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DESIGN ACROSS BORDERS UNITED IN CREATIVITY

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DESIGN ACROSS BORDERS
UNITED IN CREATIVITY

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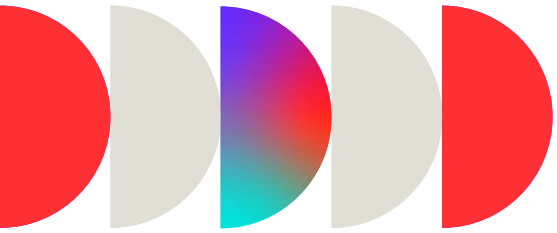


Preface

In a world shaped by constant transformation and global interconnectedness, design emerges as a bridge between people, places, and ideas. Cumulus Monterrey 2024: Design Across Borders – United in Creativity invited the international design community to reflect on the profound potential of design to transcend cultural, geographic, and disciplinary boundaries, uniting us in the shared pursuit of innovation, inclusion, and positive change.

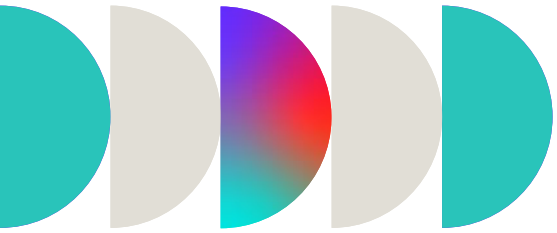
This edition of the Cumulus Proceedings gathers contributions that respond to urgent questions: How can design foster empathy and intercultural understanding? In what ways does it become a catalyst for social transformation in a complex, globalized world? Can design truly become a universal language—and what are the challenges in achieving that ideal?

The richness of perspectives represented in these proceedings speaks to the global nature of the Cumulus network. Authors, researchers, educators, and practitioners from across continents have come together to share insights, experiences, and provocations within four thematic tracks:

- Design for Change explores design's role in social innovation, sustainability, equity, and the circular economy—highlighting projects that place co-creation and inclusion at their core.
- Speculative Futures ventures into emerging territories shaped by technology, artificial intelligence, and immersive experiences, imagining the future of creative practice.
- Education in Art and Design focuses on pedagogical innovation, interdisciplinarity, and the challenges and opportunities of digital transformation in global learning environments.
- Translocality brings critical attention to issues of migration, decolonization, and the Global South, recognizing the importance of diverse voices and perspectives in shaping a more equitable world through design.

Together, these contributions reflect a collective commitment to harnessing creativity as a force that transcends barriers—linguistic, political, cultural—and brings people together around shared values and visions.

We are proud to present this volume as a testament to the power of design to imagine, inspire, and unite. May it serve not only as a record of this important moment in time but also as a spark for continued dialogue, collaboration, and transformation in the global design community.



Design Across Borders: United in Creativity

Lorenzo Imbesi
Full Professor, Sapienza University of Rome
President, Cumulus Association

The Cumulus Monterrey 2024 Conference marked a timely and vital moment in the global conversation about the role of design in shaping a better world. Hosted at the prestigious design institutions of Tecnológico de Monterrey and Universidad de Monterrey (UDEM), the international gathering has been further enhanced by the unique Monterrey's rich heritage and cultural identity, contributing to a thriving ecosystem of creative exchange for scholars, researchers, and practitioners across various design disciplines.

The central theme of the conference, "Design Across Borders: United in Creativity," provided an inspiring gateway for exploring how design holds the possibility to transcend geographical, cultural, and disciplinary boundaries. In particular, the conference was framed by four imperative trajectories: "Design for Change," investigating how design practices can drive social innovation and sustainable development; "Design Futures," exploring the interplay between technology and creativity, immersive experiences, virtual realities, and the implications of artificial intelligence; "Education in Art and Design," investigating pedagogical approaches in the field; and "Translocality," addressing complex issues of migration, decolonisation, and North-South dynamics. Themes highlight the broad scope of contemporary artistic and design pursuits.

At the heart of the conference was a shared recognition that design can be a dynamic force for empathetic understanding and intercultural dialogue. Through a rich program of keynote lectures, panel discussions, workshops, exhibitions, and informal exchanges, the international community demonstrated determination to work collaboratively across geographical and cultural divides, confirming the foundational premises of the conference: that creativity knows no boundaries, and through design, we can forge connections that transcend the limitations of space, time, and cultural difference. In an era of unprecedented global challenges, from climate change to technological acceleration, from cultural conflicts to social inequities, designing without boundaries means identifying areas of commonality, intersection, and convergence, highlighting them in ways that resonate with and reflect the spirit of our transborder region. As traditional confines between nations, disciplines, and cultural contexts become increasingly permeable, the design community must find itself uniquely equipped to harness this fluidity. Rather than resisting uncertainty, design must embrace it, transforming constraints into opportunities for innovative problem-solving and cross-cultural exchange.

The proceedings collected in this edition offer an extensive variety of perspectives on the ideas and projects discussed at the event. They include case studies, speculative work, educational reflections, and practical strategies, all pointing to the evolving role of design to shape societal interactions, encouraging intercultural dialogue, and building a more harmonious and interconnected world. However, these proceedings capture only a portion of the energy and insight shared during the conference, with the remaining impact continuing to reverberate through ongoing collaborations and dialogues within our global community.

As we move forward, the conversations from Cumulus Monterrey 2024 remind us that creativity thrives not in isolation, but in community. And in a time marked by division and uncertainty, design, when practiced with care and intention, can truly serve as a bridge. One that brings us together to learn, to act, and to imagine a positive change.

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PAPERS

DESIGN AS RESILIENCE: A MODEL FOR GLOBAL COLLABORATIONS

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ABSTRACT | Design education transcends geographic and cultural boundaries when it brings together designers from different countries and disciplines to share and create knowledge and understanding. These educational experiences impact designers in many ways, including developing cultural and historical empathy. This paper delves into an interdisciplinary, immersive learning experience, "Design as Resilience," in Siracusa, Italy, tailored for interior design students from a university in the United States. The artisans and designers of the region command widespread acclaim for their fusion of tradition and innovation, underscoring Sicily's enduring legacy as a cradle of creativity. Sicily presents a unique vantage point as a microcosm of diverse cultural influences owing to successive occupations by ancient Greeks, North Africans, English, French, and Spanish. While deeply interconnected with neighboring cultures via shared histories, the island remains physically isolated by the Ionian, Mediterranean, and Tyrrhenian Seas. Its ethos of craftsmanship and artisanal traditions, preserved and revered, forms a cornerstone of exploration. By delving into art, craft, and design, students can unravel the rich tapestry of Sicilian heritage, from the intricate mosaic-making techniques to its multitude of UNESCO World Heritage Sites.

Extensive research underscores the profound benefits of studying in unfamiliar locales, with most participants acknowledging its transformative impact on their comprehension of personal cultural values and biases. Beyond mere immersion, this program is fortified by several innovative components.

Faculty at both institutions - the university in the United States and a partner academy in Italy - have engaged in an iterative curriculum and program development process. Re-running courses allows for evolution that addresses international, interdisciplinary partners' needs, limitations, and opportunities. Although Sicily has a uniquely preserved and celebrated culture of craft and making, design education has been somewhat limited, with biases toward northern Italian universities. Since its inception in 2016, the Design Academy in Siracusa has sought to fill this significant gap. By partnering with international universities, the program offers opportunities to challenge students' perspectives continually.

A transdisciplinary research grant from the U.S. university was secured to support coursework focused on the materials of insular regions, specifically those of Sicily. A wood workshop involved scavenging driftwood that washed ashore near the workshop location. The various wood species, shapes, sizes, textures, and weights prompted questions about their previous uses and origins. The wood was assessed and then manipulated using hand and electric tools to practice making traditional wood joints.

The course also emphasized historical empathy as a tool to inform and ground contemporary design. A mosaics workshop involved using traditional tools to manipulate natural stone. This slow process of learning ancient Roman mosaic patterns and techniques offered insights into the thoughts and decision-making processes of the craftspeople who may have worked on the Villa Romana, a UNESCO World Heritage site we visited after the mosaics workshop.

In conclusion, designers can significantly benefit from developing skills related to cultural empathy, material reuse and its relationship with sustainability, and understanding how historical precedents can inform contemporary, resilient design strategies.

KEYWORDS | GLOBAL COLLABORATIONS, STUDY ABROAD, INTERDISCIPLINARY

1. Introduction: What is the value of a study abroad experience for the design student?

This paper probes the pedagogical objectives and outcomes of an interdisciplinary, immersive learning experience, "Design and Resilience," in Siracusa, Italy, tailored for interior design students from a university in the United States. Study abroad has long been touted as an effective means of providing students with opportunities to challenge preconceptions. Numerous studies have pointed to the positive benefits of studying abroad, including most respondents noting that the experience profoundly impacted their understanding of their cultural values and biases (Dwyer & Peters, 2004).

As economies become increasingly interconnected globally, there is mounting pressure for higher education institutions to foster intercultural awareness and global citizenship among students (Brooks & Waters, 2011). Global education necessitates engagement in learning processes that explore alternative worldviews, communication styles, personal assumptions, communities, and cultural perceptions, fostering cultural empathy. Yet, design curricula often need to focus on skill-building rather than creating opportunities for empathic awareness. International study abroad offers a holistic education approach, while higher education focuses on discipline-specific training and job preparation (Mendoza & Matyok, 2013).

Many academics, including Root and Ngampornchai (2013), Goode (2008), and Deardorff (2009), critique the assumed impact of study abroad programs on students. They argue that immersion in a different culture does not automatically lead to intercultural competency. For design students, mere exposure to different cultures is insufficient; they require deep immersion to transform study abroad experiences into meaningful, embedded encounters rather than superficial engagements (Mendoza & Matyok, 2013).

Reflecting on intercultural experiences with peers and professors can strengthen students' understanding of cultural similarities and differences (Brown et al., 1989).

To deepen the experience, students must first reflect on their cultural behaviors and norms. This self-awareness is crucial for students to understand that their cultural background is one of many rather than the standard to judge others (Root & Ngampornchai, 2013). According to Macdonald and MacLeod (2018), "Rather than focus on 'exposure', the internationalised education that design students need includes deep immersion and diverse contact in order to transform the study abroad tour into a layer of embedded experience rather than an artificial veneer" (p. 215).

Direct immersion and engagement through critical analysis offers an opportunity to deepen the study abroad experience. International learning opportunities enable students to expand their worldviews and develop empathy by exploring different perspectives, communication styles, personal assumptions, and cultural knowledge. These critical reflection skills can illuminate students' unconscious biases, worldviews, and ethnocentrism, fostering an empathic understanding of other perspectives—an integral aspect of the design process.

It is with this perspective that the co-directors of this program set out to create a unique learning experience for their students. Each professor has experience leading study abroad and domestic study away programs and determined the necessity for these explicit objectives: a partnership with a local institution with a similar pedagogical ethos, engaging local experts to expand worldviews and new pedagogical approaches, building in written reflections and discussions about these experiences to amplify the opportunity for critical inquiry.

The co-directors recognize that these global experiences often live on for months and even years afterward; thus, planting seeds for further development is an intentional program element. The Greek sophist Antiphon wrote that one's education is 'first among human activities' because "according to the seed which a man sows in the soil, so must one expect the crop to be. In the same way, whenever one plants a good education in a young body, it lives and increases for the whole of life, and neither rain nor drought destroys it." (Mintz, 2018, p. 414). Having led both study abroad and domestic study away programs, the authorsrecognize the imprint offered through these transformative experiences. After a program on the Eastern Shore of Virginia, one student reflected:

"One can be told a certain food is spicy, and the spiciness of the said food can be compared through giving examples of other foods. But until they try it for themselves, they will not fully know the exact level of spiciness, all the different tastes, and ingredients that come with it until they taste it and experience the

making process for themselves. These study away trips allow people to explore and understand a place from the inside looking out and from the outside looking in, not just the latter."

To enhance the program's content, the co-leaders incorporated prompts for research and reflection throughout the experience. Before the program commenced, students selected a site, building, or materials they would experience to research and present during the trip. Each student created a 4 ½" x 6 ½" card, accessible on their mobile phone during the program, to foster a sense of ownership over their education.

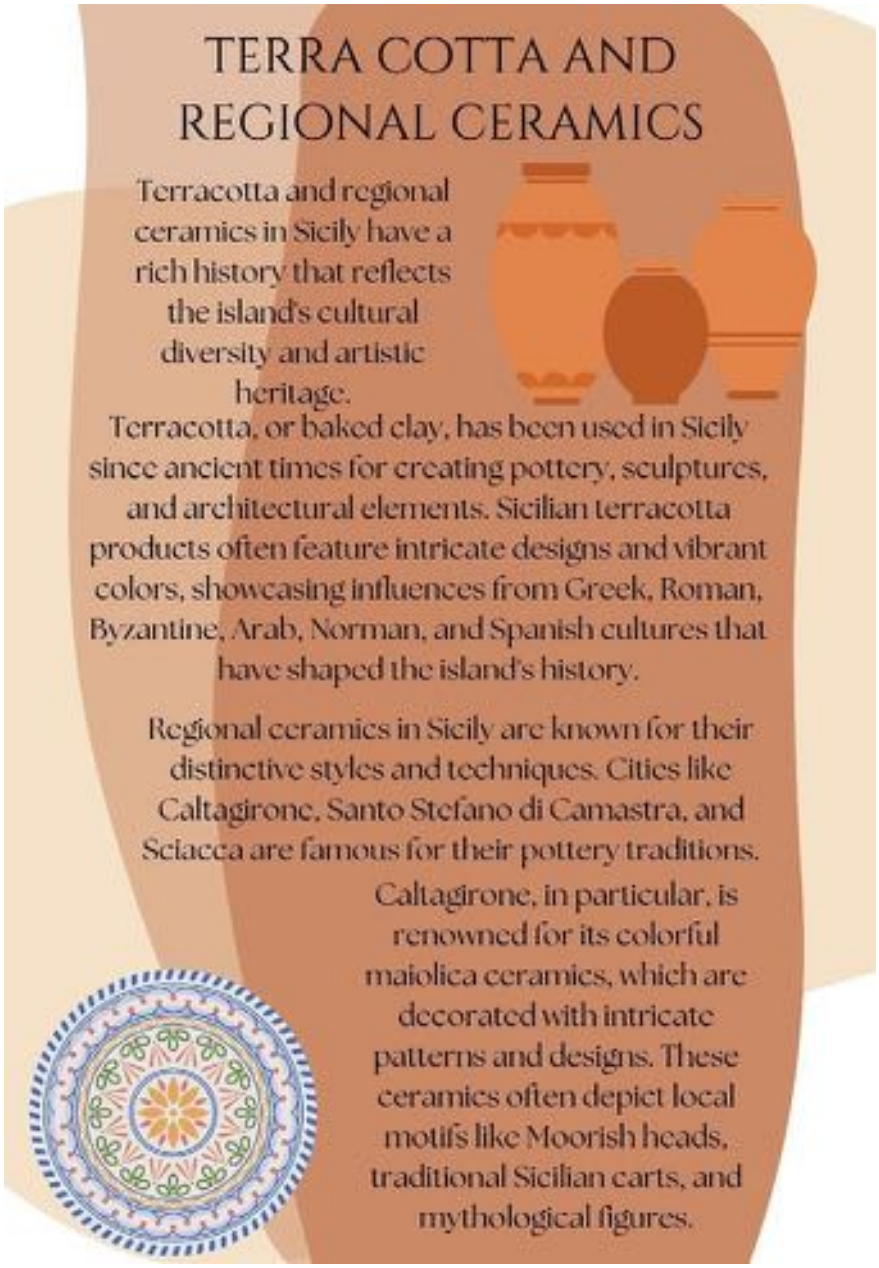

Figure 1. Here is an example of a research card created by a student and shared with the cohort before our departure for Sicily. Students were tasked with presenting their research both verbally and visually, utilizing skills such as drawing, and applying principles of hierarchy, balance, and color.

Additionally, students were encouraged to reflect on how the experience might influence their design process and ethos. Prompts included questions like: "As a designer, how do you balance rest and play with work? Are rest, play, and work distinct, or do they intersect? How do you practice self-compassion during frustration and disappointment when learning a new skill?" These reflections addressed cultural differences in perceptions of time and value, inspiring students to reconsider and adopt a more mindful approach.

2. Program Development and Implementation

As designers, we are tasked with grounding our ideas in the real needs of people and places while envisioning a world that has yet to be realized. While the world seems more accessible than ever, experiencing it through our many technological resources can sometimes feel superficial. Immersive learning experiences during a collegiate design education offer opportunities for personalized learning and authentic understanding of culture, place, and people, enriching students personally and professionally.

According to the Institute of International Education's 2017 report, students who studied abroad in countries with less familiarity or were perceived as less similar to the United States experienced a more significant impact on skill development and career utility than those who did not study abroad. (Farrugia & Sanger, 2017). Like design practice, developing quality programs that provide these benefits requires an iterative approach to curriculum development, allowing for trials, adjustments, and experiments.

In 2016, one interior design faculty co-authors co-created a new interdisciplinary study abroad program for the university's art school, focusing on the intersection of interior design and craft and material studies. The program involved the interior design faculty author and a craft and material studies faculty member from the same university. Twenty-two undergraduate and graduate students, interior design and craft and material studies majors, participated. The group spent four weeks in Florence, Italy, through a partner institution, the Santa Reparata International School of Art. Successful teaching strategies included an intentional mix of structured and unstructured blocks of time for sketchbook work and group reflections.

We observed that students would sketch alongside peers, sharing techniques and tools, asking each other questions, and sharing their thoughts, which deepened their understanding of their experiences. During group reflections, vulnerability increased as trust was built. The mix of backgrounds was evidenced in group discussions as universal and unique aspects of the different disciplines became apparent.

After the program concluded, the faculty decided to evolve the curriculum from tour- and event-based to workshop-based. Around this time, we were contacted by the

Accademia di Belle Arti "Rosario Gagliardi" Mediterranean Art and Design (MADE) program in Siracusa, Sicily. A degree-granting fine arts academy with instructors from all over Europe, MADE was newly established and wanted to partner with American universities. Discussions led to the interior design faculty author and the craft and material studies faculty member traveling to Sicily for one week in June 2017. During this visit, we spent time with MADE's Dean and founder, Alessandro Montel, and several instructors focused on ceramics, textiles, and architecture, with whom we developed workshop curricula emphasizing the intersections of craft and design.

In 2018, the program in Sicily was launched with twenty students, including thirteen interior design majors and seven craft and material studies majors, three of whom were graduate students. Over four weeks, the students participated in three workshops led by MADE instructors, covering topics such as natural dyes, urban space, and ceramics. The urban spaces workshop was led by Moncada Rangel, an architectural design duo that also partners in our 2024 iteration. To highlight the value of iterative programs and their role in evolving strategic partnerships, our interior design faculty member, who leads a community design studio at their university, has identified a shared interest with Moncada Rangel over the years. We are now pursuing grants to bring Moncada Rangel to the United States in the spring of 2025 for collaborative projects.

Figure 2. In 2018, our students took part in a workshop titled "Conquering the Space," where they were tasked with developing design proposals for the Porto Piccolo harbor that addressed prompts related to community identity. Students visited the site, worked in interdisciplinary teams, and ultimately presented their ideas to Moncada Rangel, their university peers, and MADE students for critique.

3. Background and Context: Why Sicily?

While Milan boasts the highest number of design schools and students in Italy, largely due to its proximity to many major industry brands, Sicily offers a variety of distinct advantages. Siracusa and its surrounding areas are significantly less expensive and less populated than Milan (Delmundo, 2024). According to Alessandro Montel, Dean of the MADE Program, the approach of most Milanese schools tends to be relatively homogeneous, focusing primarily on training students for rapid workforce entry, often emphasizing Interior and Product Design with a strong inclination towards what can be described as "pure decorativism." In contrast, the craft dimension retains significant importance in areas with less industrial presence.

Montel suggests that in a less "contaminated" context, students can experience firsthand what it means to design from primary needs, using natural materials and tools that often involve manual work. This approach may be slower but more deliberate, providing a solid foundation for future development. From the European Industrial Revolution to the advent of computer-aided design, technological advancements have continuously transformed the methods used to design and create interiors. While today's educators and practitioners are well-versed in modern tools, many still value traditional skills and handcrafting techniques. Scholars such as Alma Hoffman argue the importance of sketching and making by hand as a mode of thinking (Hoffman, 2020). This ethos is central to our department's pedagogy and MADE's.

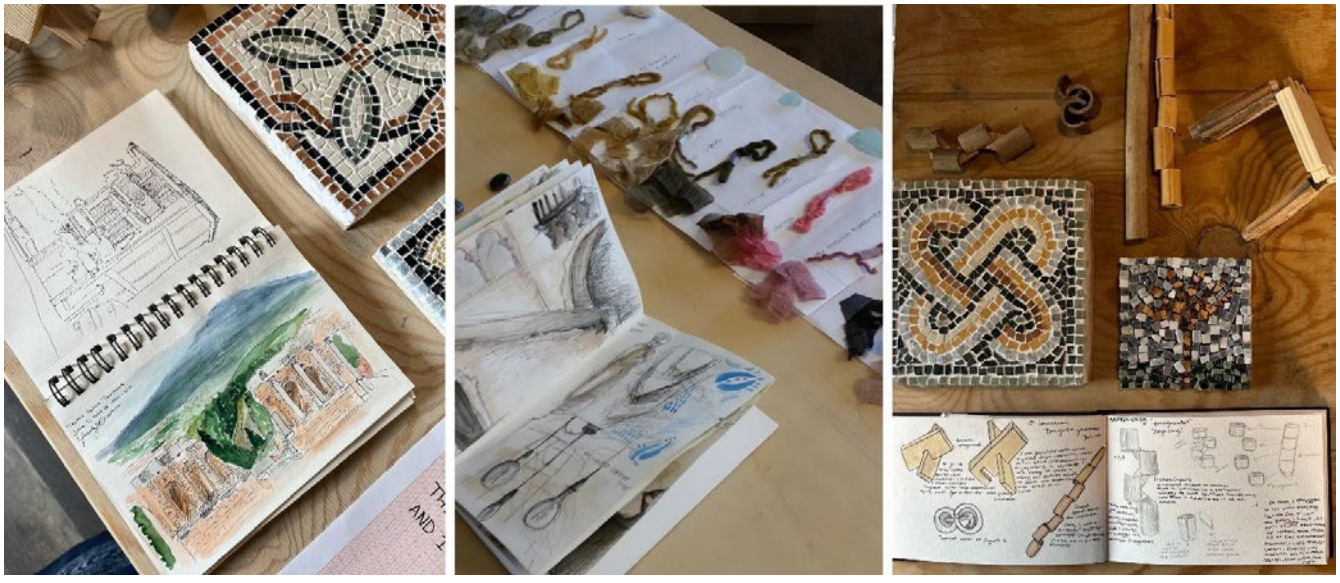

Figure 3. In 2018 (center image), a final exhibit of student work highlighted sketchbooks and hand-dyed yarns, with sketchbook media including graphite, ink, watercolors, and personal experiments. The fiber dyes were crafted from plants collected by students near Pantalica in Siracusa. In 2024 (left and right images), the final exhibit again featured sketchbooks, alongside mosaics and driftwood joinery experiments. Photos by co-author.

Sicily also presents a unique vantage point as a microcosm of diverse cultural influences owing to successive occupations by ancient Greeks, North Africans, English, French, and Spanish. While deeply interconnected with neighboring cultures via shared histories, the island remains physically isolated by the Ionian, Mediterranean, and Tyrrhenian Seas. Its ethos of craftsmanship and artisanal traditions, preserved and revered, forms a cornerstone of exploration. Students explore Sicilian heritage by delving into art, craft, and design, from ancient techniques to its multitude of UNESCO World Heritage Sites.

One of Sicily's great writers, Leonardo Sciascia, suggests, "to some extent this island serves as a metaphor for the entire world." The island's mythical narrative oscillates from assimilation to subversion, from its ancient Greek temples at Agrigento to its baroque architecture, markedly rich due to a massive rebuilding campaign after the 1693 earthquake. One is constantly reminded of the layered history evident across the island. For instance, the Cathedral of Siracusa on the island of Ortigia is built on the site of the 5th century BCE Ancient Greek Temple of Athena, revealing its Doric columns within the cathedral's walls. Building on themes of resilience and fragmentation, the co-leaders wove a thematic thread through various discussions, sketchbooks, and reflection prompts.

Figure 4. The fluted limestone Doric columns of the Duomo di Siracusa, a UNESCO World Heritage Site, are visible both inside and outside the building. Photos by co-authors.

During the 2024 iteration, twelve students and two faculty, one a design studio professor and the other a design historian, were based on the island of Ortigia, conveniently close to the MADE classrooms. The program featured two workshops led by MADE instructors, Ancient Mosaic Making and Traditional Wood joints, and included several field trips to nearby sites throughout the three-week session. These excursions helped students understand how the island's

geography and geology influenced the built environment over time. A key challenge of the program was balancing exposure to diverse sites with sufficient time for reflection. The program leaders attempted to thoughtfully intersperse these site visits with two essential workshops led by MADE instructors, ensuring a comprehensive and enriching experience for all participants.

Site visits outside of Ortigia included the 4th century CE Villa Romana del Casale, the 6th century BCE Ancient Greek city of Agrigento, Mt. Etna, and the Necropolis of Pantalica, where over four thousand rock-cut tombs were created between the 13th and 7th centuries BCE. In Siracusa, students visited several notable sites, including the Castello Maniace, a medieval citadel and castle, and the Palazzo Bellomo, originally built in the 12th century and renovated over the centuries, which houses an excellent collection of regional sculptures and paintings. Each location offered unique opportunities to explore the materiality and architectural features distinct to each era.

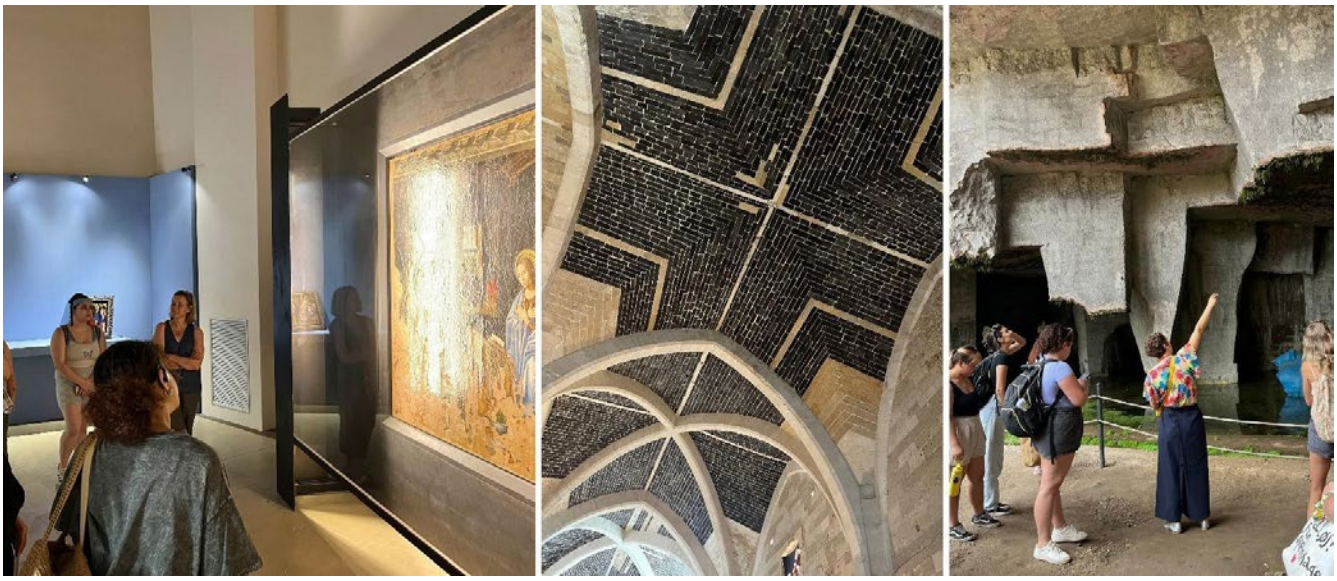

Figure 5. In the left image, students and faculty are gathered in front of Antonello da Messina's The Annunciation at the Galleria Regionale di Palazzo Bellomo di Siracusa. The center image showcases the lava stone ceiling of the Castello Maniace, which contrasts with the surrounding limestone and marble. In the right image, students pause to admire a pool inside one of the many caverns at the Parco Archeologico e Latomie del Paradiso, accompanied by faculty and tour guides Moncada Rangel. Photos by co-authors.

Students also visited the Parco Archeologico Neapolis in Siracusa, which includes Ancient Greek and Roman ruins. Local architects and MADE instructors Mafalda Rangel and Francesco Moncada, accompanied the group to provide context and prompts for further discussion. The ancient limestone quarry, Latomia del Paradiso in the Parco Archeologico, revealed historic extraction methods and the site's layered history. Once a dark and grueling prison, it became a cemetery and eventually transformed into an open-air garden after an earthquake collapsed the quarry

roofs. Program participants also attended a performance of the ancient Greek tragedy Phaedra in the 5th century BCE theater.

