocks of 36x36x18 cm). As the starter pack includes 32 blocks, the total cost of the cork blocks would be around 960€. The total production cost seems reasonable considering the possibilities that Castellets de Suro offers. To this we should add the production of the plugs, packaging, distribution, design and marketing costs, among others. This should be further developed in future stages with the collaboration of industry partners and manufacturing professionals, but at this point of the project this information is considered sufficient to validate the cost of the physical product of the proposal. Due to the purpose of this Final Work of Master, it is considered more important to analyse the possible partnerships with local stakeholders and to develop a strategic overview of the viability of the whole system offered by Castellets de Suro, rather than the technical calculation of manufacturing costs of the blocks.

COLLABORATION

The viability of this project can be ensured by finding the correct stakeholders and partners to collaborate with. As Castellets de Suro is intended as an educational tool, a partnership with the Public Education Department of the local government or other educational institutions is indispensable to reach the target users: students and teachers.

For instance, entities such as Fundació Catalunya La Pedrera or Fundació Jaume Bofill already collaborate with schools in Barcelona. Castellets de Suro could be initially financed by them and could benefit from their current activities to give visibility to the product. Educators should also be involved so they would validate the pedagogical benefits of using Castellets de Suro and they would be able to promote the product in their networks. As a pilot project, one of these fundations could establish a programme where several schools test Castellets de Suro by receiving the blocks for a certain amount of time. Their use and interaction with Castellets de Suro could be tracked by the foundation so that the final product could be improved before being distributed to a larger number of schools.

Additionally, it would be interesting to obtain the support of cork manufacturers. In Catalonia, the Institut Català del Suro (Catalan Cork Institute, ICS) was established in 1991 to promote the development and value of the Catalan cork sector through research and innovation. It is a private non-profit foundation with a scientific nature. Also, the Associació d'Empresaris Surers de Catalunya

(Association of Cork Entrepreneurs of Catalonia, AECORK) brings together the companies dedicated to the manufacture and/or marketing of cork products in Catalonia. Currently, it is formed by 30 companies that represent around 90% of the cork industry in Catalonia. These two entities could provide their expertise to ensure the quality of the cork but also find optimal manufacturing agreements. They could facilitate the production of real-scale prototypes for the pilot project and maybe even include Castellets de Suro in one of their research projects. For example, ICS is currently participating in projects on eco-design with cork, circular economy or sustainable management of cork waste, some of them funded by the European Union and the Spanish Government. Barnacork and the other companies mentioned in the production subchapter are also relevant for this part of the viability to the project.

Find below a conceptual squeme of the key partnerships.

CASTELLETS DE SURO

Pilot project

Product design
Further research on materials, blocks ideas and unions
Packaging
Creation of online community

CORK PARTNERS

ICS

AECORK

Barnacork or other cork manufacturing companies

Prototypes
Manufacturing agreements
Budget
Join bigger research projects
Financing