These sites' integrity, proximity to our home base in Ortigia, and affordability and accessibility all contribute to a rich experience.

4. Materiality, Empathy, and Making as Pedagogical Tools

Coastal insular communities provide opportunities to understand not only unique regional architectural vernacular but also the distinct materiality and influencing factors specific to these areas. Both faculty members of the Sicily: Design + Resilience program have collaborated for several years on coursework, research, and developing new study abroad and study away programs in insular communities, including Cuba (2016) and the Eastern Shore of Virginia (2022, 2023). Through repeated collaborations and evolving curricula, we have developed pedagogical strategies rooted in reflection and sketchbook practice that connect us to our personal experiences with place and the influencing factors that enhance our understanding of design possibilities.

For the 2024 iteration of the program, we incorporated a focus on materiality as a way of understanding place. One of the co-leaders of this program is a faculty researcher in our university's Materials Index Project and, through this overlap, developed coursework for the 2024 program in Sicily to support the project. In 2023, a university incubator fund supported the development of a Transdisciplinary Materials Research Lab, which subsequently fueled the creation of the Materials Index Project. Working towards climate justice requires re-evaluating the materials that enable our lives, from industrial and structural materials to the metals, fabrics, and plastics used in consumer goods. Understanding the nature and flow of these materials is critical to supporting a just transition to a circular economy and a sustainable society. Accordingly, the Materials Index Project is developing an interdisciplinary research method to understand existing materials and production processes and to develop new materials and processes that support a sustainable circular economy. Research is done on specific objects from various disciplinary perspectives and settings through collaborative research projects involving faculty and students. This approach allows us to acquire a more complete and integrated knowledge of the complex nature and impact of existing materials and production processes.

This Materials Index Assignment encouraged students to collaboratively create an index that encapsulates the questions we pose about materials, emphasizing their interconnectedness in various contexts. The assignment provided specific prompts, including phenomenological aspects (tactile, experiential, cultural, symbolic, spiritual) and end-use considerations (history, economy, environment, community, technology).

Prompts were provided, such as:

> Consider the materials as living beings, products, and beyond. Do we only perceive materials in relation to ourselves? What are this material's sensual, experienced, and phenomenological characteristics in its different stages of coming into being, use, and disposal? How do people relate to the material as a tactile presence? What qualities are felt and how? What does the material mean? What social, spiritual, symbolic, and economic values does the material hold, and for whom?

Students selected one specific material from each of their two workshops and one specific material from their daily experiences in Sicily to focus on for their assignment. An Ancient Mosaics workshop led by the Verona-based mosaicist Elisabeth Cozza used traditional tools to manipulate natural stone. For instance, one student reflected on Bianca Verona marble used in this workshop, from its formal characteristics to its inherent value. In terms of her material of choice from everyday life in Sicily, she chose terrazzo and explored its origins, how it is made, and where it is commonly used.

Figure 6. The Ancient Mosaics workshop focused on traditional stone-cutting techniques using tools such as a hammer and a metal pin mounted on a wooden stump. Students created their mosaics using five pattern templates and a selection of sixteen different marbles and travertines. The stones varied in their qualities - some broke more easily and in cleaner lines than others. Tesserae were required to be approximately 2 cm x 2 cm, with shapes including squares, trapezoids, triangles, and rectangles to provide different line types. Photos by co-authors.

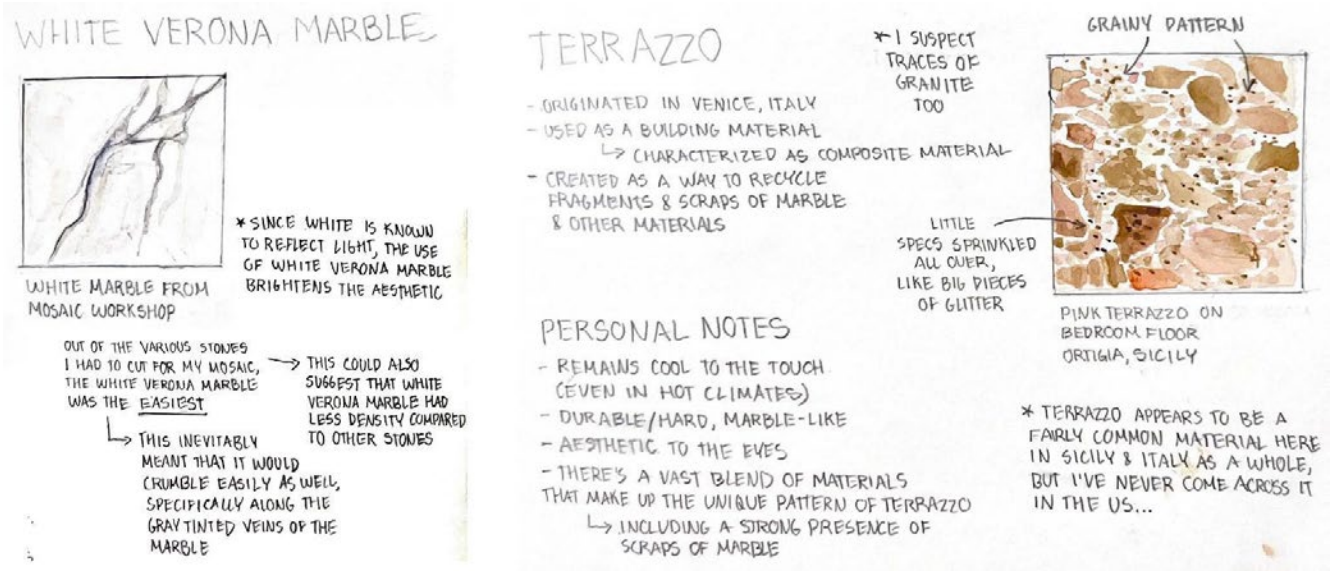

Figure 7. The image above displays notes and sketches by the student mentioned above, documenting their studies of Verona White Marble and Terrazzo. These notes detail tactile qualities and composition, providing valuable observations for us to review.

Driftwood was a focus for the second MADE workshop, "Traditional Wood Joints." Leading the workshop was Francesco Faccin, a master wood craftsman and professor from Milan, who studied and collaborated with the esteemed designer Enzo Mari. Mari's influence on Italian design emphasized a blend of artisanal and industrial techniques (Zanella et al., 2023). His vision for design education aligns with our program objectives; he once stated, "I say let's teach our kids to be craftsmen, to master again the art of drawing (a slow skill that requires thinking), to understand what was done in the past, and why and how" (Tartari, 2020).

Students worked with Faccin to gather driftwood from the northeast corner of the island of Ortigia. Driftwood originating from natural and anthropogenic sources is abundant in coastal regions and plays an important role in ecosystems, providing habitat, structure, nutrients, and carbon storage. (Murphy et al., 2021) The variety of wood species, shapes, sizes, textures, and weights sparked curiosity about their previous uses and origins. Participants assessed the wood and then used hand and electric tools to practice creating traditional wood joints. The workshop encouraged students to reimagine this found material for new uses and narratives rather than considering its story complete.

These immersive experiences profoundly impacted students, from the activation of traditional materials to revelations about personal biases and perspectives. One student reflected on the reuse of driftwood in the workshop:

"The convergence of so many different worlds is apparent through our extensive collection of driftwood. I felt as though

I was rummaging through years of history with every piece I turned over - stones and archives of times passed spilling out into the open... I hope our presence is welcome and not disturbing the environment's natural rhythm... In the end I do think that our 'disturbance' of this space has an overall positive impact on the materials we gathered as it allows these objects to be transformed and used in a way that they never would have been before."

"In the weeks we have been here, I have come to learn that, to me, the beauty of Sicily is seeing how everything is reused and cherished. Everything here has a past and is being used, It is not taken down, but restored and reused for as long as possible. The materials are reused and sourced from the nature around like lava stones from Mt. Etna, sandstone, limestone and marble. It is beautiful to see the pride and history around us."

Another student made note of an ethos of adaptive reuse on the island beyond the wood workshop:

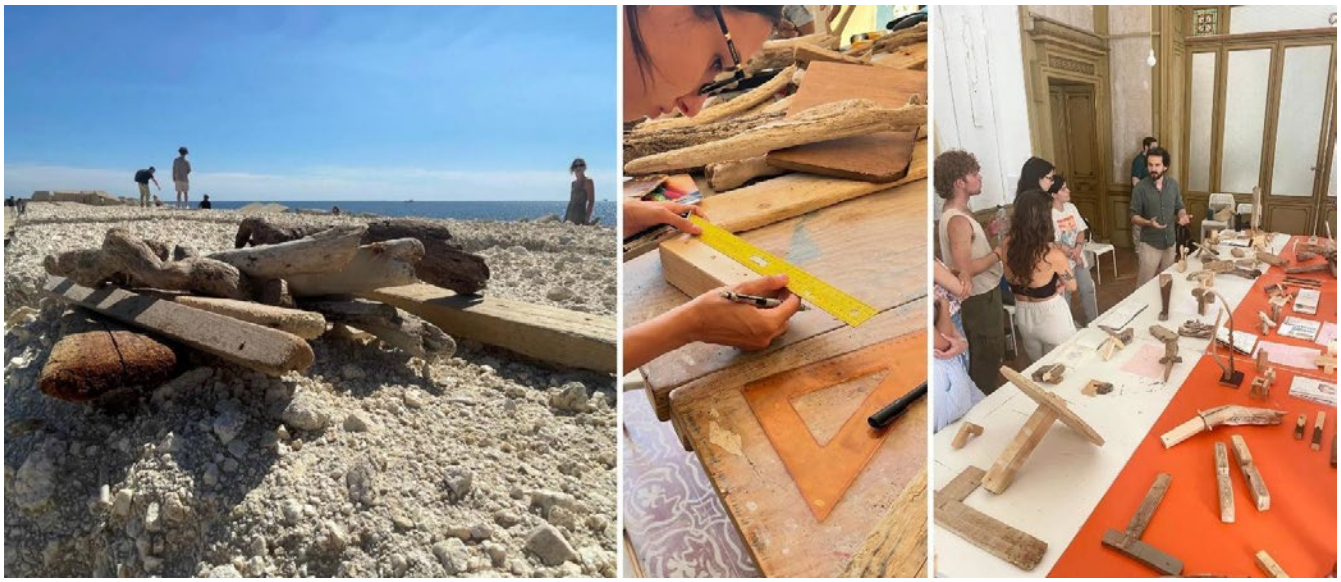

Figure 8. During the Traditional Wood Joints workshop, students collected driftwood, evaluated each piece's unique properties, and used basic woodworking techniques to join them together. The workshop was a collaborative effort, bringing together our university students with peers from MADE. At the conclusion, participants presented their joints for critique.

The Sicily: Design as Resilience program emphasized historical empathy as a tool to inform and ground contemporary design. For instance, the slow process of learning ancient Roman mosaic patterns and techniques offered insights into the thoughts and decision-making processes of the craftspeople who may have worked on the Villa Romana del Casale, a UNESCO World Heritage

site visited after the mosaics workshop. Scholars such as Carl Knappett have noted the value of finding the material and immaterial in the study of material culture, noting, "an artifact holds and encapsulates both action and thought." (Knappett 2005: 170). If we accept that mind and matter achieve codependency through the medium of bodily action, then it follows that ideas and attitudes, rather than occupying a separate domain from the material, actually find themselves inscribed "in" the object (Knappett 2005: 169).

While it is impossible to recreate the constraints and historical context by which ancient mosaics were made, using the same tools and stones within a 10" x 10" design allowed students to understand mosaics' physical and temporal nature. The scale of the Villa Romana's 3,500 m2 mosaics and their excellent state of preservation underscored the labor and skill needed for such a feat. One student noted in her sketchbook:

"This entire process has also definitely had its highs and lows; While I love this art form, its actual production is so much more involved and tedious than I previously thought... I found it frustrating to make accurate cuts in the stones. I have a newfound respect for mosaic artists."

Another student made notes and drawings in her sketchbook, referring to the relative facility of each marble type and the best use of shapes for organic forms.

Historical empathy exercises have been utilized in educational settings to assist students in interrogating the actions of an individual or group, given their circumstances. Acknowledging the bias of one's contemporary existence and the lack of complete knowledge of the past is vital. In the vein of Walter Benjamin's notion of the fragmentary nature of history, noting, "History is made up of fragments and absences. What is left out is as significant as what is included" (Benjamin, 1968), the co-leaders emphasize the superficial nature of a three-week immersion not as a negative experience, but as a way to grapple with the complexities of today. Benjamin also notes, "The true method of making things present is to imagine them in our own space and not imagine ourselves in their space" (Benjamin, PAH, 23). This activation of historical methods and techniques for exploration and discovery was evident in the program's second workshop, "Traditional Wood Joints."

Beyond the program content, students were immersed in a classroom environment alongside international peers, including those from Italy. This unique setting sometimes created discomfort for U.S. students, who were unaccustomed to the Italian instructor's pedagogical style. Some perceived the instructor's approach as a lack of consideration for alternative design processes. The co-leaders used this opportunity to engage the entire cohort in a broader discussion. Helping students distinguish between discomfort stemming from cultural differences and personal slights

was an integral part of their experience, complementing the workshop content.

Educators have long noted that building empathy in resilience leads to higher emotional intelligence. MacDonald (2021) defines emotional intelligence as "an individual's capacity to recognize, manage, and express emotions and the ability to perceive, understand, interpret, and respond to the emotions of others. EI enables us to confront our everyday problems with patience, insight, and imagination." Working through discomfort by parsing out the emotional responses to the situation supports students in evolving their emotional intelligence.

As mentioned earlier in this paper, time is a key area of cultural difference. Mosaic instructor Elisabeth Cozza remarked that our students often worked without taking breaks and then typically crashed by 4pm. In Francesco Faccin's workshop, he asked students to refrain from eating in the studio setting, something that is more common in our American university, which led to confusion and embarrassment. In one of the daily prompts, it states,

"American culture often deems time as a commodity - time can be saved, wasted or spent wisely. Listening to our bodies for signs of hunger or fatigue often doesn't match the work day. When you eat your first bit of food today, slow down. Try not to multitask. What does it taste like? What are the textures? Try to bring that sense of mindfulness of the present moment with you today."

In response, one student noted:

"It is so important to take a step back to breathe and look at things from the perspective of growth, not perfection. I tried to slow down on my walk to MADE this morning and while I wasn't able to sit while eating due to time, I tried to enjoy both my slow walk and my breakfast croissant.

I allowed myself to stroll to MADE instead of my usual speed walk. I took in my surroundings and paid closer attention to smaller details around me present in the shops and buildings along the way. I noticed these gorgeous wrought-iron flowers on a balcony I pass daily that I never noticed before."

Our faculty frequently discuss how a studio ethos can develop organically, for better or worse. Often associated with political or corporate settings, groupthink is also relevant in educational contexts. It is "a psychological phenomenon that propels well-intentioned individuals to follow the behavior or opinion of the majority and make suboptimal decisions for the sake of conformity" (Tankala, 2023). If studio time is equated with a positive work ethic, students may start spending excessive time in the studio without breaks, even eating at their desks. By removing themselves from this insular way of thinking, they were exposed to a new model in which students took short breaks throughout the day and finished later.

5. Reflection, Challenges, and Opportunities

Figure 9. Following our visits to Mount Etna (image on the left) and the Villa Romana del Casale (image on the right), students were encouraged to reflect on their experiences through poetry. At the end of the program, we curated an exhibit of their work in a street-level studio space open to the public (center image). Alongside their work, students shared handwritten personal reflections on their program experiences.

On the final afternoon of our 2024 Sicily: Design and Resilience program, we held an exhibition at MADE, where students showcased their work from the Ancient Mosaics and Traditional Wood joints workshops, along with their sketchbooks. Each student also responded with a written reflection to the prompt: "In your experience, how is Sicily's built environment and material culture an expression of its layered and nuanced past and present?" This celebration of the program's accomplishments also included discussing opportunities for growth and improvements for future iterations.

The feedback from students was overwhelmingly in favor of extending the program's duration. They desired more time in Sicily, particularly more downtime to sketch and reflect on their experiences. Initially, the decision to make the program three weeks instead of four was based on the belief that a shorter program would reduce student costs. However, the savings were minimal. Comparing the sketchbooks from the month-long course in Florence (2017 and 2019) to those from the three-week course in Sicily (2024) suggests that the program would benefit from being longer. Daily sketching and sharing offer more opportunities for an iterative process, allowing students to refine their techniques; additionally, revisiting locales for sketching fosters iterative growth and deeper understanding.

Leading study abroad programs in popular tourist destinations presents the challenge of recognizing and addressing our impact on local communities. The effects of mass tourism on local infrastructure have been profound, with platforms like Airbnb significantly altering neighborhoods, driving up property prices, and displacing long-time residents from historic areas. In their co-edited volume, Study Abroad and the Quest for an Anti-Tourism Experience, Bodinger Uriarte and Di Giovine (2020) explore the evolution of the ideal traveler, noting:

"Study abroad is a form of mobility that encapsulates anti-touristic values: traditionally slow and immersive, based on education and quality local interaction… and aimed at breaking down ethnocentrism and creating cosmopolitan 'global citizens' rather than transient visitors…" (p.284).

Balancing the economic benefits of tourism with the preservation of social, cultural, and environmental resources is indeed a complex challenge. In Ortigia, Siracusa, for example, the port serves as a stop for cruise ships that bring hundreds of tourists to explore historic sites and local culture. However, many of these tourists choose to dine on the ships, which provide their own meal plans, rather than patronizing local restaurants. This arrangement limits the economic benefits to local eateries and hotels, which cannot fully capitalize on the influx of visitors. Peer-to-peer rentals, with Airbnb leading the charge since its inception in 2008, have significantly impacted the gentrification of local communities. The pandemic underscored the profound effects these short-term rentals can have on historic city centers (Higgins et al., 2023). As a result, it is crucial for study abroad participants to be mindful of their impact and to actively collaborate with local institutions and stakeholders to address these effects. While the 2024 iteration of our program touched on these issues, we did not have the chance to explore them in depth through workshops or design charrettes. However, the relationships established between our institutions present a valuable opportunity for further development. To optimize our approach to sustainable tourism in Ortigia, aligning our curricular priorities with collaborative decision-making to minimize our environmental and tourism impact would be beneficial. For example, lodging represents a significant area of concern. If we stay outside the historic district, it would be advantageous for students to grasp the importance of reducing our footprint. This understanding would help them appreciate the broader implications of our choices and the benefits of sustainability in tourism.

After extensive experience leading study abroad and domestic study away programs, the program co-leaders have determined that short-term immersion must be complemented by local collaboration to provide students with meaningful insights into local challenges beyond the typical tourist experience. Our materials studies methodology involves: 1) immersive engagement with place, 2) collaboration with regional craftspeople,

3) a phenomenological assessment of materials and processes, 4) identification of potential end-uses, and 5) reflective analysis of outcomes. Establishing thematic threads before and during the program can enrich the student experience, helping them navigate the overwhelming influx of new information and experiences. Additionally, providing ample opportunities for reflection allows for more profound, long-term growth.

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SPACE EXPLORATION: COMMUNITY OF INTERCULTURAL IDENTITY THROUGH MEMORY SHARING.

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ABSTRACT | How can design guide future scenarios of space exploration through systems-actions-visions that continue to create connections that transcend the limits of space and cultural boundaries? As emerges from current trends, in the coming decades, the human presence in space will expand from low Earth orbit to the lunar surface and the crew will be made up not only of astronauts but of new users with heterogeneous purposes and missions. Today, the International Space Station (ISS) is a place of strong cooperation, where boundaries are not defined and people, thanks to long selection processes and shared training, acquire a strong empathy so that cultural differences are not perceived as a limitation. In the future, this balance may change significantly. In fact, the risk of a larger presence of "space travelers" with their short stay, is that the space habitat becomes just a "crossing" space without an identity, without a shared memory, a non-place.

The paper investigates how design in synergy with humanistic and technological fields can encourage the creation of a new community not only of interest, but with a shared intercultural identity within these new extreme environments.

The research, through a Responsible Advanced Design, is mapping and analyzing which analogic and virtual practices can activate a "memory" in Space habitats capable of developing a system for transferring the experiences of places and emotions from one user to another, beyond the boundary of time and exceeding it, to give continuity to a story and eliminate the meaning that it is just about experiencing the micro-gravity space for oneself.

KEYWORDS | ADVANCED DESIGN; FUTURE STUDIES; SPACE HABITAT; INTERCULTURAL IDENTITY; MEMORY

1. Introduction

The dream of reaching the moon is centuries old. Our satellite has always aroused human curiosity, making the sky more than just an inanimate blanket of stars, but a space worthy of exploration. The time has come to change things. Not only are there spectacular explorations by space heroes heading into the unknown, like the moon landing that still ignites human imagination, but also consider that in the last 24 years, the International Space Station has hosted approximately 273 astronauts and cosmonauts from 24 different countries[1]. Current trends indicate that in the coming decades, human presence in space will expand from low Earth orbit (about 400 km from the surface) to the lunar surface, with crews composed not only of astronauts but also new users with diverse purposes and missions. If today the International Space Station (ISS) is a place of strong cooperation where boundaries are undefined, and people, through long selection processes and shared training, acquire strong empathy so that cultural differences are not perceived as limitations, the future does not foresee such "harmony" when constructing new vehicles and space stations. In the future, this balance may change significantly, especially since by 2031 (Bartheles, 2024), the ISS will undergo significant modifications, if not dismantled entirely. F.e. Space X's Starship program promotes the idea that the developed vehicle could carry up to 100 people for an interplanetary journey[2], while Falcon 9 carries 7 passengers. The goal is no longer a destination within our planetary system but interacting with the space surrounding Earth in various ways.

Currently, ensuring greater psycho-physical well-being and a better quality of life for travelers within space modules seems to be one of the main objectives. However, a further step is needed: regenerating the emotional relationship and spatial and bodily interconnection among people who will experience the space habitat presumably for shorter periods, with different interests and objectives than actual astronauts. The psychological negative factor addressed in this paper concerns the risk that the space habitat becomes just a "crossing" space without identity or shared memory, a non-place for "space travelers" with their short stay.

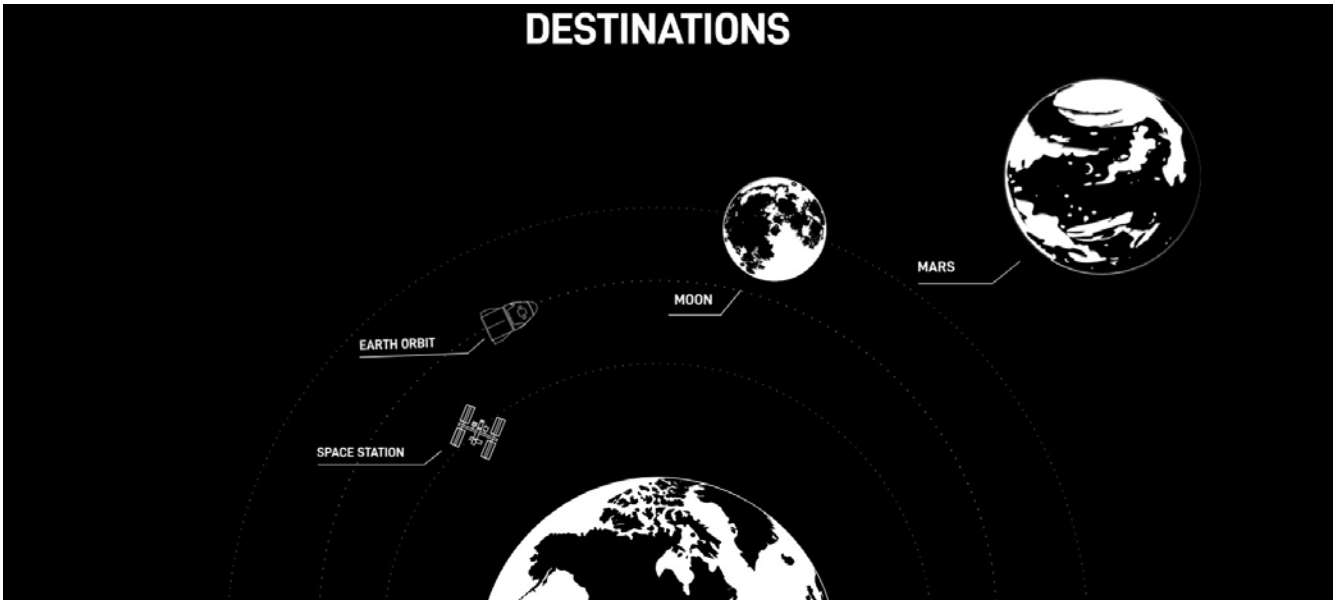

Figure 1. Image taken from the SpaceX website - Human Spaceflight

2. Concept of Belonging

Marc Augè defines a place with no personal connection as a Non-Place, devoid of narrative and functional at any point of use. In contemporary experience, Giaccardi and Magatti (2001) address the co-interest in social space as a resolution to loneliness. Places and non-places "interlock and mutually penetrate each other; the possibility of a non-place is never absent from any place," as Magatti reiterates Marc Augé's (p.44) statement on the coexistence in social space of places of solitude, non-permanence, and instrumental and contractual interaction. With current developments, space habitats in orbit can be seen as transit and crossing spaces not designed for relationships, where one does not recognize oneself as belonging except for artefactual details inserted over time by those who experienced these environments. Thus, thanks to the principle of community identity, an apparent non-place can become a place for someone who works and lives there. This distinction of attitude, not substance, must also be designed in new scenarios where innovative design approaches become the drivers of this interpretation.

What makes the environment livable is our relationship with it. Relationships with others, sensory memories, light, rhythms, physicality; these connections compose a multichannel perception capable of generating poetic images (Mallgrave, 2015, p.112) extracted from the experiences the body has lived. In the transposition of the space habitat becoming home, the

[1] Buon compleanno, ISS! - Infini.to (planetarioditorino.it), website consulted in July 2024

[2] SpaceX – Starship, website consulted in July 2024

place where we spend time beyond just functional activities like shopping but staying to eat, sleep, and interact with space and relationships with others, it is evolving from a "container/machine" towards an idea of an ecosystem that, thanks to the multiplicity of infrastructural networks (Mitchell, 1995), is increasingly interconnected with the objects and people inhabiting it. In new types of living spaces, according to Flusser (2003, p.88), "relationships are 'attracted'"; the habitat is no longer a place of protection but is "creative as a node of an interpersonal network." The infrastructures shaping the habitat are elements that compose that open network, opening new design fronts for space and life in relation to others. But also segregation with the intensified use of digital communication tools. People can relate more easily to a product, service, or experience when they can connect to it on a personal level and thus recognize in it languages, forms, and behaviors they have already experienced and can dialog with, whether effectively or not.

Zygmunt Bauman (2011, p.113) connects Richard Sennett's thought to the definition of empty space by Jerzy Kociatkiewicz and Monika Kostera, highlighting the difficulty of generating relationships, cohesion, and coexistence in spaces without meaning. For the same reason, the lack of meaning, the loss of identity, the lack of stratification of memory, and the disintegration of the collective element of non-places, according to Augé, make them alien to man in the process of participation, sharing, and association. If the connections generated between people and places do not participate in building personal, collective, and identity memory, they become meaningless and without hierarchies, failing to acquire value in human life.

Therefore, design must create a narrative that, in turn, generates memory, leading to the research question of this article: How can design guide future scenarios of space exploration through systems-actions-visions that continue to create connections transcending spatial and cultural boundaries?

3. Memory and Space-Time

Maldonado asserts that there is an evident connection between memory and identity in their relationship with dwelling and, consequently, with the objects accumulated within.

"'Dwelling means', said Walter Benjamin, 'to leave traces,' and traces are the imprint of memory. As has been said many times, in the Western world the accumulation of objects, considered as traces, represents one of the most important means of defining one's space and identity. We have seen so far how literature bears witness in an almost sculptural way to this character of our material civilization."

(MALDONADO, 2005)

This relationship lives through what is defined as bodily memory, resulting from the layering of past motor experiences the body has perceived and lived in relation to itself and

others or objects it has come into contact with. Considering the weakening relationship between man and things due to a changed nomadic configuration dictated by the increasingly digital consumption of content is another design area to consider for a general rethinking of our living systems.

The present research reveals that current space habitats are built to respond to survival and work functionalities, not to welcome passengers and placing their belonging needs in the background. It is a sense of multiple belonging: primarily physical, belonging to the station/vehicle crew, which could also be defined as a "common destiny." The other sense of belonging is to the home on Earth, with which the connection system has technically improved significantly over time, and organizationally, for example, the ISS astronauts' agenda includes space and time to correspond to this need. The sense of belonging to a space seems linked to the time spent in it. For example, on a long train or plane journey, the seat we occupy gradually becomes ours, and we identify with it. When we stay longer in a hotel room, we start moving furniture. And if years imprisoned, appropriation occurs even under the form of inscriptions on the wall, like the first humans on earth who testified their presence with a hand reproduction on the cave wall. We leave traces of our presence, like hearts carved into the tree where we encountered our first love.

3.1 Time in Relation to the Individual and the Community

As seen until now, beyond spatial and temporal factors in future space explorations, it is important to consider the relationship between the individual and (travelling) community, as well as the institution of reference.

The relationship between the individual and the community today is regulated by procedures, training paths, and highly concentrated physical-psychological preparation and the creation of a strong sense of cooperation and cohesion. People, thanks to long selection processes and shared training, acquire strong empathy so that cultural differences are not perceived as limitations. In contrast, the relationship between the community and governance is defined and protected by international agreements between public institutions, preserving a common good: extraterrestrial space and the multicultural nature of missions.

As expressed at the beginning of this contribution, the paradigm shift is defining new systems of governance of outer space, new forms of space occupation and resource use, new dynamics of partnerships between international non-profit entities and companies, focusing less on the social and cultural implications of these important changes (Pasa & Sinni, 2024).

All this brings up further questions: How will the future users relate to each other?
How can living space be made qualitative for

multicultural cohabitation? How can living space be designed to be cohesive?

In this complexity, time can be a driver of innovation by using the timely succession of people in the orbit at different moments as a community building resource: If considered as a variable of design (Celaschi et al.,2014), it can work on the design process to keep individual identity connected with being an active part of a community and a promoter of an international and multicultural cooperation system.

4. Action – Research

The Advanced Design Unit research group at the University of Bologna, through a project funded by the European community called Made in Italy Circolare e Sostenibile (MICS) - PE11 – PNRR, is carrying out the " Beyond the Space Life. Digital Living Lab for human life in space " project within the research line of Spoke 1. The work team involves various scientific fields in academia, such as design and mathematics, and an important aerospace company, Thales Alenia Space Italia (TASI).

This synergy between research and industry allows the investigation of the phenomenon of space exploration, particularly related to life in micro-gravity space habitats, through two lenses: 1) tangible factors such as the sustainability of tools and design processes, circularity of innovation strategies, use of technologies concerning the environment or people (Van Ellen, 2023; Valori et al., 2020) , and 2) intangible values such as inclusion, well-being/care of the individual, community, and space, cooperation, that belongs to the concept of Responsible Innovation (Stilgoe et al., 2013). Of particular interest for this contribution is the second research thread closely related to the elements, needs, and opportunities described earlier. As already emphasized, the reference context is an extreme environment, not comparable to life on Earth. Microgravity, the absence of natural stimuli, and altered sensory perceptions bring the human body into a new dimension and to live uncoded experiences. If until today astronauts have been able to overcome adaptability difficulties, social isolation, and identity sense thanks to their backgrounds and learned abilities, in the near future, this will not be possible due to the much shorter preparation of space travellers as described previousely.

The objectives and lines of intervention of this second track are multiple: on the one hand understanding who the new users will be and designing for the awareness and ethics of people undertaking these explorations, redesigning the experience from including ergonomic and sensorial perspectives (Burattini et al., 2014; Dominoni & Quaquaro, 2023; Inglese et al., 2024) on the other hand focusing on the design that allows to share memory and experience of travellers through time creating a new kind of "space community".

In this line of intervention, TASI's involvement is ensuring good experimentation of the project, guaranteeing related humanistic

and technological skills on a basic research level and to put theoretical visions into action by collaborating with further industry companies. The complexity of this research area, influenced by human, spatial, temporal variables, and unpredictable factors, requests combining knowledge and know-how from different fields through an interdisciplinary approach (Kopec et al. 2024).

To avoid interdisciplinarity remaining a theory and to bring to light shared design strategies, the working group takes design discipline as the engine of innovation. Design is not just seen as an innovation bearer of a product, service, or experience, but of a process; a design that assumes the role of mediator among multiple actors and disciplines and becomes an anticipator of possible futures (Iniguez et al. 2014; Succini et al. in press).

4.1 Methodology: From Human-Centered Design to Responsible Advanced Design

Today, the most widespread design approaches in the field of Space Design are guided by methodological tools typical of engineering disciplines or oriented towards design-driven methodologies. The most widespread is Human-Centered Design (HCD) (Long et al., 2022), which allows consideration of human factors, ergonomic criteria, and user experience throughout the design development. In recent years, other approaches have developed that, starting from HCD application in this field, have elaborated actions and tools that take into greater consideration the movements and changes in gestures characterizing this context, an example is Use and Gesture Design (Dominoni, 2021).

The complexity of this project led to studying these approaches and analyzing others related to solving wicked problems (Rittel & Webber, 1973) to find in Responsible Advanced Design (RAD) (Formia et al., 2023; Succini & Ciravegna, 2022) a synthesis of characteristics and tools capable of addressing not only the project from the perspective of space, human factors, and experience interaction but also considering time, the creation of extraplanetary interpersonal relationships, and the social and cultural impacts of this new paradigm shift in the entire design system. An approach where imagination is not only a factor of creativity but of desirable future design.

Advanced Design has been dealing since 2009 with the "relationship between the evolution of the time factor and innovation driven by design (Celi, 2010)" (Celaschi, Celi & Formia, 2014 p.22). Within this approach, time is not intended as a continuum but opens up to imagination and various possible, probable, or potential solutions (Celaschi, Formia & Franzato, 2018).

The relationship between future, anticipation and design (Celi 2015; Poli 2019) aims to "anticipate change" (Celi & Morrison, 2019) by transitioning from a user-centred approach to forms of collaborative design (co-design) in which each actor involved contributes

knowledge and experience by activating forms of cross-fertilisation along the value chain (Celaschi et al.; Iniguez et al., 2014).

Responsible Innovation (Stilgoe et al., 2013; Salamanca et al., 2019) introduces or reaffirms a design responsibility where everyone is an active part, a concept of innovation more focused to inclusion, care for the future, impacts not only tangible but also intangible, and the value of the community within a design process.

Therefore, the interaction between these two approaches has led the Advanced Design Unit since 2020 to develop a design model starting from this method to then experiment it in various contexts. The model consists of macro-actions that decline the concept of responsibility in four areas of design: Responsible Design, Responsible Thinking, Responsible Production, and Responsible Community, each characterized by design strategies and tools typical of design, enhanced by RI-oriented principles (Succini, 2023). Depending on the research area in which one operates, the approach can adapt, considering in the analysis, design, and experimentation process only some of these areas (macro-actions).

Specifically for the ongoing project concerning the creation of a bridge between research and experiments related to memory, space, and time in extraterrestrial contexts, strategies and tools related to Responsible Design and Responsible Production have been activated.

Below are schematically reported the RAD actions and tools considered and the purpose of their use:

Responsible Design

- Actions: Activation, Observation
- Tools: Observatory; Collaborative spaces and tools
- Objective: Mapping and observation in other contexts of memory activation systems; peer-to-peer reading and clustering of research through collaborative tools and shared definition of reading keys to identify new design strategies for activate a community space.

Responsible Production

- Actions: Experimenting; Co-producing
- Tools: Design Workshop; Checklists
- Objective: Co-produce through collaborative and multi-actor workshops, a case studies analysis system centered on project's key factors (bodily, sensorial, time, intercultural relationship, spatial inclusion, community, etc.), and possible futuristic scenarios where the concept of memory becomes the glue of these new forms of exploration and life in extreme contexts.

During the research, the two macro-actions have intertwined, and the results of one activity are defining the drivers for applying subsequent tools. Thanks to an iterative process between source research, case study

research, and field collaborative actions, the first conjectures theorized through literature are being validated.

4.2 Memory as an Inclusive and Multilevel Design Framework

Thanks to the approach described above, the research is mapping and analyzing which analogue and virtual practices can activate a "memory" in space habitats capable of developing a system for transferring experiences of places and emotions from one user to another, beyond the boundary of time, giving continuity to a story and eliminating the notion that experiencing microgravity is only for oneself.

The analysis begun with the study of the ISS, bringing to light current practices related to the concept of memory, such as the Space Mission Patches. Those stickers are attached in different parts within the ISS and can be read as a visual sign/reminder of those who have experienced the station in previous missions (fig. 2). This analysis was extended through research in other areas outside the domain, with the aim of identifying other products or experiences of memory activation and transfer.

This observation mode, inserted within the Responsible Design macro-action is allowing us to find drivers for change (Celaschi, 2016) and is highlighting design strategies and characteristics to develop systems within habitats where the memory element generates a bridge beyond time boundaries. Shared memory can be seen as an activator of relationships, interpersonal bonds, and recreates empathy among people and communities.

The interaction and iteration between design-driven observation systems (which

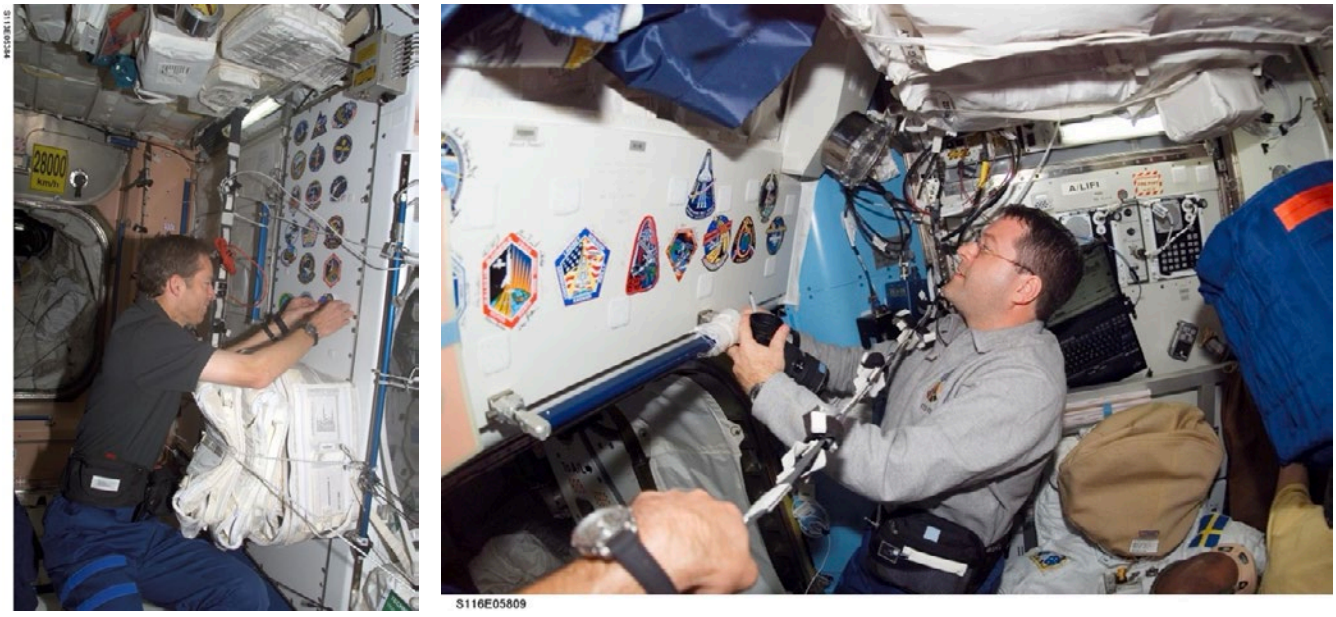

Figure 2. Images of mission patches on space habitat panels in the ISS – Source: Nasa Image and Video Library

use collaborative open-source tools for data collection) and peer-to-peer workshops among researchers, young designers, and company operators have led to a first reading of the memory concept concerning the future users' needs in space explorations. The corridors and intervention lines can be summarized in four categories:

- Body Memory: Linked to gestures and postures that lead to reliving a memory or transferring sensations already experienced through coded movements or related to proprioception (Koch et al.,2014);
- Symbolic Memory: Connected to artifacts and visual elements that establish a stronger relationship with the surrounding environment;
- Ritual Memory: Linked to ways of acting. It becomes a sense-producing element that, through a series of actions, connects the individual with the community, the past to the present and future (Durkheim in Segalen, 2002), and can generate new rituals;
- Sensorial Memory: Closely connected to our senses, whether a single sense or their combination, leading the person experiencing it to relive the intangibility of a memory or experience (Bruno, 2022).

These categories are also connected to two possible ways to keep this memory alive through analog artifacts, digital artifacts, or their combination. Main task of the work team will be to define the best balance between these four categories. It can be taken into consideration that some routine activities executed on a daily basis in the extreme environmental context become part of one's body memories, but most likely transform eventually into ritual memories. Further it is to be considered that digital memories have often short effect and need to be recalled "artificially" while analogue memory keepers guard better a symbolic memory of events and people. On top of this, the placing of by travelers added memory elements that can transport a space community feeling over time, is not necessarily related only to one specific area in the habitat, but populates in different ways specific spots, from crew quarter to newly created co- habituative areas. Most likely the design intervention, based on co-designing principles, needs to create tools that over time allow the individual creativity of travelers to express their "I have been here", that bridges to the next testimonial of human presence in space, just like the colored hand in the preistoric cave. In the very end, the first foot print of Neil Armstrong on the moon does not tell anything else to the next traveler who will land on the moon, providing with a first sense of "settling".

5. Conclusion and Future Development

Applying the RAD approach in an extreme and high-risk environment has highlighted how its adaptability is not only related to the cultural, social, or territorial factors of a context but also to the flexibility of integrating the use of tools and methods typical of other methodologies.

In our case study, to redefine the future space habitats experience systemically, analyzing the phenomenon with the proposed approach (RAD) was useful, but for the next step, which will see the development of individual components, HCD will remain important reference. Indeed, it is assumed that these two approaches will interact throughout the design process because it will always be necessary to bring the micro to the macro and verify if the actions taken respond to the initial objectives.

As already emerged from the paper, the research is in an intermediate phase of its development, and the following actions will include: 1) integrating this factor within the activities, needs, and functions of space habitats to identify areas where it is necessary to integrate it, 2) creating a taxonomy based on the spaces identified of interaction between the categories (body, symbolic, ritual, sensorial) and the values it should enhance or recreate (sharing, interculturality, inclusion, etc.). This can become a design tool for products/services/systems memory that enhance a community Space identity 3) creating study prototypes of these elements to validate them with the design community.

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APPLICATION STRATEGIES OF ARTIFICIAL INTELLIGENCE TECHNOLOGY IN ART AND DESIGN EDUCATION: A MULTI-CASE STUDY FROM THE PERSPECTIVE OF INTERDISCIPLINARY THINKING CULTIVATION FEASIBILITY.

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ABSTRACT | With the rapid advancement of artificial intelligence technology, its application strategies in art and design education have become a focal point in teaching aimed at cultivating interdisciplinary design thinking. This study employs a multi-case research method to explore the feasibility and methods of applying AI technology in the process of design thinking cultivation at four higher art and design education institutions. This study explores the relationship between artificial intelligence technology and strategies for cultivating design thinking through case analysis and comparative research using statistical methods. The findings reveal that in the early stages of interdisciplinary design thinking cultivation, higher art education institutions adopt AI technology analysis strategies, focusing on the development of students' aesthetic abilities and the establishment of knowledge graphs. During the cultivation process, generative art, as a crucial component of AI technology, becomes a key skill in design thinking cultivation, enhancing students' interdisciplinary thinking abilities and innovative multidimensional pathways. Therefore, in exploring the application strategies of AI in interdisciplinary design thinking cultivation, it is important to consider using AI to assist in forming knowledge graphs and knowledge systems in the early stages and integrating AI technology as a professional technical skill in the training programs during the teaching process.

KEYWORDS | ARTIFICIAL INTELLIGENCE TECHNOLOGY, ART AND DESIGN EDUCATION, INTERDISCIPLINARY DESIGN THINKING, CASE STUDY.

1. Introduction

Artificial intelligence has permeated various sectors of society, including education. Art and design education is currently experiencing a transformational opportunity brought by technological innovation. With the rapid development of emerging technologies like big data and artificial intelligence, the form and methods of art education are being reshaped. The integration of AI technology not only meets the demands of the era but also becomes a crucial force in driving innovation in art education. Teachers and students in design education and related fields need to have a comprehensive understanding of design disciplines in the age of artificial intelligence and specifically enhance three key capabilities: professional expertise, interdisciplinary strength in design studies, and post-human social skills.

This paper conducts a multi-case study using five typical art schools and comprehensive university art academies as examples to formulate a general education curriculum teaching plan for art and design majors. It establishes control and observation groups to conduct comparative analysis of teaching outcomes, aiming to explore strategies for the application of artificial intelligence technology in art and design education.

2. Literature Review & Case Analysis

2.1 Literature Review

The application of Artificial Intelligence (AI) in art and design education is increasingly becoming a key factor in innovating teaching methods and enhancing learning efficiency. Literature emphasizes the tremendous potential of AI technology in personalizing instruction, enhancing design expressiveness, and stimulating student creativity. At the same time, concerns are raised regarding privacy protection, intellectual property rights, and technology dependence. Teachers play a crucial role in this process; they need to master the use of AI tools and integrate them into their teaching to foster the development of students' critical thinking and innovative abilities. The related research focuses on

several key themes, including the shift in educational philosophy, the expansion of curriculum content, innovation in teaching methods, enhancement of practical teaching, and the integration of technology and art. Some representative views on these topics are as follows:

Mayo (2024) emphasizes the collaboration between AI and teachers in art education, highlighting the importance of providing teachers with AI tools and proficiency in technology. It explores the potential impact of AI in art education, including creativity and educational practices. Zhang, Y., &Zhou, X. (2023) discusses the potential of AI to enhance teaching efficiency and personalize instruction in art and design disciplines. He points out the risks of privacy invasion and intellectual property violations associated with the application of AI, as well as the potential psychological pressures it may impose on teachers and students. Zhang, T. et al (2024). Analysis of curriculum construction in the integration of AI into art and design teaching from the perspective of "integration of art and science". Discussion includes the model of interdisciplinary training of design talents, involving the integration across teaching staff, curriculum resources, and educational platforms. Zhao, L., et al. (2024). AI technology is widely used across various fields and applications for accurate recognition and detection processes. In art education, AI is employed to simulate certain aspects of human intelligence, performing specific tasks such as the AI-based Education in Art Teaching Framework (EATF) and AI-Assisted Art Design and Teaching (AI-ADT). They also proposed an integrated data representation model assisted by regression learning (IDR-RL), aimed at enhancing multimedia-based educational performance. This model provides necessary data tailored to different teaching methods/ subjects based on course and student needs.

In summary, the teaching strategies for integrating AI into art and design education are not yet clearly defined. The research presented in this paper aims to provide insights that can guide further studies in this area.

2.2 Case Analysis

Art and design institutions worldwide are increasingly integrating the intersection of art and technology into their curricula, exploring innovative educational models to enhance academic and practical skills. The Royal College of Art in the UK has developed pioneering courses and collaborative programs with other universities, focusing on interdisciplinary innovation.

Similarly, the Rhode Island School of Design in the US is promoting interdisciplinary education by collaborating with Brown University to establish a comprehensive "Art + Science" framework. The School of Design at Politecnico di Milano in Italy emphasizes the development of collaborative design capabilities, preparing students for the complexities of modern design practices. MIT's Media Lab further exemplifies this trend by concentrating on the intersection of design and technology, fostering a research

environment that encourages the synthesis of diverse disciplines. These initiatives reflect a broader academic recognition of the necessity for interdisciplinary approaches in higher education, aiming to equip graduates with the competencies required to address complex global challenges and drive future innovation in the creative industries.

Select 5 cases from arts or design Colleges and Universities for study and comparative analysis. The institutions include:

- Tsinghua University Academy of Arts & Design;
- Tongji University School of Design;
- Beijing Institute of Fashion Technology;
- Huazhong University of Technology:
- The Royal College of Art;

Tsinghua University Academy of Arts & Design: Since 2023, Tsinghua University has embarked on a cutting-edge educational innovation—integrating artificial intelligence teaching assistants. This assistant system is based on an advanced multimodal large language model (GLM) with hundreds of billions of parameters, aimed at providing comprehensive support for interdisciplinary teaching and learning activities. The core advantage of the AI assistant lies in its ability to offer 24/7 personalized learning guidance, perform intelligent assessments and feedback, which not only significantly enhances learning efficiency but also effectively promotes students' critical thinking and creativity. The introduction of AI assistants at Tsinghua University signifies a major shift in educational paradigms. By 2024, the university plans to develop and launch 100 innovative courses that incorporate artificial intelligence technologies. These courses will deeply integrate the capabilities of AI assistants and AI teachers, continuously optimizing the teaching environment and educational strategies to bring students a richer, more interactive, and personalized learning experience. This innovative initiative not only highlights Tsinghua University's leadership in educational technology but also sets a benchmark for the intelligent development of higher education globally. With the aid of AI assistants, teachers can focus more on innovating course content and improving teaching methods, while students can gain a deeper understanding and a broader exploration of knowledge through personalized learning paths. As artificial intelligence technology continues to advance, future education will increasingly focus on cultivating students' innovative spirits and abilities to solve complex problems, training more talents with international perspectives and innovative capabilities for society.

Tongji University School of Design: Tongji University's School of Design has set three phased goals for the development of its artificial intelligence laboratory, aiming to promote in-depth research and practice of AI art. Phase One: Defining the Boundaries of AI Art. Initially, the school is committed to clarifying the scope and boundaries of AI art

through interdisciplinary discussions. The goal of this phase is to bring together experts from various fields to discuss and define the application range of AI in the art domain, and how it impacts and transforms traditional art creation methods and expressions. Phase Two: Interdisciplinary Collaboration and Technology Integration. Leveraging Tongji University's rich multidisciplinary resources, the School of Design plans to pair artists with professionals from different backgrounds, such as scientists, to explore the profound potential of AI art. The development of AI art is believed to require not only technological support but also artistic creativity, industry integration, and a deep understanding and application of tools. Through such interdisciplinary collaboration, the lab hopes to foster a deep integration of technology and art, creating innovative and practical art works. Phase Three: Production and Diverse Expression of Artworks. Building on the first two phases, the goal of the third phase is to produce impactful art works and express them in diverse forms. Currently, AI art works globally are mostly concentrated in the visual arts.

However, the forms of artistic expression extend far beyond this scope. The AI lab at Tongji University's School of Design aims to go beyond the visual aspect, exploring sculptures, installations, and even performance arts to achieve diversified and in-depth artistic expressions. The lab's vision is to not only theoretically explore AI art in depth through these three stages but also practically create innovative and artistically valuable works. Through these efforts, the school hopes to advance the development of AI art, bringing new perspectives and possibilities to the art world, as well as providing new creative tools and methods of expression for artists and designers.
Beijing Institute of Fashion Technology:
Beijing Institute of Fashion Technology has collaborated with Alibaba Cloud on a two-week innovative design education course, an initiative that integrates education, technology, and the fashion industry. The aim is to ignite students' creativity and drive the innovative development of the national fashion industry. The application of Alibaba Cloud's AI tools in the design process offers students several advantages, significantly enhancing creativity and efficiency. Firstly, AI tools can analyze design trends and historical data to inspire creativity, helping students rapidly generate new design ideas. With AI-assisted image generation tools, students can obtain preliminary design sketches within seconds, accelerating the design iteration process. Personalized customization is another major advantage of AI tools; they provide customized design suggestions based on user preferences and behavioral data, enabling students to create designs that better match the tastes of their target audience.

Additionally, AI can analyze the color coordination and layout balance of design elements, offering optimization suggestions to enhance the visual appeal of design works. In terms of efficiency, AI tools save students' time by automating repetitive design tasks, such as image cropping and color adjustment,

allowing them to devote more energy to developing creative and design concepts. The intelligent layout feature of AI tools can automatically adjust the arrangement of text and images based on content, ensuring the neatness and readability of design works. Real-time feedback is another crucial feature of AI tools; they provide immediate design feedback, helping students promptly identify and address potential issues in their designs. Moreover, the collaborative features of the AI platform allow multiple students or designers to work on the same design project, sharing and discussing progress in real time, enhancing teamwork efficiency. AI tools can also serve as educational tools, helping students learn and master design principles and best practices. Integrated into existing design software, students can leverage AI capabilities in a familiar work environment, further enhancing the fluency and innovation of design work. They are able to combine their knowledge with practical issues, leveraging their professional strengths to contribute design power to society. The AI tools and computational resources provided by Alibaba Cloud offer robust technical support for design work, making it more efficient and innovative. This workshop not only provides students with a platform for learning and practice but also offers new ideas and directions for the future development of education and industry.

Huazhong University of Technology: The China Artificial Intelligence Art Education Collaborative Innovation Platform, spearheaded by the Key Laboratory of Optical and Interaction Service Technology for Culture and Tourism at Huazhong University of Technology, is a collaborative network comprising 345 universities. This platform is tasked with the mission to integrate art design education with artificial intelligence technology, striving to comprehensively revolutionize art and design education in the era of AI. The vision of the platform is to cultivate a new generation of art and design talents who possess modern concepts, master AI technology, and are proficient in art and design methods. To achieve this goal, the platform will implement three major strategies: "AI + Curriculum," "AI + Practice," and "AI + Research." Firstly, "AI + Curriculum" will integrate AI knowledge into art and design courses through textbook writing to update educational content. Secondly, "AI + Practice" aims to enhance students' practical skills through organizing workshops and project practices, enabling them to apply AI technology in real projects. Lastly, "AI + Research" encourages teachers and students to participate in research projects, enhancing research levels through funding applications and scholar visits.

The Royal College of Art: The Royal College of Art (RCA), a globally renowned art and design institution, has collaborated with the Hong Kong Polytechnic University (PolyU) to establish the Artificial Intelligence Design Lab (AiDLab). AiDLab is the first research platform in the Asia-Pacific region that integrates artificial intelligence with creative design, dedicated to fostering the merger of AI and design to drive innovation and sustainable

development, and to make a positive impact on industry and society. The institute conducts joint master's and doctoral training with the RCA, focusing on research in ergonomics and inclusive design, innovative product and service design, and smart fashion design and quality control. These research areas aim to use AI technology to improve the design processes of everyday products and services, enhancing human-computer interaction and user experience. AiDLab has also developed an interactive AI fashion design assistant (AiDF), which enables students to quickly produce diverse original designs inspired by their creativity with the help of AI (Laboratory for Artificial Intelligence in Design, (n.d.)). The executive director of AiDLab and Professor of Fashion at PolyU, Wing-Yung Cheng, stated, "The institute aims to nurture research talents in AI and design, and in the future, to extend its research achievements to the Greater Bay Area and the international market."(PolyU, 2021))

2.3 Comparison and Development of Educational Plans

Based on the teaching plans for AI design general education courses offered at various schools, compare at which stages AI is used, resulting in the following table:

Table 1. Comparison of AI usage in the teaching processes.

	Introduce Basics	Design Research	Design Sketch	Design Iteration	Project Presentation
Tsinghua University	1	1	1	1	0
Tongji University	0	0	1	1	0
Beijing Institute of Fashion Technology	1	1	1	1	0
Huazhong University of Technology:	1	0	1	1	0
The Royal College of Art	1	0	1	0	1

2.4 Setting up the teaching plan

Based on the comparative study results from the above cases, it can be observed that most art and design institutions typically use artificial intelligence-assisted design during the theoretical instruction, design inspection phase, and sketch design phase. Therefore, in this course, artificial intelligence technology is used to create knowledge graphs during the theoretical knowledge phase and the PBL (Problem-Based Learning) teaching method is applied. During the design inspection phase and the sketch design phase, AI generation technologies and other teaching methods are used.

3. Research Subjects and Methods

3.1 Research Subjects

A convenience sampling method selected 142 graduate and undergraduate students from the design program at Tianjin Academy of Fine Arts, between April and June 2024. The group consists of 30 male and 112 female students; 19 are undergraduates and 123 are graduate students. These students are aged between 18 and 24 years, with an average age of 22.21 years. After completing their initial theoretical courses, all students will proceed to the next phase of their education, which may involve further studies or internships. The artificial intelligence design course is structured in two-week cycles, with each cycle involving 90 students.

3.2 Research Method

According to the teaching plan implemented based on case analysis, and in comparison with regular teaching classes:

- Grouping;
- Control Group;
- Observation Group;
- Evaluation Method.

Grouping:
The study participants were divided into a control group and an observation group based on the sequence of their internships in the SICU. Eighty undergraduate and graduate students from the design discipline who participated in the course in April 2024 formed the control group, which used traditional teaching methods. Sixty-two undergraduate and graduate students from the design discipline who joined the course in May 2024 constituted the observation group and were taught using a PBL (Problem-Based Learning) approach combined with artificial intelligence. There were no statistically significant differences between the two groups in terms of age, gender, educational background, or course grades (all $P > 0.05$), making them comparable.

Control Group:
The traditional art and design innovative teaching method employed is the "Theoretical Foundation—Design Research—Design Sketch—Design Proposal Iteration—Project Presentation" teaching model.

Observation Group:
The teaching method combines artificial intelligence technology with PBL (Problem-Based Learning). During the teaching preparation phase, teachers formulate teaching plans and objectives according to the requirements of the syllabus, sort out the knowledge points that students must master during the course, create a knowledge map and upload it to the Smart Tree platform. These knowledge points are listed in the form of questions and reasonably distributed to various stages of learning. At the same time, in conjunction with the students' majors, three representative cases of the use of artificial intelligence technology are compiled,

including environmental design cases, visual communication design cases, and digital media art design cases.