EDUCATIONAL PARTNERS

Department of Education of the Generalitat de Catalunya or Fundations

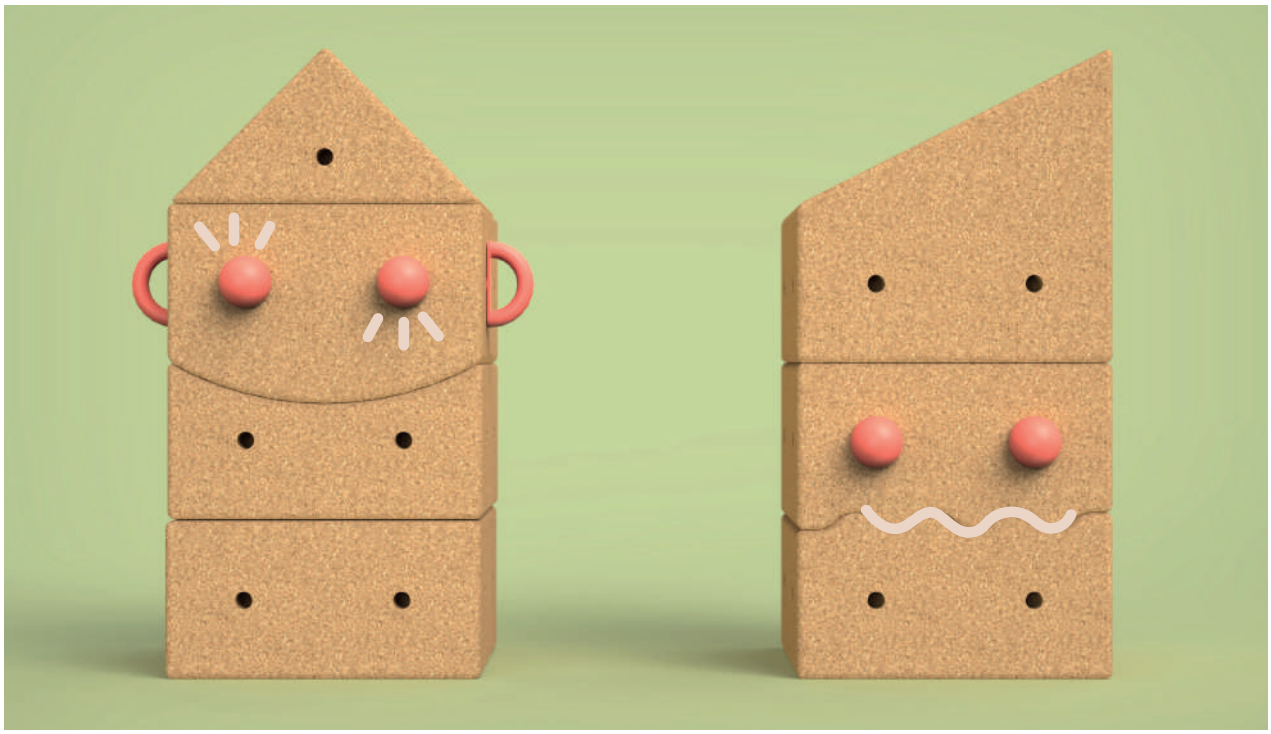
Connecting with schools
Project implementation
Test the system
Feedback from educators
Financing
Distribution
Establishment of network using existing channels

6.11. EXPANSION

The idea of Castellets de Suro was developed with Barcelona and its multicultural context in mind. Therefore, the current model is strongly rooted to its locality: the Castells tradition, the local cork industry and the great diversity of students in primary schools. All of this was taken into consideration to ensure the success of the product and to take advantage of its particular context, but this does not limit the expansion potential of this system. In fact, the concept of castles can be easily adapted to other cultural traditions, e.g. Europe has a strong heritage of Medieval castles. In other cultures, the symbol of a castle could be transformed into other types of fortified structures.

The core concept behind Castellets de Suro is to offer an open-ended modular system that children can use to build their own learning spaces, which works universally. Its use is intuitive and does not require a strong verbal communication so it can be successfully used in different environments and still facilitate collaboration, empathy and openness, challenging the children's creativity and promoting different ways of learning. To this end, the identity of the product could be adapted to new places by developing a focused research on the local schools and target groups. The material of the blocks could also be changed to maintain the sustainability of the system. The cork could be replaced by other local materials. As previously mentioned, the intention of this project is to keep researching new shapes and materials. Environmentally friendly synthetic materials could also be explored or materials that can endure prolonged outdoor use.