The teaching implementation is divided into five stages: The first stage is 1-2 days, where professional teachers explain the basic theoretical knowledge and design cases according to the requirements of the syllabus, using the PBL teaching method and arranging students to expand their learning on the Smart Tree platform in accordance with the knowledge map. The second stage, from the 3rd to the 7th day, mainly uses artificial intelligence technology to collect data for desk research and complete user research under the guidance of teachers to identify design opportunity points. The third stage, on the 8th and 9th days of the course, mainly uses AI large models to complete the production of design sketches, during which the teacher will use 2 class periods to explain the prepared design cases. The fourth stage is from the 10th to the 13th day of the course, where students use AI large models for generative art design and plan iteration. The fifth stage is on the 14th day, where students report their plans in groups.

Evaluation Method:
Evaluation is the evaluation of the learning effect of students. It is not only necessary to evaluate the final learning effect, but also to evaluate the learning situation before and during the class (Wang, 2021). Therefore, theoretical knowledge learning needs to be assessed through closed-book exams. From the 400 questions generated on the Zhihuishu platform based on the knowledge map, 20 questions will be selected, each worth 5 points, totaling 100 points. The design plan and final design grawings is to be presented on the last day of the course, and a group of teachers will score it. A questionnaire survey will be conducted on the observation group regarding the application strategies of artificial intelligence technology combined with PBL (Problem-Based Learning) in art design teaching, assessing whether it can enhance the nursing students' autonomy in learning, interest in learning, self-learning ability, problem identification ability, language organization and expression ability, analytical and problem- solving ability, teamwork ability, learning capacity, and broadening their scope of knowledge. The survey includes 9 items, each evaluated on a 10-point scale. After the course, students are organized to evaluate the teaching satisfaction with the instructors, rated as 'Very Satisfied,''Satisfied,''Neutral,''Dissatisfied,' and 'Very Dissatisfied,' with corresponding scores of 4, 3, 2, 1, and 0 respectively.

3.3 Statistical Processing

Data analysis was conducted using SPSS statistical software. Quantitative data were presented asx ± s deviation and analyzed with t-tests; categorical data were shown as case numbers and percentages and analyzed using chi-square (x^2) tests. Satisfaction comparisons were performed using the U test, with differences considered statistically significant at $P < 0.05$ or $P < 0.01$.

4. Results

4.1 Assessment scores

The theoretical and practical examination scores of the observation group's nursing students were significantly higher than those of the control group, and the difference in examination scores between the two groups was statistically significant ($P < 0.05$), Table 2.

Table 2. Comparison of the examination scores between the two groups of students ($x \pm s$, points).

Group	Number of Participants	Theoretical Knowledge	Design Proposal
Control Group	99	85.03±5.28	86.74±3.10
Observation Group	93	86.33±4.96	88.21±5.98
P-value		0.041	0.029

By preparing knowledge graphs of the essential concepts that students need to master in advance and distributing them in the form of questions at different stages of learning, and integrating these into both foundational theory studies and design creation practicum, significant improvements have been made in comprehension and mastery of the material. This approach involves using the Zhihuishu platform's knowledge graphs for learning, coupled with group discussions and interactive learning presentations to replace traditional lectures, significantly enhancing students' grasp of the knowledge points.

Problem-Based Learning (PBL), which is a teaching methodology oriented around guiding students to explore, identify, and solve problems while enhancing their critical thinking abilities, places students at the center of the learning process with instructors leading and facilitating. It is an interactive teaching model that integrates theory with practice. By combining this with AI- supported knowledge graph learning methods, student learning efficiency has been notably increased. This innovative educational approach not only makes the learning process more engaging and effective but also leverages technology to better prepare students for practical applications of their knowledge.

4.2 Teaching effectiveness satisfaction

There is a statistically significant difference in the teaching effectiveness between the two groups of students ($P < 0.05$), Table 3.

Table 3. Comparison of teacher satisfaction between two groups.

Group	Number of Participants	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
Control Group	99	28	55	6	0	0
Observation Group	93	75	17	1	0	0

4.3 Survey results of the observation group students

A total of 93 questionnaires were distributed, and 93 valid questionnaires were collected, with a valid recovery rate of 100%. The feedback on the evaluation of the PBL combined with CBL dual-track teaching method by the students in the observation group had an average score of (8.59 ± 0.48) points, which is at a relatively high level. See Table 4.

Table 4. Evaluation of the teaching planning by the students in the observation group (x ± s, points).

Survey Item	Score
Increase in learning autonomy	8.02±0.55
Increase in learning interest	8.70±0.21
Improvement in self-study ability	9.13±0.52
Improvement in problem identification ability	7.92±0.88
Improvement in language organization and expression ability	8.01±0.12
Improvement in analysis and problem-solving ability	8.51±0.27
Improvement in learning and consolidation of design innovation ability	8.83±0.63
Improvement in team cooperation ability	8.58±0.46
Broadening of knowledge scope	9.64±0.72

5. Discussion

5.1 Using artificial intelligence to help teachers build knowledge graphs

In the rapidly evolving field of education, the cultivation of design thinking has become an essential component of educational reform. Particularly in the early stages of fostering design thinking, the development of aesthetic capabilities is crucial for students. This development not only affects students' perception and understanding of beauty but also directly impacts the quality and expressiveness of their creative works. Enhancing aesthetic abilities is the cornerstone of continuous progress in the fields of art and design.

The intervention of Artificial Intelligence (AI) has brought revolutionary changes to this cultivation process. By analyzing a vast array of art and design works, AI helps students quickly establish an understanding of fundamental aesthetic elements such as color, shape, and composition. These elements are the basics of artistic creation and design practice, and the learning capabilities and data processing power of AI make this process more efficient and precise. Using machine learning algorithms, AI can identify and predict various design trends, providing students with a constant stream of inspiration and creativity. This trend analysis not only helps students understand current design fashions but also inspires them to explore future design possibilities. This capability of AI opens a door to the world of innovation for students. Additionally, AI can provide personalized feedback and suggestions based on students' design works. This feedback is based on an in-depth analysis of students' works, including color coordination, shape usage, and compositional balance. Through these specific suggestions, students can continuously optimize and improve their designs, thus advancing further on their design journey.

In the process of cultivating interdisciplinary design thinking, the application of AI extends beyond just enhancing aesthetic abilities. It also promotes the development of logical thinking, innovative thinking, and critical thinking among students. For instance, AI can assist students in data analysis during the design process, helping them better understand user needs and market trends. This analytical capability enables students to meet the practical demands of designing products or solutions more accurately. The application of AI in interdisciplinary design education also helps students build bridges connecting knowledge across different disciplines. Taking environmental art design as an example, students can integrate knowledge from architecture, environmental science, and socioculture with the help of AI. Through data analysis and pattern recognition, students can achieve interdisciplinary collaboration on real projects. This approach not only broadens students' knowledge horizons but also encourages them to adopt a more comprehensive and innovative approach in their designs.

In the field of design education, the application of AI is also reflected in providing rich learning resources, personalized feedback, and immersive learning experiences. These resources and experiences effectively enhance students' aesthetic abilities and promote their comprehensive competence in the design field. As AI technology continues to advance and its application in education deepens, it will play an increasingly important role in design education. In summary, the application of AI in design education provides students with a new learning platform. It not only helps enhance their aesthetic capabilities but also promotes their comprehensive development in the design field. With continuous technological progress, we have reason to believe that AI will play an increasingly vital role in design education, making a greater contribution to nurturing design talents with innovative spirits and practical abilities.

5.2 Generative art is a key skill in the cultivation of design thinking

Generative art, as a critical skill in the cultivation of design thinking, represents not only an innovative form of artistic expression but also serves as a significant mode of thinking and problem-solving method. In design education, the practice of generative art helps students develop a dynamic, flexible, and creative thinking pattern. It emphasizes the process over the final product. This artistic approach encourages students to explore multiple possibilities, continually experimenting and adjusting until the most satisfying solution is found. This process-oriented method aligns seamlessly with the iterative processes of design thinking, helping students to continually optimize and refine their creativity when addressing design challenges.

Generative art typically involves the use of algorithms, computer programs, or other technological means to create artworks. This requires students to possess not only an artistic sense but also a significant level of technical proficiency. During this process, students learn to integrate technology with creativity, a crucial skill in modern design fields. In this study, students in environmental design use AI to assist with environmental lighting analysis, acoustic simulation, and pedestrian flow predictions, providing a scientific basis for their design proposals. In the realm of visual communication design, AI supports students in tasks such as image recognition, color matching, and layout design, offering personalized design suggestions. For instance, AI algorithms can recommend color schemes and visual elements based on the design theme and the preferences of the target audience, enhancing the design's appeal and communicative impact. Through AI technology, students gain a more accurate understanding of the relationship between space and environment, and the impact of design proposals on the environment. Students engaged in visual communication design can create unique visual patterns and structures through the application of programming and algorithms, enhancing their aesthetic capabilities while also honing their logical thinking and problem-solving skills.

The practice of generative art also fosters students' critical thinking. During the creative process, students are required to evaluate and reflect on their work, considering ways to improve and better convey their design concepts. This self-critical process helps students develop a deeper understanding and a critical perspective on their design works.

However, the practice of generative art should not replace traditional design education methods but should be seen as a complement to them. Students still need to learn fundamental design principles, color theory, and composition. In the observation group of this study, students utilized generative art as a tool or method to delve deeper into exploration and innovation on top of this foundational knowledge. As a result, the design solutions were more effectively realized, and the application of theory and foundational knowledge was enhanced.

5.3 Artificial intelligence enhances students' aesthetic abilities in the early stages of cultivating interdisciplinary design thinking.

In the early stages of cultivating design thinking, the development of aesthetic ability is crucial for students. This aspect not only influences their perception and understanding of beauty but also directly impacts the quality and expressiveness of their creative works. A strong aesthetic sense allows students to appreciate and evaluate art and design with a critical eye, which in turn informs their own creative processes.

AI plays a significant role in this educational stage by providing tools and insights that can rapidly enhance students' understanding of fundamental aesthetic elements such as color, shape, and composition.

AI can analyze a vast array of art and design cases, allowing students to quickly build a comprehensive understanding of different styles and trends. Through machine learning algorithms, AI identifies patterns and correlations within artistic and design elements, helping students to discern and predict emerging trends. This capability serves as a rich source of inspiration and creativity, offering students new ways to approach their work and expand their artistic horizons.

Moreover, AI can provide personalized feedback and suggestions based on students' individual design projects. By evaluating the unique aspects of each student's work, AI helps them identify strengths and areas for improvement, fostering continuous refinement and enhancement of their designs. This personalized approach not only accelerates the learning process but also ensures that students develop a deep, nuanced understanding of design principles.

In the broader context of interdisciplinary design thinking, AI's application extends beyond mere aesthetic enhancement. It also promotes the development of logical, innovative, and critical thinking skills. For instance, AI can assist students in conducting data analysis during the design process, enabling them to gain a clearer understanding

of user needs and market trends. This information is invaluable for designing products and solutions that are not only creative but also practical and market-relevant.

In interdisciplinary design education, AI helps students bridge the gap between different fields of knowledge. In this course, students majoring in environmental art design can use AI to integrate concepts from architecture, environmental science, and social culture. AI facilitates collaborative work on real projects through data analysis and pattern recognition, highlighting how various elements can work together effectively. This approach not only broadens students' knowledge horizons but also encourages them to adopt a more comprehensive and innovative style of thinking in their designs.

AI's role in connecting different disciplinary insights is transformative. It enables students to see beyond the confines of their immediate field, encouraging a more holistic and integrative approach to problem-solving. Such cross-disciplinary linkages are essential for fostering a new generation of designers who are equipped to tackle complex challenges in a rapidly changing world.

In conclusion, artificial intelligence, when applied in the early stages of interdisciplinary design thinking, enhances students' aesthetic abilities and promotes their comprehensive competence in the design field by providing rich learning resources, personalized feedback, and immersive learning experiences. As AI technology continues to evolve and its application in education deepens, it is poised to play an increasingly significant role in the field of design education. This progression will help prepare students for the future, equipping them with the skills and insights needed to excel in an era where technology and creativity intersect.

6. Conclusion

The results of this study indicate that in general education design courses, the integration and optimization of artificial intelligence technology with PBL (Problem-Based Learning) teaching methods create a new, effective teaching approach. This method can fully engage students' interests and initiative, cultivate their abilities to analyze and solve problems, and enhance learning efficiency. At the same time, it also improves the completeness of design schemes, making it a valuable and effective teaching method for art and design education worth promoting.

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UPDATING WAYFINDING LITERATURE AND TEACHING METHODOLOGY

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ABSTRACT | The introduction of a theoretical course on wayfinding, offered for the first time to secondyear interior design students at the Università Iuav di Venezia, was the starting point for reflecting on the methodology of teaching wayfinding design. By the structuring of the course, it emerged that the disciplinary bibliographical apparatus, although foundational, is meager and dated, where the most recent volume dates back about ten years. This analysis highlighted the need to implement the common bibliography primarily from a contemporary design perspective, thus offering a selection of interdisciplinary theoretical and methodological contributions to build a common background among students.

These theoretical and methodological reflections have set off the absence of any disciplinary tool capable of integrating both the load-bearing and historical aspects of the discipline and the knowledge on complementary contemporary design themes, that together can shed light on the many facets of wayfinding. One of the main results of the course is the construction of a glossary of up-to-date wayfinding design, written and designed by the students in a co-partecipative way. In the form of an analog flexible design artifact, it can be used as a teaching tool in future classes and it can be expanded by future students, even in an asynchronous co-creation model.

KEYWORDS | DESIGN EDUCATION, TEACHING METHODOLOGY, WAYFINDING, CO-CREATION, GLOSSARY

1. Starting and positioning the wayfinding design teaching

In the 2020-21 academic year, the new Interior Design curriculum was envisioned within the Bachelor of Product and Communication Design at Università Iuav di Venezia - a study program already existing for more than 15 years. The "Wayfinding Design" course was included as compulsory teaching in the second and final year and it was first taken by students in the 2022-23 academic year.

Beforehand, the new curriculum had to be accredited by the Italian Ministry of University and Scientific Research, following a documentation process involving several key steps until final approval and actuation. Alongside this, a documentation was conducted to justify the activation of the new curriculum by comparing it with the offerings of other actual degree programs at national level. The comparative reconnaissance carried out consulting the ministry's database showed that there are 15 public universities (including Università Iuav di Venezia) who make it possible to earn a degree in product design and/or visual communication - these are broadly the names of the curricula accredited since the beginning of the 2000s - to which are added 2 Polytechnics and 4 ISIAs - Istituto Superiore per le Industrie Artistiche/ Higher Institute for Artistic Industries, for a total of 21. Each of these institutions propose Bachelor's degree programs, while only 12 of them (including Università Iuav di Venezia) also offer Master's degree programs.

Overall, only 2 institutions explicitly had a curriculum in Interior Design before 2021-22.

Regarding the inclusion of the teaching of wayfinding design in the new study track, an equally articulate comparative study was not required by the ministry. Nevertheless, we - the lecturer in charge since a.y. 2022-23 and the teaching assistants for respectively the years 2022-23 and 2023-24 - have conducted a reconnaissance aimed at verifying the existence of a similar subject, in order to best define the content of the new teaching. The observation, conducted consulting the curricula submitted by each university on its respective website, revealed that none of the 21 product/ visual/ interior design degree programs included a compulsory teaching class that dealt explicitly with wayfinding design.

This does not mean that topics related to orientation and signage systems have never been the subjects of theoretical studies or design studios before. More likely, they might be addressed within intensive workshops or in shorter activities than the stated teachings, or they can be addressed in specific extracurricular activities, or else it can be that wayfinding is the subject of studies or exercises within courses and labs identified by different names, usually more generic ones (e.g., "Visual communication studio," "Product design studio").

This reconnaissance shows that the Wayfinding class in the Interior Design curriculum at Università Iuav di Venezia, approved by the ministry and first activated in a.y. 2022-23, is - still - the only one available in Italian public universities.[1]

The Wayfinding course was thus born closely related to the Interior Design curriculum at Università Iuav di Venezia. The teaching of interior design is as scarcely practiced at the university level in the country as much as the teaching of wayfinding, and each of them still needs further reflections for their theoretical definition, in a mutual and continuous cross-reference between the two parts.

The nature of interior design has been the subject of a series of lectures and classes given cross-curricularly at Università Iuav di Venezia in the academic years 2021-22 and 2023-24. Richard Buchanan, who conducted an online lecture to design students, defined it as the field that deals with the transformation of the space around us into an environment that enriches the human experience in a meaningful and substantial way (Buchanan, 2019). In truth, this attitude is shared among many areas of design, ranging from graphic and industrial design to interaction design, service design, organizational design, and complex systems design. Indeed, all areas of design involve the transformation of the surrounding space into the environment. This concerns both physical and digital aspects because design must also deal with how to transform information space into an information environment (Buchanan, 2019) and how to connect and integrate physical and real aspects with virtual and digital ones (Buchanan, 2019). As it has been highlighted by reflections conducted at Università Iuav di Venezia in the framework of crosscurricularly lectures, interior design is a pluralistic practice with different dimensions of attention to the issues and practices of communication, artifact construction, and interaction design (Bonini Lessing et al., 2024). Thus, interior design would be the discipline that is able to provide responses appropriate to the contemporary condition in which we live and operate, because of its constitution, its dimension and mediation between technical-scientific components and cultural and people-relationship ones. In a few words, the ideal framework in which reflections on wayfinding training can be developed.

1 A more recent reconnaissance still in progress showed some new results:
NABA - Nuova accademia di belle arti, a private institution based in Rome and in Milan that grants a degree recognized by the ministry, proposed in a.y. 2023-24

1.1 Wayfinding Design course preparation

These briefly exposed remarks, aimed at defining what interior design is about, were fundamental in structuring the new teaching course of Wayfinding Design, in a substantial absence of comparisons in the Italian university system.

Moving from the specific field of interior design to other design fields, academics agree that we all operate in complex and interconnected systems, characterized by disciplinary transversality which therefore require an interdisciplinary approach (Norman et al., 2016; Dubberly, 2017). In Italy the need for transdisciplinary dialogue and research has been repeatedly stressed too, including in scientific meetings among SID - Società scientifica del design/ Scientific Society of Design members (Di Bucchianico et al., 2019).

Rejecting the call for hyperspecialization that was widely popular in the last decade of the twentieth century, what would then be the disciplines that should lay the ground for interior designers today? What scientific fields of research should cooperate among each other? Can wayfinding teaching play a role in such a context?

These questions were essential in guiding the preparation of the didactics of the Wayfinding course, which was structured along two main lines: the definition of a specific and historically consolidated field-related bibliography, the search for insights in the contemporary design debate that can reframe wayfinding in our society.

In other words, the purpose was to define a body of specific consolidated knowledge on wayfinding enriched by other design studies "transversal" to it, like visual communication design, product design and others. In this way, the teaching of wayfinding would become an ideal area of experimentation within interior design, understood as a pluralistic and systemic dimension of all forms of design that responsibly intervene in an ecology of relationships between people, the natural and artificial environment (Buchanan, 2019).

As it will be seen in the next section, we conducted an extensive literature search to sustain the choice of the topics and of the scopes of each lecture. Then we decided to present students with a set of broad and multifaceted references, so as to stimulate further multidisciplinary research, rather than narrowing the knowledge down to a few specific contributions. In the same direction went the request to the students to cooperate, to debate and eventually collectively construct the most suitable disciplinary and didactical tool still missing, the glossary of wayfinding terms, which will be accounted for in a dedicated section of this contribution.

Here it is worth pointing out how the most recent edition of the volume "Environmental Graphic Design" (Calori & Van den Eynden, 2015) has been a central point in defining the

course objectives and has significantly oriented the approach of the course, since it includes diverse areas of design theory and practice that deal with the themes of orientation and signage in a broader sense. The authors of the book identify environmental graphic design as the discipline that aims to transform spaces into places, proposing a synthesis between the needs to identifiably connote a public space, provide narrative, analog or digital support to users, while encompassing design aspects of orientation and signage. The volume proposes the need for a mix of professional expertise to operate in the areas of placemaking, signage, interpretation (Calori & Van den Eynden, 2015, p. 5), which go beyond the skills of graphic or product designers. The design project, which involves continuous intersections between different fields, would thus become a stimulus to continuous solicitations, narratives and evocations, and never as a definitive landing place of knowledge.

In Italy, there are relevant contributions reflecting on the opportunity to juxtapose different areas of design theory and design, aware that this implies the blurring of boundaries between them, activating processes and leading to final results that re-discuss the integrity and existence of design in the traditional sense (Bortoloni & Dal Buono, 2020; Bucchetti, 2020; Lussu, 2010). This assumption also implies an idea of direction of both theoretical and factual components of design that no longer empowers only one discipline in the coordination of the others (Anceschi, 1988). Instead, its driving force would lay in the need to mediate among all actors involved in the design process (Celaschi, 2008), from design concept phase to the final fruition of the physical space - often enhanced including the digital dimension - , involving complex and interconnected domains of knowledge, through a plurality of tools (Trocchianesi, 2024). Another assumption that played fundamental role in structuring the teaching was to confer to the theory and design of wayfinding not only a functional value of spatial orientation, but also the cultural orientation, stimulating the knowledge of the people who resort to such supports. Fostering orientation in an additional cultural sense facilitates the process of identifying people with spaces/places unfamiliar to them through design artifacts and systems, analog or virtual (Cerri, 2022), with potentially unprecedented social and ethical reverberations. In this way, wayfinding becomes an area of contact between narrative and functional, theoretical and design components, conferring coherence and connection between the parts.

2. State of the art: bibliography of references

Communication, product, interiors, urban planning: wayfinding design can be placed in each of these areas, and from each of them it can be differently approached depending on whether the emphasis is on the message to be communicated, the medium to be used, or the positioning in space. Given the multidisciplinary nature of the topic, which is one of its intrinsic richness, it was necessary

to determine the appropriate angle for the course: it is precisely from the analysis of this cross-disciplinarity that some texts emerged as cornerstones of the discipline. The first text examined, the one that can be called foundational to the discipline, is "The Image of the City," written by Kevin Lynch in 1960. In this text, the term wayfinding is coined as a word composed of the two English terms that stand for "finding the way." In this first definition, Kevin Lynch inscribes wayfinding within the framework of urban planning. The author is an urban planner and therefore he works mainly on the aspect of wayfinding related to the city and its key elements, he takes into consideration other disciplines as well: among them, psychology, linking it inseparably to some of the pivotal themes presented in the book, such as the definition of the five elements that contribute to the creation of a mental image of the city and the concept of imageability of urban space. This text, which is still considered a reference for the field of planning, left behind a gap of about thirty years before another equally relevant one could stand alongside it in establishing a bibliography on the subject. The second book analyzed is therefore "Wayfinding. People, Signs and Architecture" by Paul Arthur and Romedi Passini from 1992, which reconsiders and expands the earlier hypotheses, moving them from the purely urban field to the architectural design field. Nevertheless, in this text as well as in some other relevant papers of the same years, the two authors emphasize how wayfinding is a multidisciplinary field, placing alongside the architectural approach that of visual communication design and some aspects drawn from the human sciences proper to the perceptual field, such as psychology. Although the professional practice of wayfinding design has continued over the years with numerous major design projects and some issues on spatial orientation are dealt with in other texts pertaining to the human sciences - think of Reginald Golledge (1999) and his studies on mind maps -, another ten years or so go by before another volume on the subject is written. This time not from the point of view of urban planning nor from that of architecture but from that more purely of communication design. "Wayshowing. A guide to environmental signage," written by Per Mollerup in 2005 and reissued in 2013, posits a shift in perspective from the theory to the practice of wayfinding, bringing the work of the wayfinding designer to the center by proposing the meaning of 'wayshowing,' that means, showing the way rather than finding it. In this paradigm shift, Mollerup invests great relevance in the figure of the wayfinding designer, who, in his design action of wayshowing, integrates the many aspects of professional practice by not limiting it to one area. The author also reiterates the importance of design practice as a level of reading and communicating of and with place, placing special emphasis on the communicative aspect of wayfinding systems.

If Per Mollerup stresses the communicative issue, Chris Calori and David Van den Eynden, only a few years later, emphasize the link between the communicative aspect and the environmental one of the design

intervention, dealing in a broader sense with Environmental Graphic Design, in another of the founding texts for the discipline, "Signage and Wayfinding Design" of 2007. In this contribution, the authors devote ample space to the methodological part focusing on the three main components of a wayfinding system namely the information contained, the graphic system and the structural system.

A few years later, all these arguments are projected into the growing debate around the public space. In 2009 David Gibson writes "The Wayfinding Handbook: Information Design for Public Places," which positions itself as a useful tool for practitioners and anyone interested in better understanding the profession of the wayfinding designer.

Thus, our review of the books that are considered fundamental in the creation of a bibliography related to wayfinding design, a shift emerged from the earliest in chronological order that deal with the subject from a purely theoretical point of view, to the latest that instead turn out to be almost manuals for professional practice. Many other volumes have since been published that are mainly collections of case studies and projects carried out in the field of wayfinding, categorized by distinctive features, but rarely introducing theoretical or major innovations for the discipline. In addition, in recent years there has been a growing publication of papers that, however, have only partially explored the topic, although in some cases they have brought interesting reflections. Examples include Quentin Stevens' "The Shape of Urban Experience: A Reevaluation of Lynch's Five Elements" (2006), which proposes a revision of one of the most relevant concepts addressed by Kevin Lynch (1960) considering the contemporary social and economic system, and Lund's (2003) "The public debate on Jock Kinneir's road sign alphabet", which takes up a historical case to address issues of typographic legibility applied to signage and it explores the possibilities of applying scientific research methodologies to this field. Also relevant are the ethical aspects of wayfinding addressed by Linda Knight's (2021) contributions, which touch on issues related to the sense of caring for the history and politics of a place and its inhabitants. In this perspective, the strong and rapid social changes that have taken place in recent decades highlight the need to place the historical assumptions of wayfinding in a contemporary design perspective, exploring them in a more coherent and extended way. We placed great importance on how the issue of wayfinding was addressed in Italy, enhancing some perspectives that could mirror the multidisciplinary nature of the topic. Considering at the same time that the interior design curriculum does not offer any historical, theoretical or design teaching specific to the field of visual communication, we felt it was also relevant to enhance the bibliographic references from that field and others bordering it. Among these, we selected the text "The Images of the City"[2] by Mario

2 Translated by the authors from the original title "Le immagini della città", Piazza (2009)

Piazza (2009), which reconnects the theme of wayfinding to the concept of territorial visual identity by considering the perspective of communication design applied to urban public space. Mario Piazza approaches the issue from a historical point of view, highlighting some case studies of design and historical relevance in Italy, such as Mimmo Castellano's wayfinding and visual identity of the Aeolian Islands, which began in 1976 and developed over several years. With the same framework based on case studies, but this time contemporary, Susanna Cerri (2020) in "Sign in the public space" deals with the theme of visual communication applied to public space from the perspective of orientation, identity and participatory design. Bonini Lessing's two texts on Luigi Ghirri (2014, 2019) deal with some timely aspects related to cartography and its graphic representation, a specific but relevant issue in wayfinding systems. Also considered was Raffaella

Trocchianesi's volume "Design and Narratives for Cultural Heritage"[3] (2014), which expands the theoretical field to include the concept of communication of place as storytelling, moving from the urban environment to the built environment of the museum space, becoming a kind of link with interior design and leading to an in-depth examination of the theme of orientation and signage in museum spaces.

Continuing in this vein, therefore, "In Praise of the Labyrinth Museum"[4] by Salvatore Zingale and Fiorella Carità (2013) and "Museum Accessibility"[5] by Dina Ricc (2024) were examined in depth. The first because it deals with the theme of orientation as inherent in the organization and planning of space with a point of view that articulates from semiotics toward interior design. The second one because it integrates aspects proper to communication design to the museum context by opening the field to the issues of inclusion and accessibility to multiple categories of users, a pivotal theme of a contemporary wayfinding approach.

3. The participatory glossary: a teaching tool for wayfinding design theory

Parallel to the construction of a theoretical-critical apparatus of references capable of highlighting the multidisciplinary nature of wayfinding, we found it necessary to identify a teaching tool suitable for the course's educational objectives.

As highlighted in the previous paragraphs, one of the major critical issues encountered was precisely the scarcity of specific literature, most of it dating back to the 1990s or the very early 2000s, and therefore not sufficiently up-to-date on contemporary instances. Thus, we identified the construction of a "wayfinding glossary" as the most appropriate teaching tool.
Students were asked to identify and compose a corpus of foundational and representative lemmas of the discipline that takes into account the terms already covered in the

3 Translated by the authors from the original title "Design e narrazioni per il patrimonio culturale", Trocchianesi (2014)

4 Translated by the authors from the original title "Elogio del museo labirinto", Zingale e Carità (2013)

5 Translated by the authors from the original title "Accessibilità Museale" Riccò (2024)

wayfinding literature, but also, and above all, to find new ones to meet the theoretical and design needs of the current contexts of space use, with the aim of implementing the theoretical and action field. Thus, first pupils studied in depth the bibliographic sources proposed by the professors and, second, they identified terms of different nature derived from publications and references not necessarily pertaining to the field of wayfinding or other design areas (e.g. literature, arts, ect.). In addition, working on word definitions characterized by ambiguous meanings was encouraged, along with the possibility of clarifying them through the visual support of selected virtuous or successful design examples.

This teaching tool is centered on a co-participation process in which students are involved on several levels: all of them are required to construct the content apparatus, while few of them, because of their personal interests, were involved in designing the graphic layout through a cross-over discussion with one of their colleagues from the Communication Design curriculum at Università Iuav di Venezia, during the academic year 2022-23.

Before continuing with the description of the organization of the content and specifications of the graphic layout of the glossary co-developed by the students, it is necessary to present the analog and digital models taken by us as pre-reference and to explain the selection criteria applied. As for the analog examples - the publications -, the choice fell on the volumes with apparatuses dedicated to both bibliographical and iconographical in-depth references of the topics covered, while for the digital examples the participatory and choral approach was preferred.

3.1 Typological references for the construction of the glossary

The first type of publications examined is that of design dictionaries and encyclopedias, in which the foundational terms of the discipline are collected. The survey began with international volumes, such as "The Bloomsbury Encyclopedia of Design" edited by Clive Edwards and published in 2015. This volume, in addition to providing coverage of terms relating to 250 years of design history and theory, falls within the two criteria identified: it presents both images and reference and further reading accompanying the various headings, and it is a choral operation, as each term is written by leading international scholars and design historians. A further relevant aspect is the division of terms into a container term, to which terminological subcategories refer to principles that were used in the construction of the course glossary.

The second volume analyzed is "Design Dictionary. Perspectives on Design Terminology" edited by Michael Erlhoff and Tim Marshall in 2008, a handbook designed for all those who deal with design in the profession or in education, which is enriched by the choral work of several academic figures and a number of designers and which provides in-depth bibliographical references.

Unlike the "Bloomsbury Encyclopedia", it does not supply images.

The last category observed is the anthological collection of specific design themes. Reference is made to Grahame Brooker's 2018 volume "50/50 Words for Reuse - A Minifesto: an anthology of terms on reuse practices" containing an iconographic and bibliographical apparatus, boosted by added sitographical and illustrative project references inherent in each term presented, providing the reader with a complete picture of the subject matter. In addition, the volume proved very useful particularly because of its pocket format, a feature taken up in the design of the graphic layout of the course glossary.

Then several international contemporary online archives were observed, starting with "The People's Graphic Design Archive" (https://peoplesgdarchive.org/about), born from the idea of three designers and teachers - Brockett Horne, Briar Levit and Louise Sandhaus - to launch from the bottom (crowd-sourced) an archive capable of expanding the history of graphic design, in as inclusive a way as possible, continuing to the participatory project of the Portuguese graphic design studio Itemzero "Design Words. Glossary of definitions and meanings" (https://itemzero.com/design-words/back-cover/), a glossary on graphic design lemmas, permanently updated through the active participation of users, invited to collaborate through an on-line form. The component of expansibility typical of digital tools has also become a fundamental aspect of the educational purpose of our glossary. Indeed, such a formula allows it to be implemented from year to year by new Wayfinding students, progressively building the essential foundation of the discipline. Thanks to the analysis carried out, the content and organizational aspects of our glossary have been identified: the treatment of terms in Italian and English[6], the annual implementation of its words, the presence of an iconographic apparatus made with original photographs taken by the students - useful for facilitating the understanding of some lemmas, especially the more ambiguous ones, - and a bibliographical reference apparatus for each lemma.

3.2 The graphic structure of the glossary

The idea of making a flexible, implementable and easily transportable tool affected several graphic-formal aspects of the glossary.

First, we worked on the organization of the content, considering the need of dividing the students into working groups of 5 to 6 persons each. We asked each group to first identify the container term, of which to return the definition (min 400 strokes, max 1090) by selecting the most relevant entries found in the Treccani online Italian vocabulary. This operation was considered essential to demonstrate how (little) the most well known generalist dictionary is able to help define the theoretical and operational system of design. For this reason, students were asked to rework the same term, writing their own

6 The Italian students drew from an Italian and English bibliography, but preferred to write in Italian, while the English terms were written by the Erasmus students, who drew from a bibliography mainly in English.

definition together, selecting the sources they felt were most appropriate. Subsequently, they associated secondary words, the contained terms on which to work individually, chosen for the affinity of meaning or understood as nuances of the previous word (min 3500 strokes, max 6000). The working process was similar to the container term: each person started from the Treccani definition of the selected word to move to their own "design-oriented" definition of it.

The textual apparatus of both categories of terms is accompanied by a bibliography - at least 5 references, 3 of which proposed during the lectures -, and by an eventual iconographic apparatus consisting of diagrams and schematics made by the students themselves, or, alternatively, photographs taken by them of existing projects considered virtuous, as an aid to understanding the identified lemmas.

Regarding the order of the terms in the final glossary, it was preferred to chronologically distinguish the results of the two years from each other, giving priority to the academic year 2023-24 and then presenting the results of 2022-23. Both sections are preceded by a table of contents and a colophon providing information about the corresponding year. In turn, the terms for each year section are organized alphabetically for ease of use [Figure 1].

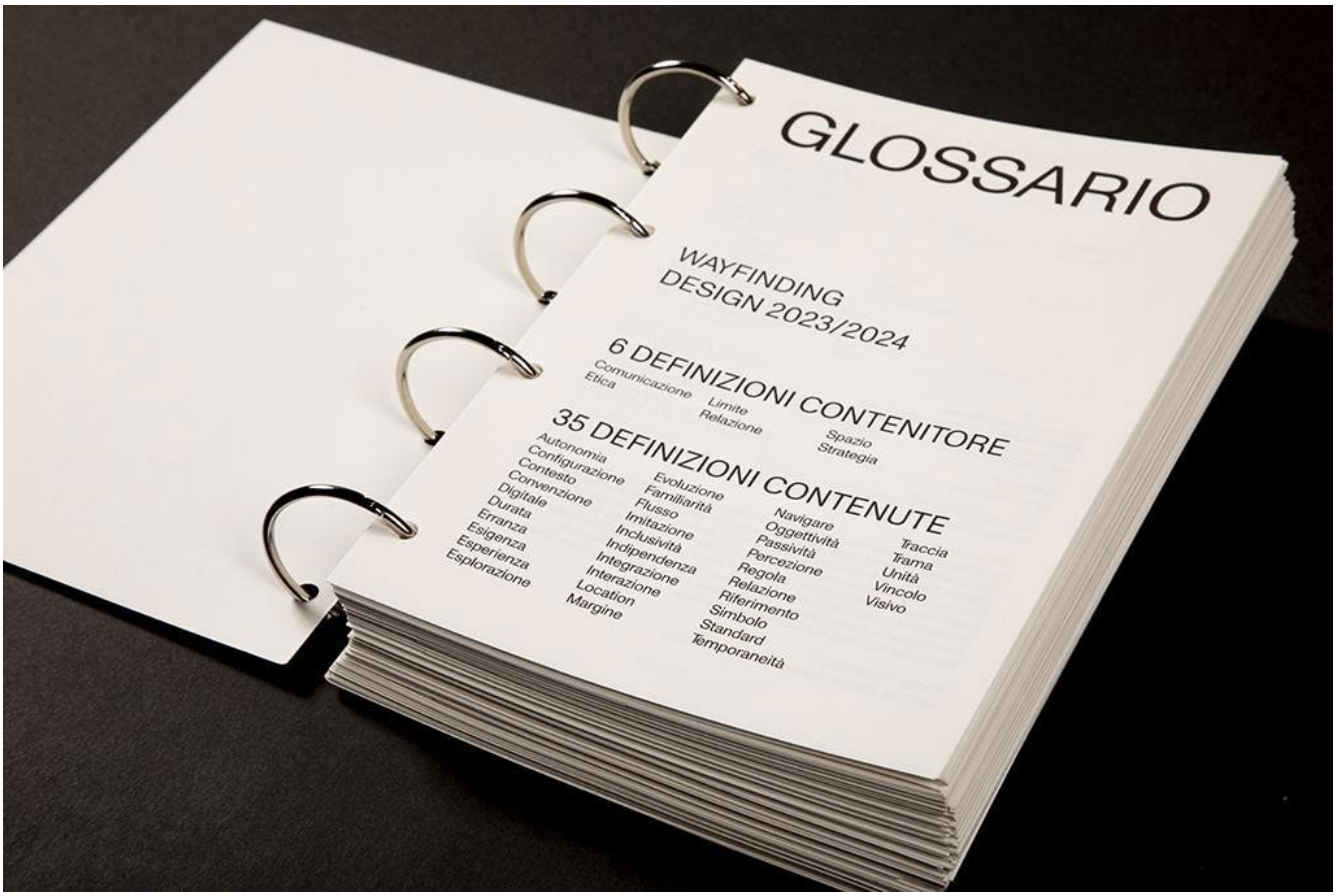

Figure 1. Glossario: index of the chosen words.

What remains unchanged throughout the two years is the organization of the textual apparatus; while the graphic layout was designed during the first annual teaching by two first-year students with the collaboration of one of the Communication Design curriculum. The glossary's graphic layout mainly took into account the need to design a tool that can be implemented over the years, flexible to the different characteristics of each individual lemma and easily transportable. Therefore, the proposed artifact is a paper filing cabinet with a ring binder in A5 format [Figure 2].

To especially highlight the hierarchy between container term and content term students developed a layout that is articulated in two double pages, one suitable for the generic term and the other one for all secondary ones. The textual elements of the first double page are precisely the main lemma and its definition-positioned on the right-hand opening page-and the bibliographical apparatus on its corresponding back page. The layout of the double page of the generic term is also taken for contained terms, differing only in the body of word text and in the addition of a space dedicated to notes. For content terms, three different types of pages dedicated to the inclusion of iconographic apparatus are possible, through the introduction of a special accordion fold available in different sizes - a f.to A5 + ½ A5, a f.to A5 + 12.85 cm, a f.to A4 horizontal 12.85 cm -. This variation was introduced especially for cases where images with strong horizontal orientation were needed, e.g., maps [Figure 3 and 4].

Finally, from the typographic point of view, the use of a stick typeface, ABC Monument Grotesk designed by the Swiss Kasper-Florio studio in 2018, was preferred in order to give an appearance of objectivity to the publication.

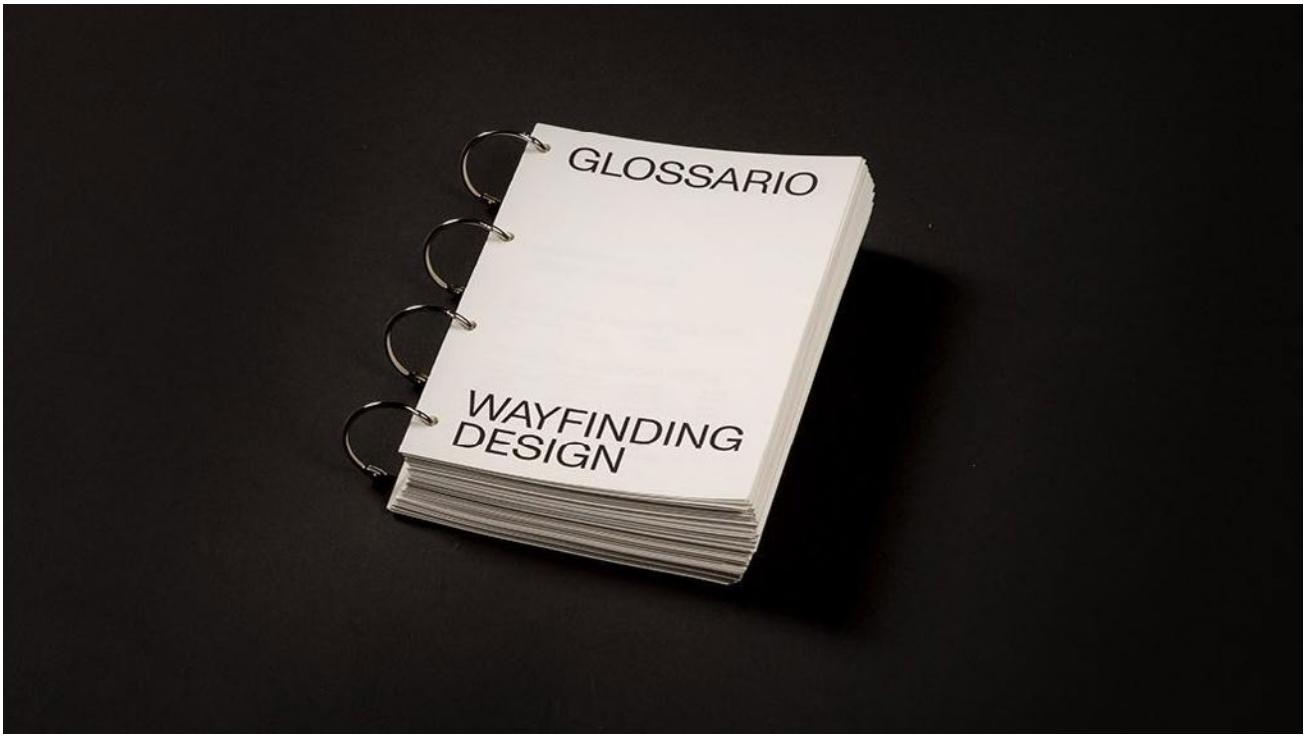

Figure 2. Glossario: cover and binding

Figure 3. Glossario: example of a plain text page.

Figure 4. Glossario: example of a page with text and image.

Table 1. The wayfinding lemmas identified during the academic year 2022-23[7]

Coerenza	correlazione	gerarchia	identità	univocità
Decodificare	contaminazione	prossimità	sistema	stratificazione
Equilibrio	invisibilità	ridondanza	sintesi	visibilità
Fruizione	accessibilità	barriera	comportamento	densità
	suggerimento			
Identità	codice	coerenza	gerarchia	linguaggio
	pittogramma	riconoscimento	sistema	stratificazione
Orientamento	guidare	riconoscere		
Segno	messaggio	narrazione	nomenclatura	percorso
	pittogramma	segnaletica	tipografia	uniformità
Usability	accessibilità	leggibilità		

7 The lemmas presented in the table have been kept in the original language, for consistency with the printed glossary. he container term is marked in bold, in regular the related content term.

Here follows the translation provided by the authors:

Consistency: correlation, hierarchy, identity, uniqueness

Decoding: contamination, proximity, system, stratification

Balance: invisibility, redundancy, synthesis, visibility

Fruition: accessibility, barrier, behavior, density, suggestion

Identity: code, coherence, hierarchy, language, pictogram, recognition, system, stratification Orientation: guidance, recognition

Sign: message, narration, nomenclature, route, pictogram, signage, typography, uniformity

Usability: accessibility, readability

Table 2. The wayfinding lemmas identified during the academic year 2023-24[8]

Comunicazione	digitale	interazione	simbolo	standard
	visivo			
Etica	esplorazione	familiarità	imitazione	indipendenza
	oggettività	passività		
Limite	durata	inclusività	location	margine
	regola	temporaneità	traccia	
Relazione	configurazione	evoluzione	percezione	trama
	vincolo			
Spazio	contesto	esperienza	flusso	integrazione
	navigare	relazione		
Strategia	autonomia	convenzione	erranza	esigenza
	riferimento	unità		

8 The lemmas have been kept in the original language, for consistency with the printed Glossary.
The container term is marked in bold, and in regular the related content term.
Here follows the translation provided by the authors:
Communication: digital, interaction, symbol, standard, visual
Ethics: exploration, familiarity, imitation, independence, objectivity, passivity
Boundary: duration, inclusiveness, location, margin, rule, impermanence, trace
Relationship: configuration, evolution, perception, plot, constraint
Space: context, experience, flow, integration, navigate, relationship
Strategy: autonomy, convention, wandering, need, reference, unity

4. Conclusions

We have described how the activation of the Wayfinding course in Università Iuav di Venezia in the academic year 2022-23 provided the impetus for a broad reflection on the theory and teaching of wayfinding design in the university setting and how the topic of signage and orientation, historically linked to the analysis of urban space with Lynch's volume compiled now about half a century ago, needed an update that takes into account both the contemporary social and technological condition and the design outcomes developed in other fields in more recent years. The positioning of the teaching in the field of interior design saw the need to initiate an extensive bibliographic survey, both at international and national level.
The ultimate goal was to identify texts that specifically embraced the perspective of interior design on wayfinding, while maintaining a multidisciplinary gaze demonstrating the multifaceted nature of the subject, not only referable to architectural or graphic-communicative issues, but as part of a broader and more inclusive approach.

The glossary was chosen as a useful teaching tool to identify concepts for understanding the discipline of wayfinding, and addressing issues not fully investigated and theorized at the academic context yet. It was interesting to observe the reaction of astonishment of the students of the year 2022-23 in front of the printed artefact, almost of disbelief, given that the Interior Design curriculum does not require graphic designer skills. While Students in 2023-24 were urged to participate in a call to action to implement the previous year's work. In both cases, alternating face-to-face lectures, conducting exercises in analyzing concrete spaces and the participatory glossary construction constituted a valid method of inquiry. The intention of the authors' working group is to continue with the development of wayfinding theory through the preparation of lectures, the administration of specific exercises and the fostering collaboration with students on the implementation of the glossary in the next academic year. The possible participation of students from the communication curriculum in the next Wayfinding class will certainly provide interesting stimuli and new scientific perspectives.

The glossary, which is still planned to be implemented in paper format the next academic year, may be transformed into an online and open-access tool in the future, so as to speed up the implementation process and facilitate open discussion among scholars of the subject.

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EXPLORE BOUNDARY SPACE: DESIGN STRATEGIES FOR STREET RENEWAL IN BEIJING'S HUTONG NEIGHBORHOODS BASED ON THE IDEA OF SYMBIOSIS

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ABSTRACT | In recent years, urban planning in China has shifted from the original incremental expansion to stock development for the purpose of enhancing the quality of urban space. The traditional hutong street environment preserved in Beijing's old city center is rich in daily life activities. Residential, commercial, and office functions are mixed with trivial details of daily life as the main spatial characteristics. Therefore, it is often difficult to improve the street quality of hutong through government-led top-down governance. Hutong communities that are not effectively governed can hardly satisfy the residents' demand for quality of life. In the face of the complexity and contradiction within hutong communities, this paper utilizes the sharing and co- production characteristics of symbiosis to solve these problems.

Based on the symbiosis perspective, this paper will summarize the human behavior in the boundary space and construct the renewal mechanism of the street. From the dimension of spatial composition, the characteristics of sharedness and coproduction advocated in the concept of symbiosis will be transformed and applied to promote the renewal within the hutong community. This strategic design of street renewal in Beijing's hutong communities can better coordinate the relationship between broom hutong and the surrounding area, and achieve the goal ofsymbiosis between people and the environment.

KEYWORDS | BOUNDARY SPACE, SYMBIOSIS IDEA, BEIJING HUTONG NEIGHBORHOOD, STREET RENEWAL

1. Introduction

Since the founding of the People's Republic of China, a program of renovation of Beijing's old urban areas has begun. Between 1949 and 2003, Beijing underwent a total of three renovations. The first was in the 1950s, when ancient buildings such as city walls and pagodas were demolished as obstacles to urban construction, and the second was in the 1990s, when the national economy recovered and the city underwent a second large-scale renovation program. Due to the lack of correct direction, the renovation program of the old city not only failed to achieve the expected purpose, but also caused problems in various aspects (Song, 2010). The third time was during the millennium, when the government planned to renovate all dilapidated buildings in Beijing in five years.After 2003, there was no more government-led top-down large- scale renovation of the old urban areas in Beijing, but rather small-scale pilot renovations initiated by various social organizations.

In terms of scale, there are now two ways to renovate Beijing's Hutong: one is to start with the renovation of the siheyuan, the basic constituent unit of the Hutong; the other is to renovate the Hutong themselves, including the buildings and their traffic roads, greenery, and other surroundings (Wu, 2015).

The current Hutong environment and renovation and renewal methods are no longer able to meet the needs of the current society, so it is necessary to explore a new renewal mode to coordinate the relationship between Hutong and the surrounding area, and to achieve the goal of symbiosis between people and the environment.

2. Symbiosis theory and its developmental lineage

2.1 Concept of Symbiosis Theory

"Symbiosis" is based on mutual benefit, collaboration, self-fulfilling equilibrium, heterogeneous unity and communication. The concept of "symbiosis" was first proposed by the German biologist De Berry in 1879 (Zhang et al, 2003). Kisho Kurokawa describes his philosophy of symbiosis in The New Symbiotic Thought (Kisho, 2009),

in which he argues that symbiosis is the creation of a creative relationship between opposites and contradictions.

Theories based on metabolic and open structures, intermediate domains, and ambiguity constitute symbiotic thought (Shen, 2013). Facing the problem of loss of local culture and national characteristics in the mechanical age, Kisho Kurokawa introduced the "symbiosis theory" into the field of architecture, urban design and planning, and put forward his own symbiosis ideas, including metabolism, metamorphosis, and change of life, etc. (Qin, 2003).

2.2 Development of Symbiosis Theory

Many ideas in traditional Chinese culture contain the expression of symbiosis, such as the Confucian ideals of "Harmony of Life" and "Cosmos" (Guo, 2021). Originating in biology, the idea of symbiosis has gradually taken on a way of thinking that is applicable to modern life, which inherently embodies and requires the sharing and co-existence of equality, reciprocity, and in- depth cooperation between subjective positions (Wang et al, 2021).

At present, "symbiosis idea" is applied in many research directions such as architecture. Wu Liangyong puts forward the concept of "organic renewal" from the perspective of transformation and development of old cities, which coincides with the concept of "symbiosis" in the development of urban architecture; at the level of landscape design, Hou Yiming puts forward the design principles and design methods of symbiotic urban streetscapes from the perspective of time and space, culture and landscape (Hou, 2015); at the level of urban renewal, the idea of symbiosis is applied to old industrial areas, and the design methods are applied to old industrial areas.

At the landscape design level, Hou proposed the design principles and design methods of symbiotic urban streetscapes from three aspects: time-space, culture and landscape (Hou, 2015); at the urban renewal level, the idea of symbiosis is applied in the research and practice of old industrial areas, historic districts, as well as heritage preservation and so on (Gao et al, 2017).

The design principles of functional mixing, cultural diversity, symbiotic coexistence, and ecology in the symbiosis idea provide a lot of valuable experience in the field of architecture and planning, but there is still a lot of research potential for the boundary space as a concrete space to implement the benefits of symbiosis and the strategy of symbiosis.

3. Defining the boundary space of the Hutong

3.1 Boundary space

Urban boundary is the boundary between various spatial areas in the city, which plays the role of separating and linking at the same time. Boundaries are generally linear in shape, but in reality, all boundaries have a certain

width, and when the width of the boundary line is wide enough to accommodate human behavioral activities, it can be understood as a "boundary domain" (Yuan, 2010), which is the object of spatialized research. Boundary is not simply a line without thickness, especially for the boundary of urban space, it should be regarded as a place, an area with volume (Su, 2012).

3.2 Boundary Space in Hutong

From the perspective of spatial composition, the physical composition elements of the Hutong boundary can be categorized into four types: vertical interface, horizontal interface, top interface and opposite interface. The boundary space carries different urban functions and reflects the role it plays in the urban functional system (wu, 2023).

Horizontal interface is the ground, and the horizontal interface elements of Hutong include roads and streets, public space, ecological landscape space, etc.

The vertical interface elements of Hutong include buildings, plant landscape, fence and railing, which can appear in various plane forms. Vertical interface elements of the Hutong include buildings, plants and landscapes, fences and railings, etc., which can appear in various plane forms.

The boundary of the Hutong takes structures and green landscape as the top interface, specifically including landscape pergola, store canopy, green space shade, etc.

The interface of the opposite view refers to the end or the turning surface seen along the boundary forward, that is, the end of the closed line of sight, and the interface of the opposite view can be composed of plants, landmark buildings, landscape structures, etc.

4. Beijing Hutong case study

4.1 Symbiosis Home Model

The courtyard houses in Beijing's hutongs were once the ideal homes for Chinese people. However, after the founding of the People's Republic of China, due to the surge in population and changes in the concept of family structure, the courtyard of a large family has become a "compound" for several families to live together, and the living environment in the compound has gradually become out of touch with modern life, with lack of light in the rooms, chaotic layout, cold in winter and hot in summer, and the kitchen and toilet are the biggest problems, and all kinds of illegal construction has destroyed the traditional architectural pattern and damaged the overall appearance of the old city. Destroyed the conventional architectural pattern, but also damaged the overall appearance of the ancient city.

Professor Wu Liangyong in The Old City of Beijing and Juer Hutong's book put forward the theory of "organic renewal", advocating the use of small and flexible ways of urban renewal, based on sustainable development, the demolition of dangerous, old houses, repair and transformation of the general

residential compound, to retain the form of the complete residential compound. After some architects' attempts in the hutongs, the demonstration effect brought by star architects is after all limited, and it is better to form an effective mechanism to promote the people's self-renewal of their houses. The 2019 Beijing Municipal Government Work Report puts forward the idea of "symbiotic courtyard" renovation, which opens the door to a new world for the preservation of old cities, and some districts have already begun the pilot project of "symbiotic courtyard".

No. 16, 18, and 20 Yu'er Hutong, a typical "symbiotic courtyard" in which URBANUS Urban Practice participated in the renovation design, is mainly inhabited by the original residents. According to the concept of a "symbiotic courtyard", the original mixed elements in the courtyard are expressed in a unified architectural language. Public spaces are set up to stimulate the residents to spontaneously maintain the beauty of the public areas and cohesion of neighborly relations, as well as to add small apartments in the miscellaneous yards to meet the living habits of the single youths, to attract young tenants and bring new vitality to the courtyard. They are bringing new vitality to the miscellaneous courtyard.

Figure 1. URBANUS Urban Practice Participates in the Renovation Design of Yu'er Hutong

The pilot "Symbiosis Courtyard" in the Caochang area restores and protects the courtyard landscape and adds basic living facilities. 9 courtyards with about 16 sets of rooms have been launched in the pilot project, which is functionally positioned as "youth apartments", introducing young people with high levels of knowledge to be neighbors with the old Beijingers. Neighborhood. After completing the signing and vacating of part of No.7 Yinzhuoqiao Hutong Courtyard in the Shichahai area, the B&B business was introduced, and the tourists can live together with the remaining 4 residents, and the "outsiders" and the "local households" are constantly exchanging, bonding and sharing, and No.7 Yinzhuoqiao Courtyard has been transformed into a neighborhood.

has become a "shared home" among neighbors.

The model of symbiosis proposed by the Beijing Municipality includes three meanings: "symbiosis of old and new buildings, symbiosis of old and new residents, and cultural symbiosis". The symbiosis of old and new buildings is the restoration and protection of traditional architecture and texture, while at the same time meeting the needs of modern living so that the original functions of the neighborhood can be continued while new functions are put in. In the Dongcheng District of Beijing, several historic and cultural districts have piloted "symbiotic houses", which on the one hand, restore and protect the appearance of the vacated houses, add modern living facilities, and improve the living environment for the residents; on the other hand, it attracts new residents, reuses the vacated houses, and injects new vitality into the hutongs (Xu et al., 2020).

4.2 Symbiotic Neighborhood Model

The "symbiotic courtyard" model of "architectural symbiosis, resident symbiosis, and cultural symbiosis" proposed by Beijing has been recognized by the relevant plans and has been put into practice in many ways, and relevant studies have pointed out that "symbiotic courtyard" can also be expanded to the level of "symbiotic neighborhood". Relevant studies have also pointed out that a "symbiotic courtyard" can be expanded to the level of a "symbiotic neighborhood", and after the whole courtyard is vacated, symbiosis can be realized between courtyards of different functions and forms. Relevant practices have been carried out in historical and cultural neighborhoods such as the Guanyin Temple and the Fayuan Temple in Beijing.

The Guanyin Temple area of Beijing Dashilan is a densely inhabited neighborhood rich in historical and cultural elements, and the sustainability of the residential function and cultural value needs to be realized in symbiosis. The renewal project expands the form of symbiotic courtyards and puts forward the concept of "symbiotic neighborhoods," optimizing space through the neighborhood model, and creating a livable environment that ensures the needs of the original inhabitants while at the same time creating a livable environment and ensuring the living needs of the original residents, the project also explores the connotation of the area and integrates it with the surrounding cultural resources to form an experienced route for cultural visits.

The concept of symbiosis is extended from courtyards to neighborhoods, and through the example of the Dashilan Historical and Cultural Neighborhood, it explores the possibility of realizing symbiosis through a wider range of population decongestion, resource allocation, and functional coordination (Lou et al, 2020). The Fayuan Temple Historical and Cultural Neighborhood, in the planning of the "symbiosis neighborhood", preserves the historical art and cultural symbols of the alley while maintaining the texture of the alley and the historical buildings; strengthens the cohesion of the residents through diversified sharing; and injects new vitality into the old city. It also injects new vitality into the old city and brings new ecology to the old city.

5. Renewal Design Strategies for Broom Alley

5.1 Status of Broom Hutong

Broom Hutong belongs to Dazhalan Street, adjacent to Chaji Hutong and Charcoal Hutong. The length of Broom Hutong is 250m, the width is 4m, the height is 3m, and the direction of the Hutong is east-west. The total number of houses in Broom Hutong is 123. In March 2022, the Hutong was selected to be on the List of Traditional Geographical Names Protected in the Functional Core Area of the Capital. There are schools, tourist attractions and commercial stores around the Hutong.