Figure 81: Sculptures renders (2020)
Source: Author



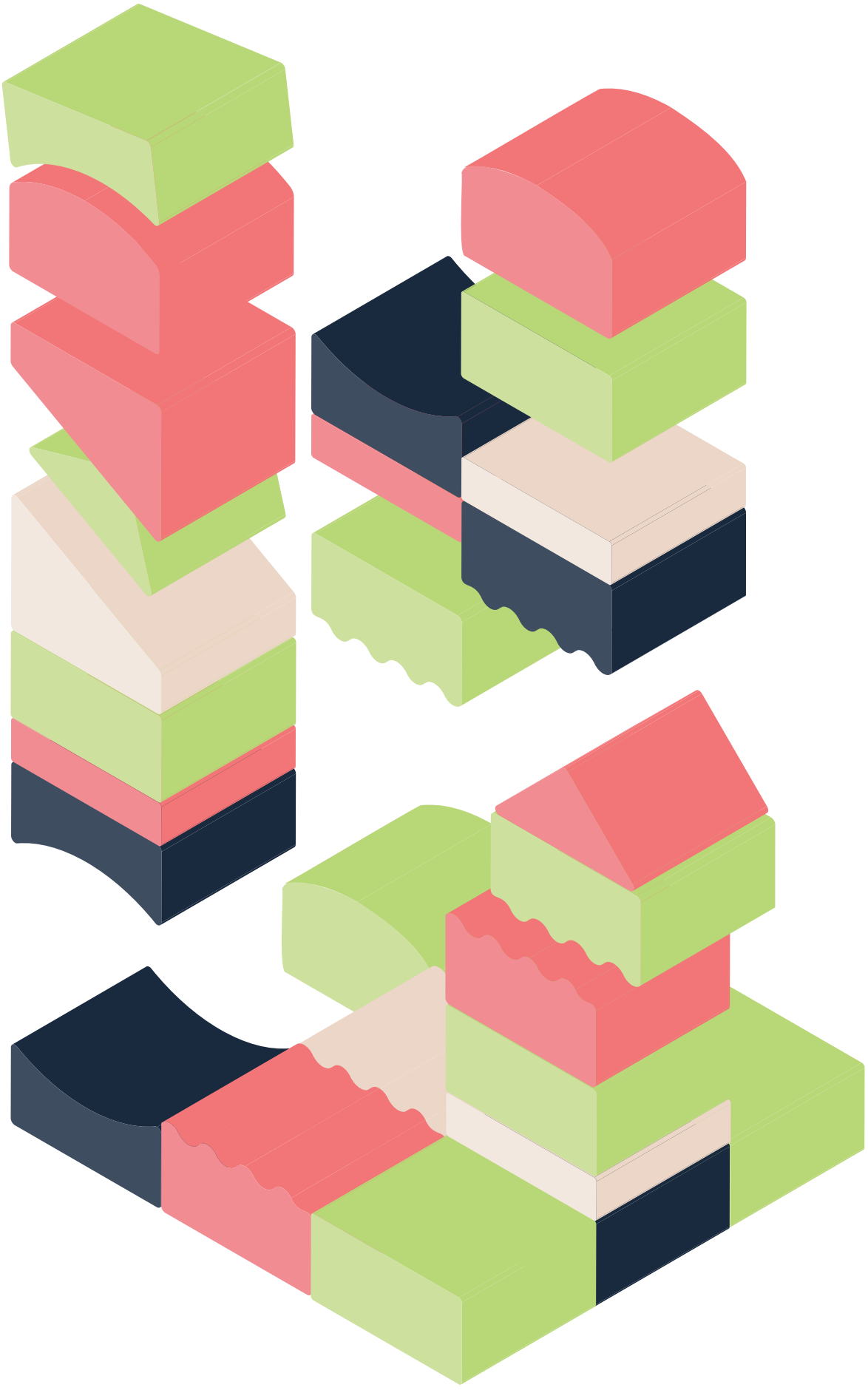
As Jorge Raedó points out, "childhood is very similar everywhere. The differences arise when we grow up, when we become adults. Growing up involves assimilating the manners, customs, rites and behaviours of the societies in which we live. The atmosphere around us sculpts us, chisels us, fossilises us" (Raedó, 2019). Castellets de Suro has the potential to trigger similar possibilities in other contexts, by adapting its positive characteristics to other locations and it will open a design path for multiple opportunities in learning spaces.

7

CONCLUSIONS

This final chapter gathers the main findings of this research and design project.

Figure 82: Conceptual illustration (2020) Source: Author



FINAL THOUGHTS

The development of the idea behind Castellets de Suro shows that design can generate new scenarios that satisfy the educational needs of today's world. Its concept is validated by the extensive research developed through the first chapters on design for social good, education, learning spaces, flexible, playful and contestatory design, showing examples and studies that guided the project to the proposal of this modular system. The design outcome might seem simple, but was only achieved after a long investigation on the material, the context, the understanding of basic geometrical shapes and the production of several prototypes and digital models.

Castellets de Suro proves to have the potential to facilitate the adaptation of current learning spaces to the ever-evolving pedagogy that requires flexibility and contingency. The system is a source of fun imagination and creativity for children, but also considers the teachers' needs to be able to be the choreographer of children's development to become the citizens of tomorrow's society. In this manner, this project becomes an example of the potential of design to create positive impact, without forgetting of course that educators have a fundamental role and designers should only provide their skills to assist them.

The dimensions of the blocks also promote collaboration between children and its visually intuitive use aims to bring children from different backgrounds together, without the need to verbally explain the potential of Castellets de Suro. Children (and their teachers) become the designers and architects of their own spaces, so they can fill their classrooms (or other informal learning scenarios) with their own experiences and learnings. With Castellets de Suro, I designed for learning, but did not design the learning, as it is the users of the system who are the authors of the possibilities that can arise.