Through the research on the site, many problems of the Hutong are found. At the level of spatial layout: 1. low functional vitality, which is manifested in closed boundaries, negative boundaries, and weakened humanistic attributes; 2. poor road network. At the level of spatial environment: 1. weakening of historical and cultural attributes, 2. insufficient utilization of public space, 3. low satisfaction of crowd perception.

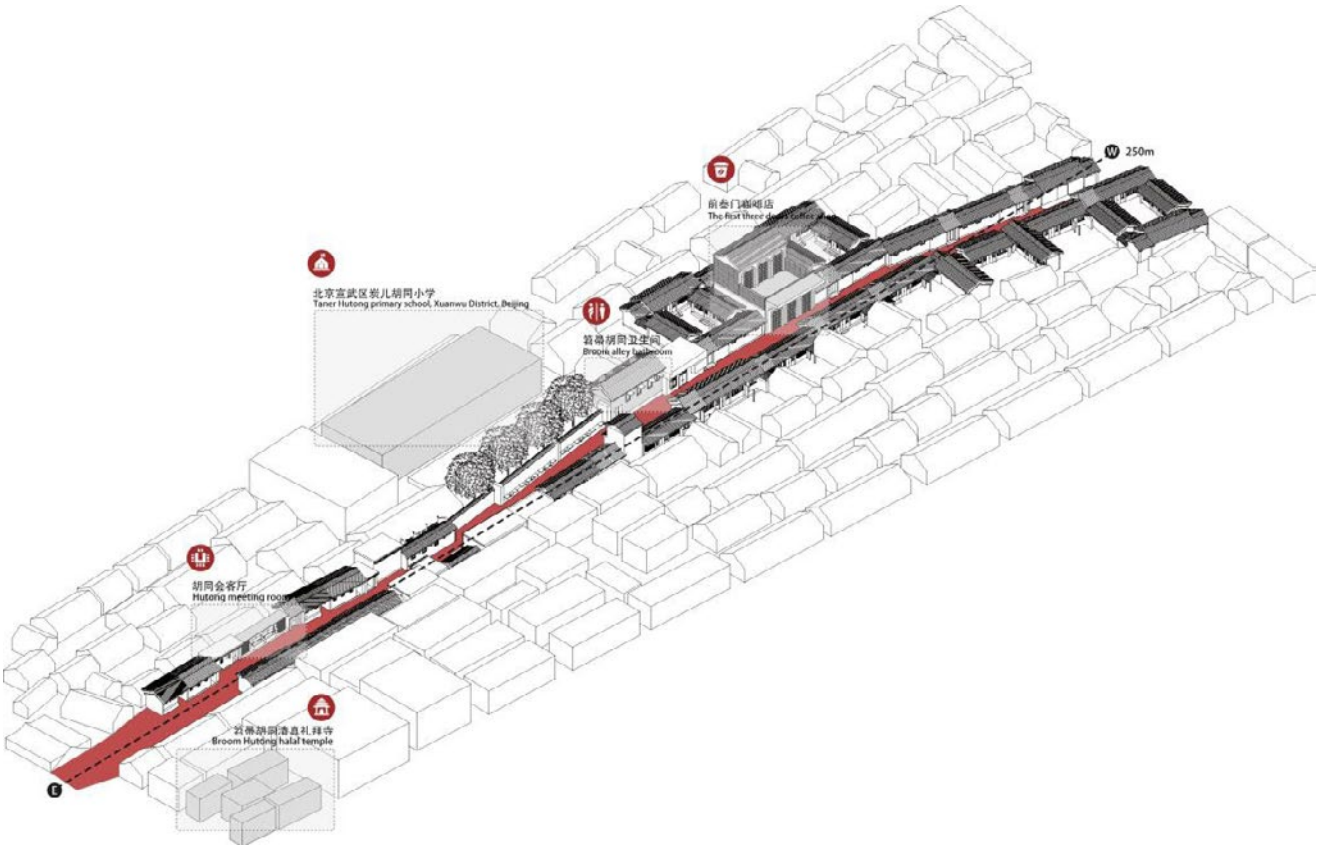

Figure 2. Status of the Broom Alley site

5.2 Broom Alley System Layer Strategy

The construction of the renewal mechanism based on the symbiosis perspective provides a symbiotic environment and basis for proposing spatial renewal, and the boundary transforms and applies the spatial attributes advocated in the concept of symbiosis in the dimension of its spatial composition, generating spatial symbiosis strategies and sharing strategies of the boundary, and ultimately realizing the goal of spatial symbiosis.

For the broom Hutong in the system layer strategy has two aspects: the first is the symbiosis strategy, and the second is the sharing strategy. The symbiosis strategy includes functional symbiosis, cultural symbiosis and ecological symbiosis. Functional symbiosis refers to the protective restoration of old buildings while improving the quality of the buildings and the living environment of the residents, and at the same time, new businesses such as cultural and creative industries can be introduced in the vacated courtyards or houses. Ecological symbiosis refers to the transformation of the vacated gray space and the planning of vegetation in the Hutong. Cultural symbiosis refers to the symbiosis of modern living concepts and the cultural concepts of the Hutong courtyards, through the introduction of new residents, while inheriting the culture of the old city courtyards, new cultural vitality is also injected.

Sharing strategy: I. Space time-sharing, the crowd behavior of Hutong boundary space use has time-sharing characteristics, combined with the needs of group behavior, to create conditions for the development of group behaviors such as morning exercises and visits in this space (Du, 2020). This kind of behavior carried out at the boundary of the neighborhood helps the neighborhood to share resources, promotes communication between neighborhoods, enhances the local characteristics of the community boundary zone, and strengthens the spiritual activities of the crowd. Carrying more civic activities and accomplishing more urban functions in the same space makes the border space more active, effective and safe.

Second, the sharing of all-age people, the functional types of the border are diverse, even for the same residential function, the composition of the residential population in different communities is also different, in the design of the border space, it is necessary to combine with the design of the street building space and road space, and give full consideration to the needs of different age groups and different behavioral purposes of the crowd's passage, stay, play and other needs. Third, the composite space sharing, for the same facilities in the boundary space can have different facilities to use the scene, such as the Hutong parlor can not only be a place for community residents to chat, but also a place for tourists to visit the Hutong culture or rest.

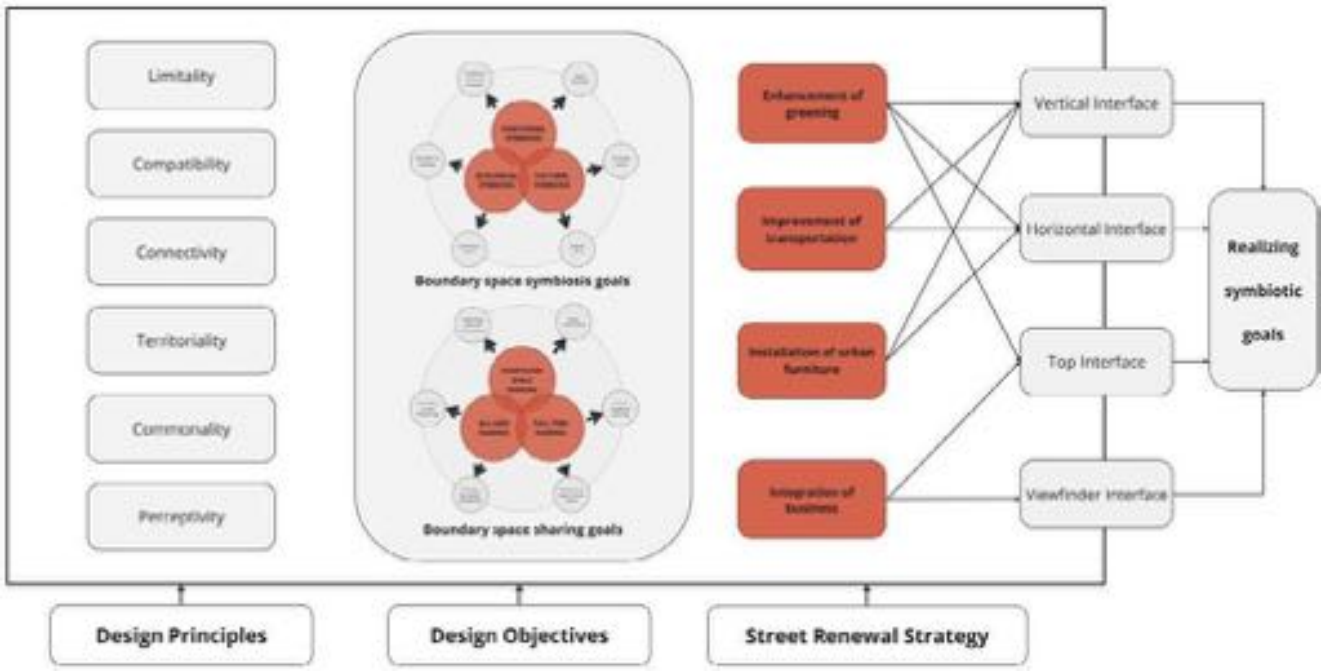

Figure 3. Broom Hutong Boundary Spatial Renewal System

Broom Alley Implementation Layer Strategy
On the basis of the system layer strategy for the Hutong boundary space specific update design strategy:

First, upgrade the greening and determine the main spatial location of the greening of Broom Hutong: top boundary space, horizontal boundary space, vertical boundary space. Using different Hutong greening methods, designing flexible planting devices, and selecting plant varieties adapted to the Hutong environment and conducive to winter ornamental plants, so as to improve the green landscape of the Hutong.

Secondly, to improve the transportation, we put forward an update strategy on static transportation using the boundary space as a carrier. For motor vehicle parking problems, the use of shared parking, three-dimensional parking and other ways to maximize the use of Hutong parking space. For non-motorized parking, the demand for temporary and fixed parking for bicycles is considered, and functions such as planting, power generation, and rest are integrated into the parking area, so that the single-function parking area is transformed into a composite public space.

Thirdly, planning activities, as a kind of common public space in the old city of Beijing, there are many possibilities for the daily use of Hutong, such as drying, bird-walking, chatting, chess and cards, trading, etc., and these activities tend to have a "tidal wave" in time. Two levels of leisure activity circles are designed: a pocket park circle within 50m and a leisure micro-space circle within 250m, the former containing Hutong, sports and leisure micro-gardens, and the latter containing living, recreational and ornamental installations, with a view to perfecting the activity functions of the public space on the basis of the continuation of the daily functions of the Hutong and improving the quality of daily life.

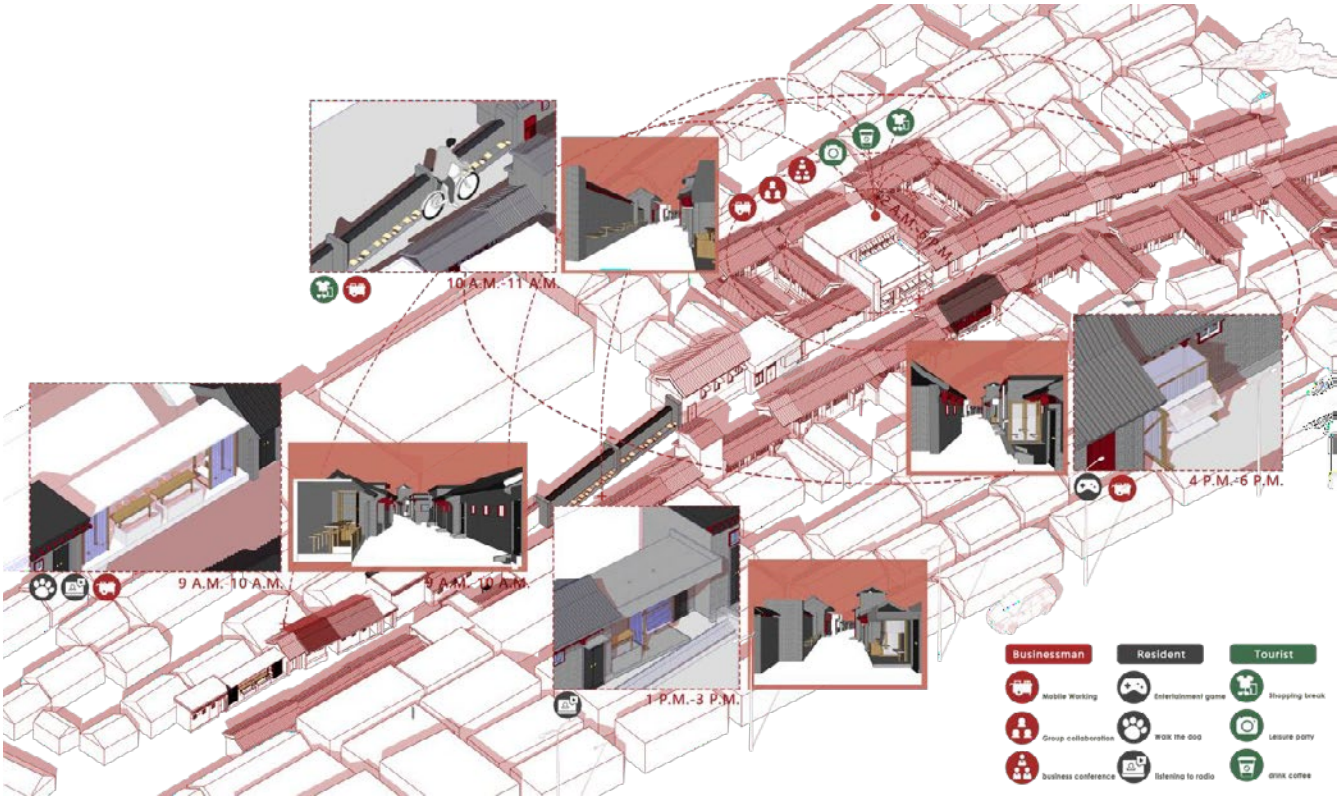

Figure 4. Broom Hutong Street Renewal Design

6. Conclusion

In summary, as China's current urban development shifts from expansion to sustainable development of land resources, the renewal of Beijing's Hutong needs to improve the surrounding environment through bottom-up progressive micro-renewal. Based on the symbiosis perspective, this paper categorizes the symbiotic influencing factors of the boundary space, and proposes a renewal strategy at both the system level and the implementation level, which can better harmonize the relationship between broom Hutong and the surrounding areas and thus achieve the purpose of solving the contradiction between the old and new areas of the city.

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IDENTITY CONSTRUCTION AND SPATIAL PRODUCTION: THE EVOLUTION OF MILAN'S CHINATOWN

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ABSTRACT | Postcolonial scholar Homi Bhabha's "Third Space" theory elucidates the ambiguous spaces characterized by cultural hybridity formed during intercultural exchanges. Milan's Chinatown, one of the largest and oldest Chinese immigrant communities in Italy and one of the earliest Chinese settlements in Europe, exemplifies this postcolonial "Third Space" with a history spanning over a century. This paper, based on literature review and empirical research, focuses on Milan's Chinatown to study its historical evolution, spatial characteristics, and impact on urban culture within the framework of Chinese immigrant identity construction and urban neighborhood space production.

The first part of the paper systematically reviews the historical evolution of Milan's Chinatown from the early 20th century to the present, detailing its four main historical stages: "spatial creation - spatial development - spatial conflict - spatial integration," and analyzing the interactions between each stage and the spatial evolution of Milan. The second part focuses on the specific clues of immigrant identity construction and neighborhood space production. Through map analysis and empirical research, it summarizes the spatial evolution characteristics of Milan's Chinatown and explores the manifestations of spatial order, spatial types, visual symbols, color patterns, and other aspects in the process of cultural integration between immigrants and the local community. The third part further discusses the unique value of the "Third Space" as a symbol of Milan's urban space and culture in integrating contemporary Milanese urban activities and shaping the city's form.

Through this research, this paper aims to reveal that Milan's Chinatown is not merely an immigrant community but a dynamic space full of cultural exchange and integration. This space, in its continuous adaptation to and influence on the city it inhabits, displays multi-layered and multidimensional cultural implications, providing a valuable case for studying urban space production and identity construction in a postcolonial context. Ultimately, this study not only offers new perspectives on understanding the spatial evolution and characteristics of Milan's Chinatown but also provides important theoretical and empirical support for broader urban studies and immigrant community research.

KEYWORDS | THIRD SPACE, CULTURAL INTEGRATION, IMMIGRANT

1. Introduction

As a unique urban space and cultural phenomenon among immigrant communities, Chinatown have become spatial symbols and narrative emblems of the Chinese diaspora worldwide. According to statistics, there are now over 200 Chinatown globally, with a population exceeding 600,000 living in these areas. Since the establishment of diplomatic relations between Italy and China in the 1970s, bilateral cooperation has increased, leading to a growing number of Chinese immigrants settling in Italy. The Chinese population in Italy rose from around 400 people in 1975 to over 20,000 by 1993. (Carchedi, F., Ferri, M., 1998) Entering the 21st century, the number of Chinese immigrants to Italy continued to rise, surpassing 300,000 in 2013 and reaching its peak in 2016, stabilizing at a hundredfold increase in population over 50 years. Today, Chinese immigrants are the third-largest immigrant group in Italy, with more than 30,000 Chinese residing in Milan. Milan, Italy's second-largest city, is renowned globally for its fashion and design industries, making it a popular destination for Chinese immigrants, surpassing other Italian cities in this regard. (Ministero del Lavoro e delle Politiche Sociali, 2020) While most Chinese residents in Milan are dispersed throughout different city areas, Chinatown remains a symbolic landmark that connects the Chinese community's living and emotional needs. Some Chinese media rank Milan's Chinatown as the fifth largest in Europe, and excluding the UK, Milan's Chinatown is only surpassed by those in Paris and Amsterdam, ranking third on the European continent, underscoring its influence. (Chinatown, 2022)

Academic research on Chinese immigrants in Italy tends to focus on Chinese language education, Chinese business economies, Chinese media, and cities with larger Chinese populations, such as Prato, within China. Outside China, research often emphasizes immigration policies, the integration of Chinese immigrants into local work and life, and anthropological and sociological studies of Chinese social phenomena. From a design research perspective, scholars have noted the spatial changes in Chinatown and their relationship with urban morphology.

However, few researchers have focused on the connection between identity construction among immigrant groups and the everyday life and micro-scale spaces of Chinatown. Therefore, this study is based on the author's personal experiences living in Milan and observations of Chinatown. It combines the postcolonial theorist Homi Bhabha's theory of the "Third Space" to trace the spatial evolution of Chinatown, summarize the characteristics of its current spatial presentation, and attempt to analyze the reasons behind these characteristics.

2. Spatial Evolution of Milan's Chinatown

Milan's Chinatown is located in the eighth district in the northwest of the city. Broadly speaking, Chinatown is an area centered around the pedestrian thoroughfare Via Paolo Sarpi, home to thousands of Chinese shops, and is a traditional commercial district in Milan. (Figure 1) In a narrower senwwse, Chinatown often specifically refers to Sarpi Street itself, the representative street of Milan's Chinatown. The first wave of Chinese immigrants to Milan can be traced back to the 1920s and 1930s, with most originating from Wenzhou, Zhejiang. Wenzhou people are known as the "Jews of the East" for their

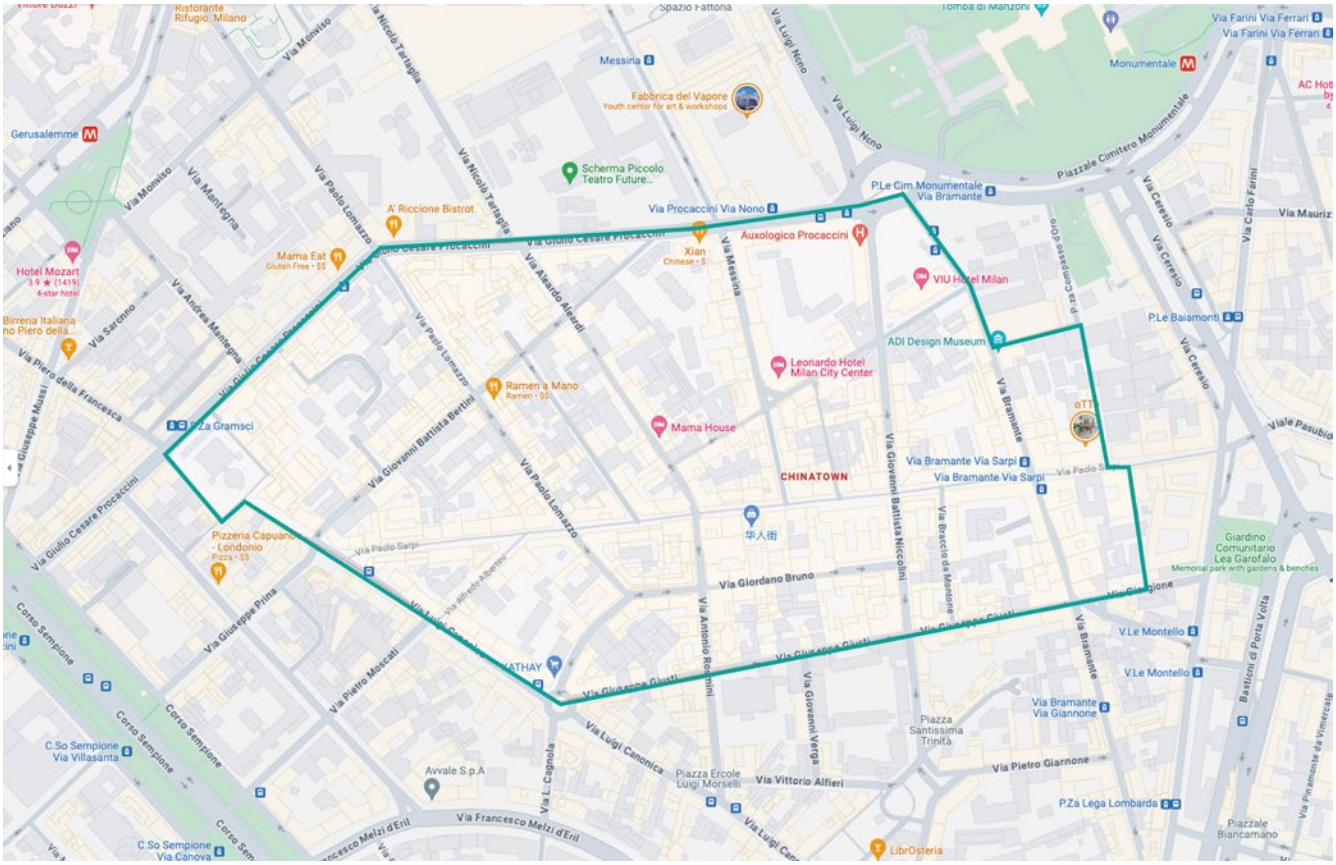

Figure 1. Milan's Chinatown.

intelligence and business acumen. Bordered on three sides by water, Wenzhou has limited access, a high population density, and scarce resources, and it did not experience significant development in its history before China's economic reforms. During World War I, the Chinese government, as a member of the Allies, sent more than 140,000 Chinese workers to Europe as laborers. After the war, some workers chose to stay in Europe to work and live, and Milan became one of their destinations. (Figure 2) In the first 20 years, they lived in the Canonica-Sarpi area and progressed from street vending to running workshops and shops. Most of the buildings in this area were multi-story residences developed in the early 20th century, with commercial shops on the ground floor facing the street. (Figure 3) Chinese immigrants initially earned profits by selling leather and textile products, which provided them with the original capital for long-term business in Milan. It is important to note that the spatial clustering of Chinese communities in the early stages of immigration was due to the convenience of commercial activities rather than government-led immigration policies. As a result, Chinese immigrants have never been the majority population in this neighborhood, setting the stage for future conflicts between the Chinatown commercial district and community residents.

Figure 2. Earlier Chinese immigrants in 1920s.

Figure 3. Milan's Chinatown in 1928.

Between World War II and the 1970s, the number of Chinese immigrants did not increase but gradually decreased, leaving only about 700 Chinese living in Italy by the early 1970s. (Overseas Chinese Affairs Office of the State Council of the People's Republic of China, 2004b)

Beginning in the 1980s, thanks to the establishment of diplomatic relations between China and Italy and Italy's immigration policies, Italy and Milan once again became destinations of choice for Chinese immigrants. A significant portion of these immigrants also came from Wenzhou, often joining relatives or attracted by stories of fellow countrymen seeking economic opportunities. Two Chinese immigrants from Wenzhou whom I interviewed mentioned that they arrived in Italy in their teens in the early 1990s to join relatives. They obtained residency permits and legal status through Italy's amnesty policy in the late 1990s and early 2000s and settled permanently in Milan. During this period, many Chinese in Milan engaged in the wholesale clothing business, benefiting from China's foreign trade market and Italy's fashion industry. Due to the rapid increase in immigration, new immigrants also began operating restaurants, supermarkets, hair salons, and other service-oriented businesses to serve the emerging Chinese community. Meanwhile, unlike the burgeoning Chinese economy in Chinatown, the number of

Chinese residents living in the area decreased again during this period, with Chinese immigrants gradually relocating to other parts of Milan. (Cologna, D., 2008) For them, Chinatown was merely a place to earn a living, not a place to settle down and live. This phenomenon led to the marginalization of the Chinese immigrant community for an extended period, with little interaction between Chinese businesses and the Italian residents living around Chinatown. As a result, Chinatown became an isolated space, with limited real connection to urban activities.

Since most of Chinatown's businesses were in clothing wholesale, supermarkets, and other commercial services, freight transport and unloading became the primary street activities, leading to the disorderly development of the street space, negatively impacting the sanitation and tranquility of the area. (Figure 4) At the same time, Milan's government began implementing policies to protect Italian-operated businesses and exclude Chinese businesses, leading to growing tensions between the Chinese community and local residents and authorities. In 2007, these tensions culminated in large-scale street riots and demonstrations involving clashes between Chinese individuals and Italian police. Following these events, the Milan government engaged in negotiations with the Chinese immigrant community, ultimately relocating most wholesale businesses out of Chinatown. In response to these events, to improve commercial operations and traffic order, the Milan city government began renovating Via Paolo Sarpi in 2008. Over nearly three years, the street was transformed into a commercial pedestrian street. The renovation plan involved redesigning the streets and facilities, using materials, shrubs, and urban furniture to divide the street into different zones to better serve pedestrians and shop owners. The renovated Via Paolo Sarpi Chinatown reopened in 2011, and contrary to the pessimistic expectations of many Chinese business owners before the renovation, the street achieved significant improvements in spatial environment and business scale compared to before the renovation. The micro-scale design of the street undoubtedly enhanced the spatial order and pedestrian experience of Chinatown, improving its previously closed and chaotic state and creating better opportunities for new Chinese immigrants and the Chinese community to integrate into the city.

Figure 4. A pushcart war in the streets of Milan's Chinatown in 2007.

Figure 5. The redevelopment of the streetscape of Chinatown.

Since 2010, Chinese students studying in Milan have emerged as a significant source of new Chinese immigration to the city. According to statistics, in 2020, study-related immigrants accounted for 50% of the newly registered immigrant population in Italy, a proportion that continues to rise. Notably, women constitute 59% of this group. (Immigrants.Stat, 2020) The increasing presence of young immigrants with advanced educational backgrounds, alongside the growing number of female immigrants, has facilitated the formation of a clearer group identity, which in turn has significantly enhanced the integration of Chinese immigrants into Milan's urban fabric. The proliferation of mobile internet and the advent of new social media platforms have further accelerated this process. Within the Chinatown community, a portion of these young immigrants has chosen to establish businesses after graduation, introducing

innovative Chinese business models and brands. This has attracted a younger clientele, including both Chinese students and Italian youth. As a result, Chinatown—particularly Via Paolo Sarpi—has evolved from a space traditionally dominated by Chinese merchants into a more diverse area. Today, local residents and tourists from various countries increasingly frequent the district, drawn by its Chinese restaurants and supermarkets.

Encouragingly, the development of the Chinese immigrant community has prompted the city of Milan to propose a comprehensive redevelopment plan for Chinatown. This initiative aims to enhance urban transportation and street infrastructure in commercial areas adjacent to Via Paolo Sarpi, such as Via Bramante and Via Mesina, with the goal of stimulating economic activity and urban vitality while fostering closer integration between Chinatown and the surrounding city spaces. (华舆, 2020)

3. Homi Bhabha's "Third Space" Theory

The "Third Space" refers to an "in-between space" formed by the amalgamation of two or more cultures. Homi Bhabha, a postcolonial cultural scholar at Harvard University, is one of the key figures discussing the concept of the "Third Space." Bhabha, from the perspective of postcolonial cultural critique, argues that the traditional binary notion of space cannot explain the processes, mechanisms, and outcomes of cross-cultural exchanges. He focuses on the "in-between" spaces of two or more cultures, considering it a space that transcends the binary concept of space and is widely inclusive, known as the Third Space. (Zha, R., 2011) Homi Bhabha believes that cultures cannot maintain their purity during interactions; the collision of multiple cultures inevitably creates a new domain. This domain cannot be simply classified as "self" or "other"; it is necessarily an intermediary position that includes features of both cultures. From the name "Milan Chinatown," the combination of the nouns "Milan," "Chinese," and "street" undoubtedly possesses the characteristics of the Third Space. However, the reality is that Milan's Chinatown, as a Third Space, did not form at the moment of its naming but rather went through a long process. Bhabha contends that any culture, including its inherent factors such as race, class, gender, and beliefs, can engage in dialogue and discourse within the Third Space. However, Bhabha also points out that this exchange "will not always be cooperative or dialogical; it may also be deeply oppositional, confrontational, or even incommensurable." (Zha, R., 2011)

Considering the spatial evolution of Milan's Chinatown, although the Chinese working and living in Milan have a long history throughout the 20th century, Milan's Chinatown did not exhibit the characteristics of a Third Space before the 21st century. This is because, in the 20th century, Chinese immigrants in Milan were not closely connected to the city in terms of work or life. Even though the residents

living in Chinatown were primarily Italian, the Chinese who traveled across the ocean for business had a clear goal: to earn more money rather than integrate into the city and local community. This resulted in a disconnect between Chinese immigrants and the outside world in terms of space and daily life. Chinese immigrants were not interested in establishing deep connections with local residents, who, in turn, viewed Chinatown and the Chinese as a closed space and community. In both name and reality, the Chinese immigrant community in Chinatown was marginalized. Therefore, it is not difficult to understand the conflict between Milan's local residents, the government, and Chinatown merchants in 2007. After the conflict, the streets of Chinatown were redesigned to improve the connection between the street and urban spaces. Although this transformation was primarily a top-down operation led by government intervention, from a design perspective, the physical renovation of Chinatown provided opportunities for interaction and integration between Chinese immigrants and local residents. In recent years, due to the ongoing urban space updates in Chinatown, changes in business types, the younger demographic of immigrants, and increased cultural activities between the two countries, interactions between Chinese immigrants and local residents have strengthened. The characteristics of the Third Space, with Chinatown as its medium, are continuously forming.

4. Current Characteristics of Milan's Chinatown from the Perspective of the Third Space

4.1 Cultural Controversy: The Paifang as a Symbol of Chinese Culture

The paifang, or Chinese archway, is an iconic traditional architectural form, characterized by a sloped roof supported by multiple pillars. In ancient Chinese architecture, paifang served as the entrance to a space, its towering presence signaling the transition into a new realm. In Chinatown around the world, paifang often marks the boundary between the Chinese community and the rest of the city, symbolizing, to a large extent, the perception of Chinatown by outsiders. (Figure 6) Milan's Chinatown has seen several proposals to construct an archway at the street entrance, but due to differences between local Milanese residents and the Chinese immigrant community, a permanent paifang has yet to be built at the entrance of Via Paolo Sarpi.

The debate over constructing the paifang reflects long-standing cultural differences and a lack of mutual understanding between the two communities. For some Chinese immigrants, the paifang represents a sense of identity and emotional connection for Chinese people living abroad. It also symbolizes a "gateway of friendship," welcoming local residents into the immigrant community. However, for local Milanese residents, the construction of a paifang would brand their

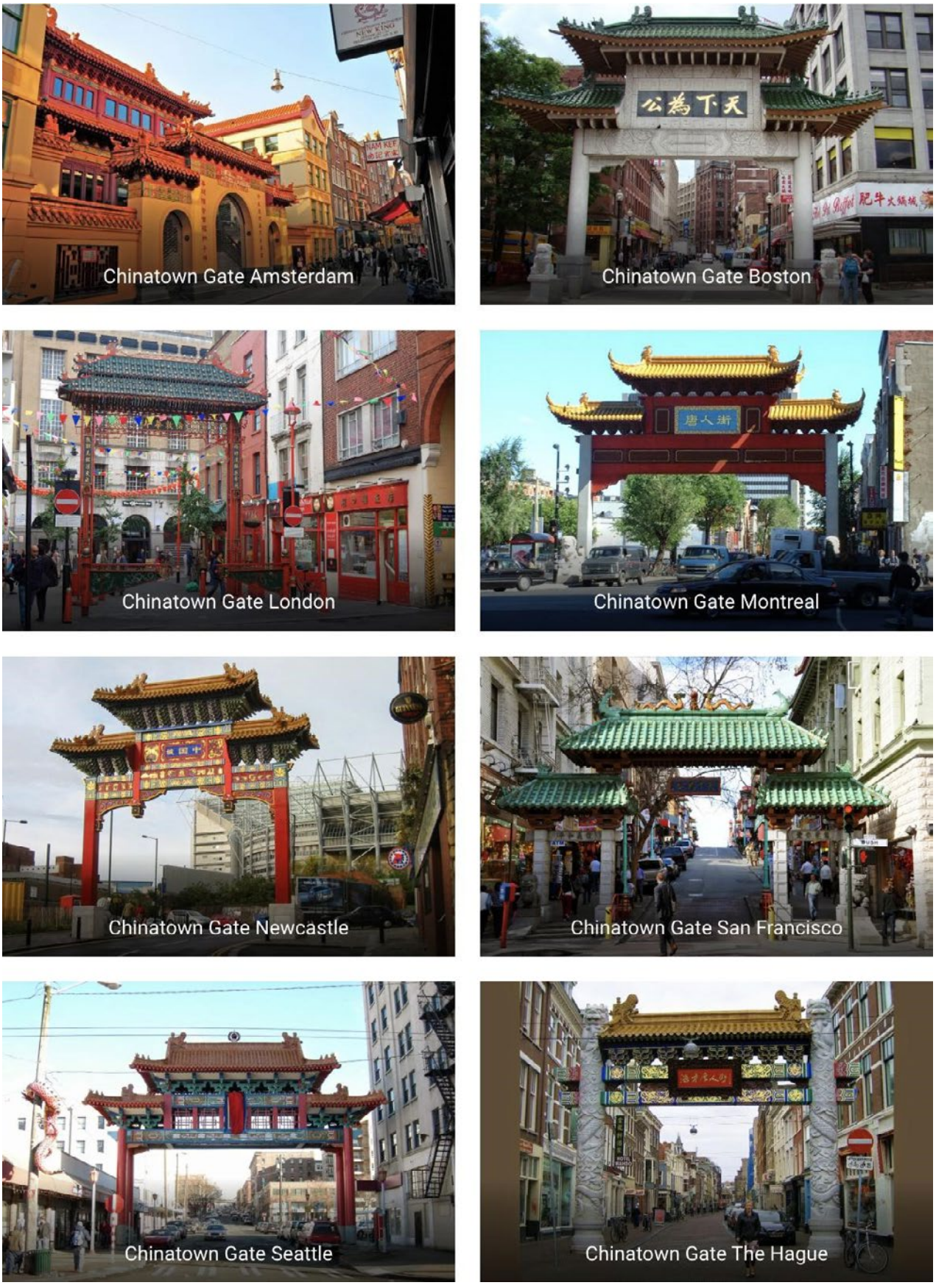

Figure 6. Chinatown Gate in the World

neighborhood with the label of a foreign culture. During the 2015 Milan Expo, a temporary compromise was reached, with a temporary archway erected at the entrance to Chinatown to welcome visitors. (Figure 7) A series of cultural activities during the Expo helped local residents gain a deeper understanding of the cultural significance of Chinatown. Increasingly, people began to explore Chinatown, experiencing its restaurants and purchasing traditional Chinese products from its supermarkets.

Over the past decade, as Chinatown has undergone spatial redevelopment and integrated more deeply with the city's fabric, official and community-led Chinese cultural activities have become more frequent, attracting large numbers of local residents. Cultural differences have gradually diminished, and mutual understanding has grown. Local residents' participation in Chinatown's everyday life reflects greater awareness and interest in Chinese culture, while Chinese immigrants have embraced the practice of decorating Chinatown for specific festivals rather than insisting on a permanent paifang as a cultural marker.

In 2024, during Milan Design Week's "China Week," an Italian designer created a temporary paifang infused with Chinese elements at the entrance to Chinatown, naming it "Our Gate." This installation became

Figure 7. Milan Design Week 2024 in Chinatown.

one of the highlights of Design Week. The phrase inscribed on the structure, "Different, but together," underscored Chinatown's transformation into a "third space" that embraces both cultures. In the future, it is possible that Chinatown will be permitted to construct a permanent paifang, but it will likely serve as a "symbol" of the community's successful integration into Milan's urban and cultural life, rather than a contested "marker" of cultural division. (Overseas Chinese Affairs Office of the State Council of the People's Republic of China, 2024)

4.2 Spatial Integration: Streets and Communities Harmoniously Connected with the City

Unlike other well-known Chinatown around the world, Milan's Chinatown was formed through the concentration of Chinese commercial activities rather than the settlement of Chinese immigrant communities. As a result, for nearly a century, Milan's Chinatown has lacked the prominent traditional Chinese cultural elements, visual symbols, and architectural decorations that are typically seen in Chinatown like those in London, New York, or San Francisco. When pedestrians enter Milan's Chinatown, they do not immediately notice a significant difference from other nearby streets.

From an urban spatial perspective, Milan's Chinatown is closely integrated with the city center. Since the 2008 redevelopment, the street has maintained the same scale as surrounding areas, and the redesign has introduced green spaces that delineate clearer pedestrian pathways and create more comfortable environments for leisure. This approach has enhanced the walking experience in Chinatown while maintaining a harmonious spatial relationship with neighboring residential areas, encouraging local Italian residents to naturally enter the district. This, in turn, increases opportunities for local residents to engage with Chinese businesses and culture within Chinatown.

Visually, the lack of traditional Chinese elements in Milan's Chinatown can be attributed to the different composition of its immigrant population compared to other Chinatown like those in New York or London. The latter two were initially populated by immigrants from Hong Kong, Guangdong, and Fujian provinces in the early 20th century, whose distinct Southern Chinese culture and customs shaped the visual identity of those Chinatown to closely resemble Hong Kong. For example, the vibrant, eye-catching shop signs lining the streets evoke the stereotypical imagery associated with Chinatown. However, it is worth questioning whether such visual elements foster opportunities for cultural exchange between Chinese immigrants and the local society, or if they merely reinforce cultural imagination within the immigrant community and perpetuate stereotypes of Chinese culture among outsiders.

In contrast, Milan's Chinatown lacks these visual symbols. While temporary decorations featuring Chinese cultural elements have been introduced during recent festivals, the

street design and decor remain restrained. The Wenzhou community, known for its practicality, along with a younger and more open-minded generation of immigrants, has focused more on business operations and daily life than on creating a visually distinct environment. Today, Milan' s Chinatown bears more resemblance to the atmosphere of a third-tier Chinese city. In China, commercial districts in first-tier cities typically attract the elite and tourists, often accompanied by complex traffic conditions and large crowds. In contrast, third-tier cities offer commercial streets that cater more to everyday citizens, providing a better walking experience. These streets encourage both locals and visitors to stroll leisurely and gather, fostering a casual, community-focused environment that Chinese people describe as "smoke and fire" (yanhuo qi)—a phrase symbolizing the vitality of everyday life. Increasingly, this ambiance is becoming more apparent in Milan's Chinatown.

Figure 8. Chinatown in New York and Milan.

4.3 Communication Platform: Recreational Space Integrating Chinese and Italian Lifestyle Cultures

A continuous observation of the commercial landscape in Milan's Chinatown reveals that in recent years, newly opened Chinese restaurants, specialty snack shops, bubble tea stores, and supermarkets have attracted a substantial number of both Chinese and international customers.

Many of these establishments are "internet-famous" restaurants, popular among young Chinese for their delicious offerings and widely promoted through online platforms,

making them highly sought after. These venues have also gained the affection of Milan's local residents and foreign tourists, not only due to the appeal of the cuisine but also because Chinatown provides a familiar and comfortable dining environment.

In other Chinatown around the world, most restaurants follow the traditional format of Chinese "restaurants" or "dining halls," with both the interior design and menu geared primarily toward Chinese communities living abroad, rather than the local population. Even when some of these restaurants adapt their dishes to better suit local tastes, they rarely attract a regular local clientele. Milan's Chinatown, however, offers a different experience. Many restaurants feature outdoor seating and sun canopies, allowing diners to become part of the street scene while enjoying a leisurely meal. This integration of dining spaces with the street is common in Milan and other European cities but is rarely seen in large Chinese cities or traditional Chinatown elsewhere. It has drawn more local residents to engage with and experience Chinese cuisine in Chinatown, facilitated by the pedestrian-friendly, small-scale streets and pub-like dining spaces that invite people to stroll, relax, and enjoy convenient street-side dining. For Chinese immigrants and tourists, Chinatown offers a taste of home, while for local residents and international visitors, it serves as a space to explore Chinese cuisine and unwind. As previously mentioned, young Chinese students studying in Milan often bring their local friends to Chinatown for gatherings and relaxation—an urban scene rarely witnessed in Chinatown a decade ago.

Figure 9. Recreational Space Integrating Chinese and Italian Lifestyle Cultures.

5. Conclusion

The century-long development of Milan's Chinatown reflects the history of Chinese people living in a multicultural society, with the construction of identity and spatial production of the Chinese community undergoing various stages of change and challenges. From the perspective of Homi Bhabha's theory of the "third space," the exchange between two cultures is not static, and the third space is not a fixed form or location, but rather an evolving process influenced by history, culture, policy, economics, space, and community dynamics. The origin, development, conflicts, and eventual integration of Milan's Chinatown illustrate the continuous interaction between cultures and the impact of these multifaceted factors.

From a design research standpoint, spatial redevelopment has played a crucial role in the integration of Milan's Chinatown into the local culture. The focus of this redevelopment is not about "new" versus "old" or specific design styles, but rather about identifying the "core issues" of spatial phenomena. This involves determining how to reasonably allocate street space and optimize the environment to create an urban experience that fosters daily life and cultural exchange. In the context of widespread cross-cultural exchange and the growing importance of cross-cultural design, the spatial form of immigrant communities is becoming a key area of interest for researchers. Whether in terms of urban design, neighborhood planning, visual design, or design history, the evolution of Milan's Chinatown offers a representative case study for the design research of immigrant cultures.

For designers, understanding the reasons behind the specific design of a region and making improvements requires an inquiry into the historical and cultural factors that shaped the current phenomenon. It also necessitates a critical examination of design phenomena, looking at design issues from perspectives beyond the discipline of design itself.

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ARCHEOLOGY IN TRANSIT

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ABSTRACT | The paper outlines the research methodology and initial results of the exhibition "Arqueología en Tránsito" opened in Tijuana (Mexico) and San Diego (USA) during two Design Weeks (Tijuana on May 4-5, 2024 and San Diego on September 19-25, respectively). The project employed a collaborative design research strategy involving researchers from Tecnológico de Monterrey across various Mexican territories, from Chiapas to Chihuahua, to collect and analyze artifacts reflecting migrant experience.

"Archaeology is the only way to access the present," philosopher Giorgio Agamben writes at the beginning of his essay "Creazione e anarchia" (Agamben, 2017). Grounded in these premises, the research and the exhibition emphasized the analytical exploration of the relationship between individuals and artifacts as an essential framework for examining the complexities of contemporary migration.

The methodology was centered around generative and co-creative workshops, where participants selected and scrutinized artifacts based on designated criteria. The selected artifacts, which included everyday items such as modified plastic bottles alongside more symbolic objects, transformed from mere silent witnesses into central figures in a narrative that vividly portrays the profound human stories intertwined with issues of migration and borders. The exhibition served as a reflective platform to consider the dynamics of current global borders, highlighting the paradox whereby the construction of more barriers coincides with increased migrations and conflicts. It invited attendees to delve deeper into understanding the objects silently accompanying migrants on their journeys. In addition, this project suggests that the archaeological study of objects can enhance the design process by offering insights into the potential impacts of functional objects. Through "Arqueología en Tránsito," the project

provided valuable insights into the complex interplay between human lives and the objects that are both part of and witness to these life-changing experiences, enriching the dialogue on migration, cultural heritage, and human resilience. Furthermore, the exhibition underscored the transformative power of design and research in fostering greater empathy and awareness about global societal challenges.

KEYWORDS | OBJECTS, HUMANS, BEHAVIORAL CHANGE, COLLABORATIVE DESIGN RESEARCH, MIGRANT EXPERIENCE, GENERATIVE DESIGN WORKSHOPS, ARCHAEOLOGICAL RELEVANCE

Introduction

Mexico is experiencing a significant shift in its migration landscape, transitioning from being primarily a country of emigration to one facing substantial internal migration flows. The country is now receiving an increasing number of migrants who transit through and settle within its territory, along with a rise in the arrival of asylum seekers and refugees. Despite the growing importance of migration, Mexico lacks a comprehensive and coordinated policy to effectively integrate newcomers, leading to potential social cohesion issues and increasing the vulnerability of migrants (Sánchez-Montijano & Ortega, 2022).

Migration patterns between Mexico and the United States have undergone significant transformations in recent years, driven by a confluence of economic, social, and policy factors. These changes have notably affected migration flows' demographics, volume, and nature. The demographic profile of Mexican migrants has diversified, with a noticeable increase in the number of women and older individuals participating in migration. Additionally, the geographic origins of migrants have expanded, now including previously considered stable states (E. Valdez et al., 2015; R. Sáenz, 2015). The migration of women and children from Mexico and Latin America to the United States has been a significant phenomenon in recent years. This movement is driven by various factors, including economic opportunities, family reunification, and the need to escape violence or persecution. Understanding the trends and patterns of this migration is crucial for developing effective policies and support systems. Men primarily migrate for employment opportunities, while women are motivated by both family reunification and economic reasons. Notably, daughters exhibit a high propensity to migrate for work, paralleling their male counterparts. The increase in the number of women and children migrating from Mexico and Central America to the United States can often be attributed to structural vulnerabilities and traumatic experiences (E. Valdez et al., 2015; G. Valdéz-Gardea, 2009; Marcela Cerrutti & D. Massey, 2001). The migration dynamics in Mexico have evolved significantly, with the country increasingly becoming a transit

route for migrants from Central and South America heading to the United States. Various socioeconomic and political factors, including violence, economic opportunities, and immigration enforcement policies, drive this shift. As a result, Mexico has become a crucial transit country for migrants from Central America, particularly from the Northern Triangle (El Salvador, Guatemala, and Honduras), who are fleeing violence and seeking better economic opportunities in the United States. However, the journey through Mexico is fraught with significant violence and exploitation. Migrants often face organized crime and human rights abuses, exacerbating their already precarious situation. Particularly vulnerable are migrants, especially children, who encounter severe humanitarian challenges during their transit through Mexico. These challenges include exposure to violence, exploitation, and inadequate access to healthcare (Benjamin J. Roth et al., 2020; F. M. Flores, 2020; L. Pries et al., 2023; Laura Naranjo et al., 2023; W. Vogt, 2013).

Tijuana, a city on Mexico's northern border, has emerged as a significant hub for migrants, particularly those aiming to enter the United States. Various factors have shaped this role, including legal frameworks, economic opportunities, and the city's strategic location. Notably, Tijuana's position as an industrial center and its location on migration routes from Central and South America to the U.S. attract both internal and international migrants (J. Hennebry et al., 2018; M. Marchand & Adriana Sletza Ortega Ramírez, 2019).

The city's export-processing areas create a complex interaction between local and global labor markets, reinforcing its status as a migration hub. Many migrants initially arrive in Tijuana with the intention of crossing into the United States. However, due to various obstacles, they often settle temporarily, which can become permanent as they find work and other commitments in the city—additionally, deported Mexican men in Tijuana experience a state of "permanent temporality," navigating their lives in a borderscape that mediates their mobility and emotional wellbeing. This phenomenon underscores the complex social and emotional dimensions of migration in Tijuana, highlighting the multifaceted challenges migrants face in this critical border city (Renato de Almeida Arao Galhardi, 2022).

As designers, educators, and researchers, it is essential to understand complex situations deeply through a design perspective. The migration phenomena should no longer be perceived merely as a constant emergency to manage. Instead, it must be approached as a multidisciplinary, interconnected, and complex issue. Addressing migration requires implementing a systemic approach, which allows for a comprehensive understanding of its various dimensions and interdependencies. This exhibition emphasizes the importance of a holistic and strategic perspective in dealing with migration. Specifically, product design plays a crucial role in shaping the relationship between objects and society by creating artifacts that reflect human life's cultural, emotional, and functional aspects. These artifacts act as boundary objects, bridging

knowledge gaps and fostering emotional and identity connections. By learning from long-lasting artifacts for sustainability, understanding the mutual influence between products and societal change, and using previous products as carriers of engineering knowledge, product design underscores its multifaceted role in creating meaningful and sustainable connections between objects and society. Design artifacts promote shared representation, transform design knowledge, mobilize for action, and legitimize design expertise, highlighting the importance of design in our daily lives (D. Orth et al., 2018; G. Mark et al., 2007; L. Bucciarelli, 2002; S. Walker, 2006). The intersection of design and anthropology provides a unique perspective to understand contemporary living conditions, particularly for migrants. By examining material cultures and relational paradigms, researchers can gain deeper insights into the lived experiences of migrants, including their challenges and adaptive strategies. This interdisciplinary approach is crucial for uncovering the complex realities of migrant lives and their socio-economic integration. It enhances our understanding of contemporary living conditions and offers practical tools to support migrants' journeys (D. Schultheiss et al., 2011; P. Basu & S. Coleman, 2008).

With the specific issue of migrations, it is a good start to see what objects are left behind from these activities. The objects that migrants leave behind in inhospitable areas while crossing the border, such as in Sonora, provide us with a deeper understanding of their situation in various ways. Firstly, these objects reflect the bodily techniques and repeated experiences migrants have developed to face the dangers of crossing. For example, the visible wear on shoes, bloodstained socks, and sweat-stained clothing can offer intimate details about the hardships of the crossing process, evidencing their daily suffering (De León, 2013).

This research was genuinely inspired by Jason De León's work by identifying the water bottle as an agent of change: De León argues that the water bottle emerges as a crucial change agent in the migrant experience, particularly in the context of crossing the Sonoran Desert. It is essential for survival, as the lack of water is a leading cause of migrationrelated injuries and deaths, primarily due to hyperthermia. The bottle provides hydration and symbolizes resilience and adaptation in the face of harsh desert conditions and border surveillance. Additionally, water bottles have been modified to attempt to evade Border Patrol detection.

Migrants have adopted black plastic gallon bottles, which are less recognizable from a distance. This adaptation illustrates how an everyday object can become a tool of deception, highlighting the creativity and ingenuity of migrants using their material culture to avoid detection. Over time, changes in the design and use of these bottles reflect the socio-economic and political conditions migrants face. For example, before 2009, many bottles were clear plastic, making them more detectable. The shift to camouflaged bottles indicates a response to increased border security.

Furthermore, some companies have capitalized on the preference for black bottles among migrants. After 2009, certain companies began producing black plastic gallon bottles, reflecting a technological shift in response to migrant necessities. Migrants perceive these dark bottles as a tactical advantage for avoiding detection, although this assumption does not always hold up against the surveillance technology used by authorities. In addition, the year 2009 emerged as a significant chronological marker for archaeologists, distinguishing a clear shift in bottle color from white to black. This change is particularly noteworthy as it illustrates the dynamic relationship between supply and demand; the necessity for adaptation prompted a response from the market, which accommodated to this new demand. Finally, the repeated use and recontextualization of the water bottle by migrants reveal patterns of suffering and vulnerability. Dependence on these objects while navigating a hostile environment normalizes the experience of migration, which is fraught with constant risks.

In summary, the water bottle symbolizes the struggle for life and resilience in a context of violation and oppression, playing a central role in the experiences and hardships of migrants attempting to cross the border (De León, 2012). Understanding the complexities of artifacts and their relationship with people and culture is essential for design scholars. This knowledge aids in creating designs that are not only functional but also culturally relevant and meaningful. The water bottle example by De León serves as an excellent case study for this research. We also recognize that the outcome of this research should be an exhibition. Research like this, disseminated through public exhibitions, can engage participants in community conversations and elicit thoughtful, in-depth responses. Collaboration between academic researchers, curators, and designers is crucial in presenting academic research in an engaging and visually appealing way in physical exhibitions (Alyssa Tang & I. Nakarada-Kordic, 2022; Anda Boluža, 2023)

Methodology

The School of Architecture, Art, and Design (EAAD) at Tecnológico de Monterrey holds a unique position compared to other institutions due to its presence on 19 campuses nationwide (ITESM, 2024). This provides a significant opportunity to conduct research incorporating diverse perspectives, localities, and scopes to understand migration through the artifacts left behind by migrants.

Criteria

To effectively identify, evaluate, and align the criteria for this study, we needed to efficiently involve various design researchers, faculty members, and other stakeholders.

Given the impracticality of gathering all participants in a physical space, we faced the challenge of engaging faculty members in a time-effective manner. We needed to

involve them quickly, allowing them to work independently while producing high-quality content. The first challenge was to align how all participants analyze the objects through specific criteria. Aligning research criteria and analysis is crucial in design research and archaeology, especially when analyzing artifacts. This alignment ensures that the methodologies used are appropriate for the research questions and hypotheses, leading to more reliable and valid conclusions (Hoadley, 2004).

The first criterion was to analyze the relevance between fabrication and use. Understanding the intersection of design and manufacturing enables design scholars to create designs that are not only innovative but also feasible and efficient to produce (Fillingim et al., 2020; Pradel et al., 2018). By applying this criterion, we excluded informal and handcrafted artifacts that might present attractive individual solutions but fall outside the scope of this research.

The second criterion analyzed how emotionally charged the objects were, as this can create a significant emotional connection with their users (D'Souza et al., 2010).

The third criterion considered the product's impact on behavioral change among individuals, industries and institutions. Understanding objects as agents of behavioral change allows designers to integrate key insights from behavior change theory into the traditional design process (Cash et al., 2017).

Finally, the last criterion analyzed the archaeological relevance, which was necessary to understand this particular situation's contemporary narratives. The water bottle served as an excellent example for understanding more objects that would build this exhibition research, assuring that our design researchers could find similar, impactful artifacts:

1. **Fabrication and Use:** Water bottles are essential for migrants, serving as practical objects designed to help them survive in a hostile environment. They are crucial for providing the necessary hydration to combat hyperthermia in the desert, effectively keeping people alive.
2. **Emotionally Charged Objects:** For migrants, water bottles symbolize the struggle for survival and the experiences endured during a dangerous journey. These objects become touchpoints connecting to the personal narratives of those attempting to cross the border, evoking emotions of hope and despair.
3. **Agents of Behavioral Change:** Migrants' selection and use of water bottles influence their behavior and interactions with their environment. Migrants understand that using dark-colored water bottles might help them avoid detection by border authorities, representing a shift in their survival strategies despite potential health consequences. And the bottle has also has an impact on the local area by causing a behavioral change in some entrepreneurs who have been starting to produce the bottle using the color black since 2009.

4. **Archaeological Relevance:** Water bottles, commonly found at migrant stations, allow for studying the use and evolution of border-crossing practices over the years. Analyzing the "use" of these bottles highlights patterns reflecting migrants' suffering and experiences, providing valuable insights into the historical and contemporary narratives of migration.

As we can see, water bottles not only fulfill practical functions but are also intrinsically linked to migrants' emotional narratives and the changes they provoke in their behaviors and surroundings. This multifaceted understanding is crucial for design scholars aiming to create culturally resonant and impactful designs.

Co-Creative Workshops

Having established criteria, we needed to design a way to bring all interested participants together for collaboration. We decided that remote co-creation workshops were the most cost-effective method. Utilizing platforms like MIRO and Zoom, these workshops effectively united diverse stakeholders to align criteria, workflows, and quality standards in archaeological analysis. They offered increased flexibility, reduced costs, and high levels of engagement and interactivity (A. Boone et al., 2023).

We designed the co-creative activities in two workshops. The first workshop focused on brainstorming, where participants identified artifacts in their localities related to migrants. Early brainstorming sessions are valuable for initiating archaeological research, especially involving many participants (Runa M. Korde & P. Paulus, 2017; T. Connolly et al., 1993). Each participant then used MIRO boards to analyze the artifacts, focusing on fabrication and use, archaeological relevance, emotional impact, and their role as agents of behavioral change. The session concluded with presentations and feedback from the group.

Following the brainstorming session, participants conducted self-managed research using ethnographic interviews, news articles, and academic papers to validate their ideas. Integrating evidence from these sources is essential for generating comprehensive insights. Academic papers provide rigorous, peer-reviewed data; news articles offer timely and broad coverage; and ethnographic interviews deliver deep, contextual understanding. By combining these sources, researchers can achieve a more balanced and thorough perspective, enhancing the reliability and depth of their findings (Michael K. Martin et al., 2013; Simon Cottle, 2007). This validation process took about two weeks. The second workshop was then held to present the results and select the most exciting artifacts identified by participants. Invitations to the online co-creative workshops were distributed through the design department chairs in each region, resulting in about 15 participants.

One challenge we faced was that some participants needed help understanding the importance of the constraints of the criteria, often disregarding the manufacturing

criterion and bringing artifacts that were more anecdotal than empirical. These anecdotal artifacts were not selected as participants could not find further evidence of their importance. Another challenge was commitment. Some participants who attended the first session did not participate in the second one; if they did, they needed to work more on validating their findings. While commitment issues may go beyond our methodology, group research activities must combine group and individual participation and validate findings through ethnographic research, academic papers, or news articles. Nevertheless, after this exercise, we collected many artifacts that provided valuable insights into the migrant situation in Mexico.