The biggest challenge of this project was the impossibility to observe children in an academic setting due to the current circumstances related to COVID-19. This was compensated by interviewing an educational expert with a long experience on the topic and using her expertise to validate the design proposal. The collaboration with Pilar Ugidos was extremely valuable and this project could not have been developed without her insights.

Given the uncertainty of how schools will organise the return to the schools after the summer break, the idea of postponing the delivery of the project was discarded. This does not mean the project should end here: as explained in the viability subchapter, the designed system should be tested by collaborating with more professionals working in Education and in the cork sector.

As regards COVID-19, even if Castellets de Suro obviously cannot solve the main concerns of disinfecting spaces or improving virtual learning, it can be used as a physical barrier to facilitate social distancing measures. As noted by Vicent Mañes, president of Fedeip (spanish federation of associations of directors of public nursery and primary schools), children's socialization and their psychomotor development is fundamental for their education and virtual learning still does not have the tools to solve this issue (as quoted by Zafra, 2020). This shows that the return to schools is indispensable and indeed, Castellets de Suro facilitates children's interaction and socialization and the development of their psychomotor skills by building the spaces of their imagination. Castellets de Suro fosters the child's creativity and empathy by offering a collaborative construction set.

Regarding the avenues that this study could open, prospective projects could explore the technical side of the viability of this project, rather than focussing on the conceptual possibilities of making learning spaces flexible. For instance, this Final Work of Master could be used as reference to analyse its sustainability, ensure that the main idea behind Castellets de Suro could follow a circular economy model; study in detail the production and resistance of the blocks, research on alternative solutions with other materials, colours, textures and shapes or even ideate how Castellets de Suro could be translated to other contexts, as introduced in the previous subchapter.

Finally, this project aims at motivating future research on the power of design in Education, how pedagogy should be integrated into the design process of educational projects and critically question the role of designers and other creatives to assist educators and students to improve their learning and prepare them for the tomorrow we want to live in. This could be done in the shape of other design projects or more theoretical or speculative projects that reflect on the opportunities and the future of Education.

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ANNEX A:

PILAR UGIDOS' PROFILE

This Annex summarized the reasons why Pilar Ugidos' participation in this research was essential to ensure that the outcome of this project can offer value to schools and other learning institutions.

Pilar Ugidos graduated in Teaching with a Specialization in Philology and French from the Escuela Normal de León. Most of her career has been developed at Escola Miquel Bleach where she worked as a teacher and director of the school. Ugidos also has been a teaching technical advisor to the Department of Education of the Generalitat de Catalunya and teacher advisor in language, interculturality and social cohesion in Primary and Secondary schools in Badalona, Santa Coloma and Barcelona. She traines other educators on diversity issues, behaviour chanhe management, team work and communication.

She is the co-author of the book *Diversitat cultural i exclusió escolar. Dinàmiques educatives, relacions interpersonals i actituds del professorat (Cultural diversity and school exclusion. Educational dynamics, interpersonal relationships and attitudes of teachers)*, published by Fundació Jaume Bofill.

She is deeply involved in fighting against all prejudices that attack immigration and poverty, with a clear intention and direction: to offer to each child the highest educational quality. Her career has shown her that the most important thing for teaching is to establish meaningful relationships with students. She believes that to educate one must project to the future and be critical with the present.

While working as director of Miquel Bleach School, the center was recognized with the "Ciutat de Barcelona" award for the successful participation in the "Tàndem Schools" initiative.

Figure 84: Pilar Ugidos, by Gemma Ventura (2016) Source: Catorze

"IT'S ABOUT LETTING EACH CHILD BE WHO THEY ARE AND OPENING WINDOWS TO SHOW THEM WHAT ELSE THEY CAN BE"

(UGIDOS, 2016)

ANNEX B:

STUDY : UNION SOLUTIONS

Firstly, several ideas were proposed and analysed based on the benefits and disadvantages that they offer to the blocks:

All of these options are interesting and offer different benefits for the children: for example, the rubber plugs allow more creativity in terms of construction, as any side of any block can be assembled with another, but the assembly takes longer than other solutions. The option of adding ropes to the system is also attractive, but small children do not know how to tie a knot and it also slows the construction and Castellets de Suro aims to offer a simple and fast system to build learning spaces.

Type	+	-
Magnets 	Playful to discover which side matches another Simple and fast union	Works in pairs
Tongue & groove 	Does not require external elements	Limits assembly combinations Works in pairs
Plugs 	Easy to manipulate Smooth - unite blocks by pressure Holes can be places in geometrical positions but also in random locations to increase the playfulness of the blocks	Small pieces can get lost Slow assembly
Velcro stickers 	Inexpensive Easy to manipulate	Stickers can easily peel off Works in pairs
Knots 	Inexpensive	Rope can get lost easily Slow union Smaller children might not know how to tight a knot

Figure 83: Prototype E=1:5 (2020)
Source: Author

As it was not possible to organise a focus group with children to test how they manipulate the blocks and the different joints, I organised a second interview with Pilar Ugidos to show her my proposal and get something as close as possible to a product testing in the current circumstances (check subchapter 6.5 for more details). She commented that magnetic unions seemed interesting to her, as discovering the polarity of the blocks can add a playful component to the system that triggers the creativity of children.

I developed several prototypes with magnets and in different scales (E=1:2, 1:5 and 1:10), as shown in the following images, to test how the magnets would work. I consulted a magnet company

MAGNETS' CALCULATION:

The union between blocks could be achieved by inserting magnets in different faces of the blocks, as shown in the following image. To make sure this was possible, I requested external help to calculate the resistance of the magnets and cork:

Firstly, I verified with Barnacork that it was possible to put magnets inside cork and they confirmed that they had the technological means to do this and they had done it in the past for other types of products, but they did not have the expertise to calculate which type of magnets would be necessary.

Then, I contacted a magnet company (Supermagnete) and when I presented them the technical details of the material and the product, they suggested trying one of the following disc magnets made of Neodymium (N50 magnetisation), nickel plated:

- Ø 9 mm, height 5 mm, Strength 2.7 kg
- Ø 10 mm, height 5 mm, Strength 2.6 kg
- Ø 12 mm, height 5 mm, Strength 3.6 kg
- Ø 12 mm, height 8 mm, Strength 4.8kg

To verify that these magnets could work, it was necessary to calculate the magnet force when detaching the blocks and make sure that it is smaller than the tensile strength of cork, so it does not break, but is strong enough to hold the blocks together. This calculation was done with the help of Marcos Gelizo (geologist and physics teacher). It is important to take into consideration that the zone of influence of the magnet force when separated is much smaller than the faces of the blocks, at most 1 extra radius maximum. Considering we use the magnet with Ø 10 mm (R 5 mm):

The surface of the magnet is

$\pi*0{,}5cm^2=0.785cm^2$

The force per unit area that the cork will have to withstand in the local area next to the magnet (radius of 1 cm from the centre of the magnet) will be:

$2.6kg/(\pi)*1cm^2= 0.82\ kg/cm^2$

This value is dangerously close to the tensile strength of cork (0.94 kg/cm^2). To solve this, the surface of the magnet can be increased by gluing a plastic disc to the magnet and glue this disk to the cork.

By increasing the radius of the rear disc to 3cm (6cm diameter) we manage to increase the contact surface to $9*\pi\ cm^2$.

The traction to be supported by the cork remains:

$2.6/9\pi= 0.092\ kg/cm^2$

This is a safety coefficient of 10, which should be enough to ensure the safety of the magnets. Future steps of this project could provide a deeper analysis of this, but for the purpose of this FWM this can be considered sufficient.

(Supermagnete) and a cork manufacturing company (Barnacork) to explore the viability of using magnets and I calculated the necessary strength of the magnets, considering the tensile resistance of cork.

The results showed that this option would be possible to develop, but the prototypes demonstrated that the magnets are not so practical, as blocks attract and repel each other in ways that disturb the construction of micro-architectures. Therefore, I decided to develop the plugs as the union-system. Even if plugs could seem like a less attractive solution, it is the solution that offers the higher number of possibilities as it does not work in pairs. Another benefit of plugs is that blocks can be used without them for more ephemeral constructions (e.g. when the activity organised by the teacher is the actual building of something) or with them for micro-architectures or objects that will be used for several hours, days or weeks (e.g. a specific scenario, use the blocks as a seating solution).

A soft material such as rubber or other elastomer is considered the most adequate, because it has a pleasant texture to manipulate by children and its friction together with cork should be sufficient to ensure a stable union between blocks. This synthetic material is sustainable, as explained in the subchapter 6.9. Technical details, and it fits into the eco-friendly philosophy of using local cork for the blocks.

In any case, the other types of unions are not fully discarded as they could work for future developments of the system and this analysis can be used as a starting point to calculate the technical requirements of UNE and ISO recommendations in future stages for the actual production of the blocks.

CastelletsdeSuro