The Exhibition

The objects selected for the Tijuana Design Week 2024 were clustered for the exhibition curatorship according to 5 macro areas, representative of the changes in behavior that occurred at the company, migrant, user, and designer levels (figure 1).

Figure 1. Exhibition Arqueología en Tránsito at CECUT, Tijuana, May 2024

Figure 2. Exhibition Arqueología en Tránsito at CECUT, Tijuana, May 2024

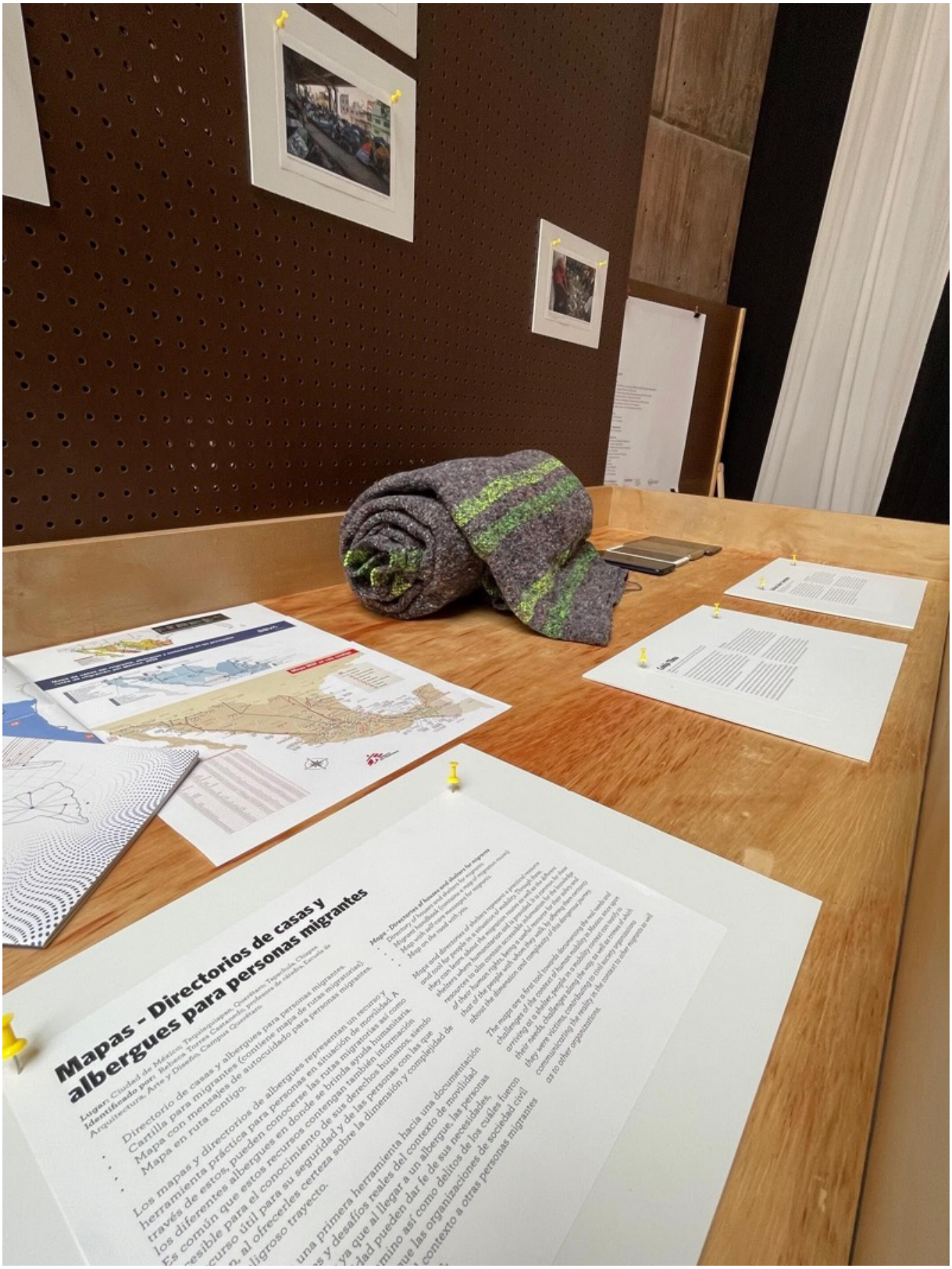

Figure 3. Exhibition Arqueología en Tránsito at CECUT, Tijuana, May 2024

Figure 4. Exhibition Arqueología en Tránsito at CECUT, Tijuana, May 2024

Figure 5. Exhibition Arqueología en Tránsito at CECUT, Tijuana, May 2024

Figure 6. Exhibition Arqueología en Tránsito at CECUT, Tijuana, May 2024

1) The first section is **"Tools"**. The tools migrants use are vital to their journey toward the border area. These tools include a wide range of resources and equipment that enable them to overcome obstacles and navigate unknown territories safely. Among them, we find ropes, which serve as anchors and support while crossing rugged terrains, ensuring a safer passage. Colored bracelets identify migrants, encoding important information such as their place of origin, health status, and those who have paid a fee to cross. Modes of transportation, such as trains, buses, planes, and trucks, are another crucial element, allowing migrants to cover long distances efficiently and economically. Shoes are a fundamental item, often overlooked but extremely important, as they provide protection and support during long walks on variable terrains, including paved roads, rugged trails, or arid deserts. The objects included here are as follows:

Polypropylene Hollow Braided Rope:

The rope is a historical object whose use has persisted across various cultures since prehistoric times. It is an instrument employed in many fields, including construction, navigation, sports, and recreation. In the absence of safe mobility options, undocumented migrants seek irregular migration routes to reach U.S. territory. Often, these routes are well-known by smuggling groups, coyotes, or organized crime bands, who, in exchange for large sums of money, promise to help migrants cross through "weak" points of the border with less surveillance or seemingly lower risk. However, any situation endangers their integrity. The Mexico-U.S. border has become the "most dangerous" land migration route in the world, according to the United Nations (UN), with a significant number of deaths due to drowning. Ropes have become a commonly used tool among these smuggling groups, who use them as a safety measure to face the currents of the Rio Grande and to help groups of migrants cross into U.S. territory.

Location: Piedras Negras and Ciudad Juarez.
Identified by: Zara Alexandra González Aguirre, Director of ESC Entry and Director of the LDI Program, Campus León.

Camouflaged Shoes

The shoes worn by migrants along their journey between Mexico and the United States are emblematic of the migration experience, representing one of this journey's most significant and symbolic objects. These shoes can be considered part of the "tools" category for migrants, playing an instrumental and functional role in the migration process and being indispensable for reaching the desired destination.
The footprints left on the soles and the evident wear are tangible testimony of the challenges, efforts, and sufferings people face during their journey. These marks not only tell individual stories but also represent a tangible symbol of the collective struggles

and shared experiences of migrants on their path to a new life. Some models of footwear used by migrants are modified to minimize the footprint left on the ground during their journey. These shoes are characterized by having additional layers of material, such as carpet or other soft fabrics, applied underneath the sole. This measure plays a crucial role in optimizing the effectiveness of such footwear in masking footprints. In the desert context, where even a minimal footprint can attract the attention of authorities or individuals monitoring the border, these additional layers can enable a more discreet crossing and avoid detection.

Location: Sonoran Desert.
Identified by: Pier Paolo Peruccio, Visiting Professor at the School of Architecture, Art, and Design, Campus Mexico City.

Bracelets

Plastic wristbands commonly used for identification and control at events, concerts, and hospitals emerge in the migration context as a perverse strategy to mark and categorize people who, unfortunately, traverse territories governed by cartels. These bracelets, often brightly colored and inscribed with the words “deliveries” and “arrivals,” indicate that the wearer has paid their “ticket” to access areas controlled by coyotes and clandestine networks, allowing them to continue their journey. For migrants, they represent an “amulet” or “code” that provides some security against robbery, kidnapping, or even death. Each bracelet carries an emotional and significant information load: it reveals personal stories names, has been in contact with the wearer’s skin, indicates how much they paid and consequently their status, where they have walked, and who the traffickers involved are. The cost of these “protection” bracelets ranges from 300 to 700 dollars, a sum that goes directly into the pockets of the cartels that plan these operations. These sophisticated and structured criminal organizations have created a “business model” that ruthlessly profits from the dignity of vulnerable human beings desperately seeking a better life.

Location: Banks of the Rio Grande, U.S.-Mexico border.
Identified by: Edgar Ludert, Regional Director of Art and Design, Campus Sonora Norte.

2) The second area of investigation is **“Evolving Needs.”** The “Evolving Needs” section aims to highlight the ongoing changes in the profile of immigrants. Until about ten years ago, the migration flow across the United States-Mexico border was mainly composed of young single men from rural areas, especially from Mexico. The migration landscape has changed considerably: families, often with children, are the primary migrants crossing the border. Even the objects left behind or forgotten by migrants reflect this new identity: alongside backpacks and caps, we now see baby slings for carrying infants during the journey, document holders for the family, or simply stuffed animals. These

are now the essential accessories of the journey. Here we have the following items selected for the exhibition:

Fular

The northern regions of Central America, Mexico, Haiti, and Venezuela host one of the largest and most complex child migrant crises in the world. Currently, the largest group of child and adolescent migrants consists of those under 11 years old, representing up to 91% of displaced children. Some flee violence, political persecution, and extreme poverty, compounded by political conflicts, climatic phenomena, and the chronic dysfunction of state institutions. Others leave accompanied by their parents seeking more significant opportunities and a better future for their children or wanting to reunite with family abroad. Additionally, it is essential to note that many women in transit give birth along the way, although there are no exact figures. The physical risks along these irregular routes are innumerable, especially for children. Parents traveling with their infants use the full as a means of transportation to provide warmth and containment and ensure infants' care and integrity in migration situations. "This year in Latin America and the Caribbean, a record number of children in transit on the main migration routes has been reached. Even more worrying is that the majority group of child migrants is made up of those under 11 years old," said Garry Conille, Regional Director of UNICEF for Latin America and the Caribbean.

Location: Migrant Caravans from Honduras, Haiti, Guatemala, and Mexico.
Identified by: Zara Alexandra González Aguirre, Director of ESC Entry and Director of the LDI Program, Campus León.

Document Holder Bag

Identity and health documents, along with family photographs, are more than just papers for migrants; they are symbols of resistance and humanity in contexts where fundamental rights are denied. These artifacts carry the narratives of their lives, roots, and hopes, revealing stories of struggle and connection with often distant loved ones. Each document affirms identity and existence, demanding recognition and respect from the institutions responsible for protecting migrants. These emotional objects act as tools of modern archaeology, allowing the discovery and retelling of hidden narratives of resistance through the ages. Essentially, documents and photographs are living testimonies of human dignity, challenging perceptions and social dynamics and fostering change toward greater understanding and protection of migrants in our contemporary world.

Location: Querétaro, Querétaro.
Identified by: Rebeca Torres Castañedo, Professor at the School of Architecture, Art, and Design, Campus Querétaro.

Plush Toy

Historically, plush toys have been companions for children in various contexts; in the case of migration, they become valuable companions. They vary depending on personal taste and are mostly simple and industrially manufactured, although some can be crafted or handmade by their families. Their primary purpose is play, but they often become more than that. They should be light, soft, and preferably small to be carried throughout the journey, as there is only space for the essentials during the trip. In many cases, they are also used as pillows and comfort objects, showing a strong connection between the children and their families during migration. These objects are laden with stories and emotions that remind children they are loved. They are gifts from parents or grandparents that become friends and loyal companions, even helping children feel brave and protected when separated from their families. In other cases, plush toys are given to children in migrant shelters or refugee centers to lighten the emotional burden of the journey. They have also been used in campaigns and protests, symbolizing the innocence and rights stripped from children when separated from their families.

Plush toys represent the significant change in migration trends. Initially, migrants were single men who had left their families searching for a better future for them. Later, couples migrated, and then pregnant women migrated. Currently, whole families are migrating with small children.

Location: Monterrey, Nuevo León.
Identified by: Griselda Esthela Oyervides Ramírez, Assistant Professor, Department of Design, Tec de Monterrey, Campus Monterrey.

3) The third is the **"Functional"** section. It focuses on practical and functional tools that facilitate migrants' journeys in all aspects. Among these, the cell phone stands out as an essential travel companion for migrants: the device offers a wide range of crucial functionalities during the journey, enabling quick and reliable communications with family and friends and access to vital information such as maps and other services. In addition to digital maps, migrants also carry physical maps, which are more reliable because they are consistently functional, independent of phone infrastructure, and provide valuable information about essential services, such as the location of shelters, food and water distribution points, and safe resting areas. Blankets and other accessories to protect against cold or adverse weather conditions are also essential for facing problematic conditions along the migration route. These devices can make the difference between the success and failure of a journey, especially considering the long distances and environmental challenges that migrants must face on their way. The following items were selected in this section:

Maps - Directories of Migrant Houses and Shelters

The directories of houses and shelters for migrants represent a practical resource and tool for people in mobility situations. Through these, migrants can learn about migratory routes and the various shelters providing humanitarian aid. It is common for these resources also to contain accessible information about their human rights, serving as a valuable resource for their safety and the people they travel with, offering them certainty about the dimension and complexity of this dangerous journey. Maps are a primary tool for documenting the real needs and challenges of the human mobility context in Mexico; upon reaching a shelter, people in mobility contexts can attest to their needs, challenges along the way, and crimes they were victims of. These maps contribute to civil society organizations communicating the reality of the context to other migrants and organizations.

Material and Manufacturing Process: Digital Printing on Couché Paper, Bond, or similar.
Location: Mexico City, Mexico; Tequisquiapan, Querétaro; Tapachula, Chiapas (most houses/ shelters have this material).
Identified by: Rebeca Torres Castanedo, Professor at the School of Architecture, Art, and Design, Campus Querétaro.

Tilma Blanket

In various shelters in Mexico City and other regions of the country, blankets are widely distributed to migrants, becoming an essential and common item among them. This textile, characterized by its softness to the touch, offers refuge against the cold, providing a sense of warmth and tranquility to those who often face adverse conditions. The design of these blankets generally features a grid graphic in various scales and colors, adding an element of visual diversity that breaks the monotony and reflects the cultural variety of the users. Besides serving as a personal cover, these textiles have a multifunctional use within the shelters; for example, they are used as insulators in tents, offering additional protection against the cold ground. This versatile use of blankets not only improves the temporary living conditions of migrants but also provides small yet significant comfort in their arduous journey, demonstrating how a simple object can profoundly impact the daily lives of people in vulnerable situations.

Material and Manufacturing Process:
30% Cotton, 30% Polyester, 30% Acrylic, 10% Various.
Location: Migrant camps in major city centers (Mexico City).
Identified by: Gerardo Sandoval Osio, Full Professor, Campus Mexico City.

Cell Phone / Smartphone

Cell phones have transformed the way migrants travel. Thanks to technology, the migratory journey seems more manageable and more achievable. Digital maps and real-time location allow them to find directions and follow routes without getting lost. Instant messaging and internet access provide communication channels with smugglers and coyotes who offer their services for border crossing through social media posts, somewhat professionalizing these human trafficking services. On the other hand, cell phones allow migrants to keep in touch with their families occasionally and have photographs of their loved ones. These objects strongly speak of human connections; a cell phone in today's culture is an extension of the person, carrying significant information and the intimacies and stories of the owner. In this sense, it functions as a double-edged sword: providing security through contact with loved ones while increasing the chances of being located, leaving a trace of their crime when crossing the border.

Material and Manufacturing Process:
Cell phones are manufactured through various industrial processes and assembled in manufacturing cells. Regardless of the brand, modern cell phones are made from a wide variety of materials, such as aluminum, copper, plastic, cobalt, tungsten, silver, neodymium, gold, indium, and palladium.

Location: Monterrey, NL.
Identified by: Griselda Esthela Oyervides Ramírez, Assistant Professor, Department of Design, Tec de Monterrey, Campus Monterrey.

4) The **"Emotional"** section delves into the most emotional dimension of the migratory journey. It examines how particular personal objects gain significant importance on the emotional level for migrants. These objects range from family photographs to religious items such as the Bible or a rosary and even include identity objects like the flag of the country of origin or a hat of a specific color. The portfolio stands out among this range of objects, undergoing a transformation in its function during the journey. From simply a container for money, it becomes an organizer for images or other elements of symbolic personal value. The objects included here are as follows:

Phillies Cap

In daily life, caps are helpful for outdoor activities. In the migrant context, caps offer protection against the sun and rain and serve as a representative object for a person in a state of mobility. White caps are the most characteristic because their color helps reflect sunlight and prevents the head's temperature from rising. Additionally, this color symbolizes peaceful transit; in contrast, dark or black caps are associated with criminal groups. Strong bonds form between groups traveling together throughout the journey. They rest in the same shelters, eat together, take care of each other, and often

only cross once everyone is ready. In the case of the Phillies, the cap goes beyond its purpose of sun protection; it symbolizes the union of a group in a state of mobility. Additionally, it serves as a place to write down phone numbers or other personal information so that in case of death, this information can help identify the body and locate their relatives. “It was more of a gift to distinguish ourselves from each other,” adds Elmer Josué Rivera, a native of Santa Bárbara. “They saw that we got along very well and gave them to us.”

Material and Manufacturing Process: Personal accessories made from common materials such as synthetic fabrics, cotton, polyester, plastic, and embroidered brands that are predominant in our visual culture. Their practical and functional purpose is mainly to protect the head from the sun, offer shade to the eyes, and protect the face from rain and sweat. They can also be used as a form of personal expression or style. Manufacturing a cap involves several steps, including material selection, cutting, assembling, sewing, and finishing.
Location: This object was identified in a migrant caravan from Honduras to Mexico. Among the sea of people, 18 men and 2 women stand out, all wearing the same cap: the Phillies of Philadelphia. These are the Phillies of Honduras, or the Red Cap group, friends who met during the journey and now want to arrive and live together in the United States. (https://www.plazapublica.com.gt/content/personajes-de-la-caravana-migrante-los-phillies-de-honduras)

Identified by: Zara Alexandra González Aguirre, Director of ESC Entry and Director of the LDI Program, Campus León.

Wallet

Wallets, commonly used by migrants, function as essential objects for storing money and important documents such as IDs and photographs, prayers, and personal mementos. These objects are foldable and have multiple compartments that facilitate access and organization of their contents, making them portable guardians of personal stories and symbolic values. In the migratory context, wallets acquire a more profound meaning by transforming into “containers” of migrants’ identity and memory. These objects not only hold items of economic value but also carry significant emotional weight, being repositories of the ties and memories of loved ones left behind. The variety in their designs, from dark leathers to colorful embroidered fabrics, reflects the diversity of their owners and their cultures, contrasting visibly with the personal images and saint cards they protect, evidencing their faith and hopes. Laura M. Holson relates a relevant anecdote in The New York Times, where Tom Kiefer, a janitor at the Customs and Border Protection Office in Arizona, discovered numerous discarded wallets in 2012, still with intact IDs and credit cards. “It was so cruel. They were safe with me, but it didn’t seem right that a janitor could find these things. They should be secure,” Kiefer commented. This story highlights the vulnerability of migrants and the importance of these objects as links to their identity and dignity.

Material and Manufacturing Process:
Wallets, traditionally made from tanned leather in black or brown colors, have evolved in design since the late 20th century, diversifying into materials such as PVC and embroidered fabric and enriched with a variety of colors and designs since the 1980s, following the introduction of Velcro closures in the 1970s.
Location: The Border Patrol finds these items as confiscated items and takes them to the Customs and Border Protection Office, where they are cataloged, stored, and discarded.
Identified and Reconstructed by:
Luis Arturo Gil Islas, M.A. Professor and Coordinator of Transversal Concentration in Design, Innovation, and Technological Entrepreneurship, Campus Estado de México.

Scapular

Scapulars, more than simple garments or accessories, are symbols deeply rooted in Catholic religious tradition. Initially, scapulars manifested devotion, representing the yoke of Christ, and were worn by monks and nuns as part of their religious habit. However, in the hands of Norma, a Honduran migrant sheltered in an association in Chiapas, they acquire a new dimension of meaning and transformation in the migration context. These scapulars, acquired by Norma and her daughter before embarking on their dangerous journey to the United States, represent their faith and their search for divine protection in a journey filled with uncertainty and danger. As they face the journey's challenges, the scapulars become emotional anchors, reminding them of their connection to faith and their desire for safety for themselves and their daughter. As they progress, the scapulars acquire new layers of meaning, transforming from simple devotional objects into potent symbols of hope and resilience amid adversity. They are silent witnesses to their determination and maternal love, providing comfort and strength in the most challenging moments of the journey. In this sense, Norma's scapulars illustrate how traditional religious objects can adapt and acquire new meanings in the migration context, serving as sources of comfort, protection, and hope for those facing extraordinary challenges in their quest for a better life.

Location: Chiapas, at the Hospitality and Solidarity A.C. shelter.
Identified by: Zita Carolina González Guzmán, Full-Time Professor, Campus Guadalajara.

5) Finally, the **"kit"** section represents a set of essential food products, ranging from tortillas to rice beans and nutritional bars and water, designed to face the migratory journey. These kits are primarily conceived and produced for humanitarian purposes by people who care for migrants, such as "Las Patronas," and by humanitarian associations and organizations. Besides food, the kit includes sanitary towels, specific medications for menstrual pain, and personal hygiene products. These elements are a significant indicator of the evolving migrant profile, with increasing attention to the female gender. Including specific products for female needs indicates greater awareness and sensitivity

to the challenges and requirements of women migrants. This highlights a shift in how society and humanitarian organizations address and understand the complexities of the migratory phenomenon, recognizing the importance of considering gender as a significant factor in providing assistance and support to migrants during their journey. The items shown in this section are:

Migrant Kit

The migrant kit includes wet wipes, a roll-on deodorant, a razor, a 500 ml water bottle, a small sunscreen, a sizeable black-handled bag, a small toy if the recipient is a child, and a map of migrant houses, shelters, and food kitchens along the main migration routes in Mexico. To avoid theft, these items are provided inside a conventional, unmarked plastic bag to migrants passing through Casa del Migrante Galilea in León, Gto. Migrant kits provide people in mobility situations with essential items to meet their basic needs, even for a short time. Addressing needs such as food, hygiene, and medical care helps preserve people's dignity regarding mobility, including a toy for children that explicitly targets their emotional well-being and helps mitigate the psychological impact of migration. The specific contents of migrant kits can vary depending on the context, migration routes, and the particular needs of people in mobility situations.

Location: Human Mobility Center Casa Del Migrante Galilea, A.C. in León, Gto.

Identified by: Zara Alexandra González Aguirre, Director of ESC Entry and Director of the LDI Program, Campus León.

Food and Water Bags for Direct Aid on Train Tracks

Thousands of people in human mobility contexts use freight train cars to cross Mexico. Known as "La Bestia" or "The Death Train," migrants are exposed to high temperatures, without water or food reserves, organized crime, and security guards patrolling the trains. The train, connected to Mexico's railway network, often passes through different communities where many residents, primarily laypeople, live their faith radically by providing food, water, and personal hygiene items to migrants traveling on the freight train.

In Tequisquiapan, Querétaro, a family-formed civil organization, has dedicated over 20 years to assisting people in mobility contexts. Each day, they provide direct and immediate humanitarian aid to an average of 400 migrants. This organization is mainly sustained by donations and is known among migrants for the bread and cakes often included in the food bags. It is common to hear migrants shouting, "Thank you, mother," as the train passes.

Location: Estancia del Migrante González y Martínez, A.C. Tequisquiapan, Querétaro.
Identified by: Rebeca Torres Castanedo, Professor at the School of Architecture, Art, and Design, Campus Querétaro.

UNHCR Kit

Menstruation during mobility poses a significant challenge for women and adolescents. UNHCR, known for its work with asylum seekers and refugees, provides self-care kits that are not conditional on refugee status. These kits include essential items such as sanitary pads, laundry soap, diapers, and multipurpose soap, which are crucial for personal hygiene and well-being. In Mexico, some civil organizations complement these kits with emergency pills, addressing the gender-based violence faced by women in mobility. During an interview, the experience of a teenager who had her first menstruation in transit was highlighted. Access to this kit allowed her mother to explain the changes in her body, making the experience less traumatic. This support addresses immediate needs and dignifies women and girls in migration contexts, recognizing their specific challenges from a gender perspective. The kits, funded by civil society, not only provide essential items such as food and water but also emphasize the complexity of gender needs in migration and humanitarian aid efforts, underscoring the importance of hygiene and ongoing care in the lives of migrant women.

Location: Estancia del Migrante González y Martínez, A.C. Tequisquiapan, Querétaro.
Identified by: Rebeca Torres Castanedo, Professor at the School of Architecture, Art, and Design, Campus Querétaro.

Conclusion:

"Arqueología en Tránsito" provides a window into the human stories behind each artifact, inviting deep reflection on migration and its inherent challenges . Through these objects, visitors gain insights into the complexities of migratory experiences and the indomitable hope of those seeking new lives far from home. The exhibition underscores the transformative power of design and research in fostering empathy and awareness about global societal challenges. From an academic perspective, this project illustrates that archaeological analysis of objects can significantly contribute to the design process by providing a foresight into the potential impacts of functional items. For designers, it is crucial to consider not only usability but also the emotional resonance of a product to enhance the overall user experience (Demir et al., 2009).

There are more than 80 borders worldwide, most erected in the past two decades. Despite this, increased barriers correlate with heightened migration and conflict. The exhibited objects, representing human suffering and resilience, underscore the deep-rooted human instinct for creating boundaries, tracing back to Jericho's earliest known barriers from 12,000 years ago. Barrier, wall, fence, and fortification indicate a physical infrastructure or natural element (like the Mediterranean) separating two or more sides. They can all evoke a range of ideas, including separation and terror. After the terrorist attacks of 11 September 2001,

and especially in the last two to three years, they seem to be playing a central role again around the world.

The theme of the exhibition is, therefore, very relevant. Once silent witnesses, objects speak to us of human suffering and become protagonists of a diverse migration narrative. Moreover, the subject and research methodology can be easily replicated in other geographical contexts with partners such as local universities and non-profit organizations working with migrants. Based on the behavioral changes provoked by objects, we envision replicating this investigation methodology in locations currently central to migration flows, such as southern Italy, a primary destination for migrants from Africa heading to northern Europe. The scalability of the research and the potential design of an exhibition to present the findings will need to be evaluated on a case-by-case basis with local partners. Furthermore, this approach underscores the research's universal relevance and adaptability, making it a powerful tool for understanding migration dynamics in different regions. By collaborating with local entities, we can ensure that the exhibitions resonate with each area's specific experiences and contexts, thereby enriching the overall narrative and impact. This strategy not only enhances our comprehension of migration but also fosters a more nuanced and empathetic dialogue about the experiences of migrants worldwide.

1 The exhibition was part of Tijuana Design Week which was held from the 1st to the 5th of May at CECUT in the City of Tijuana. Attended by design professionals and students, primarily from the San Diego-Tijuana region and bilingual in Spanish and English, it also attracted design enthusiasts and users from the same region, mainly from the middle class, as well as the general public and casual visitors, including organic visitors to showrooms, tourists, and attendees of CECUT and its surroundings. The event, held in over 40 venues, featured more than 300 designers and drew an estimated 8,000 attendees over the 5 days. This included 3,796 participants via the WHOVA app and approximately 3,400 visitors to showrooms, with 60-100 attendees per day (Tijuana Design Week, 2024). The exhibition also served as a reflective platform to consider contemporary border dynamics. It gained recognition within the local design community and was featured by the San Diego Local Press (Aere, 2024). Furthermore, the exhibition was opened in San Diego in September 2024 as part of San Diego Design Week, following an invitation from the board of the World Design Capital. Additionally, the School of Architecture, Art and Design at Tec de Monterrey is working on book on the exhibition, which will include a catalogue of the objects and detail the research methodology employed.

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EXPLORING THE CONCEPT OF MULTIESPECIES DESIGN: PERSPECTIVES FROM MEXICO.

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ABSTRACT | Since the 1970s, a network of disciplines has emerged to address the environmental crisis, starting with biological and atmospheric sciences and expanding to include international environmental law, engineering, and design. Our understanding has evolved from the human environment to sustainability, and now concepts like biophilia, biomimicry, regeneration, circular economy, and life-centered design are prominent. Intersections between ethology, epistemology, philosophy of mind, and posthuman studies are offering new ways to consider worlds beyond humanity. The interest in multispecies or more-than-human design stems from the political nature of design, which challenges our behavior towards other life forms and our planet.

Experts argue that the current crisis demands a new language to reveal systemic frictions and reassemble our understanding of the world beyond cyborgs and hybrid networks. This era of kinship and hyper intelligence involves reinventing relationships and meanings with non-human intelligence, present in our daily lives with agency and complexity. This shift towards a planetary ethic seeks to foster deep empathic relationships with other species and address the multicrisis we face.

Ecophilosophical and ecopedagogical principles are being incorporated into education to build new forms of human action and mutualism. This study aims to historically review and integrate paradigms of life-centered, non-human, and multispecies design into designer training. The research focuses on Mexico, highlighting environmental and social degradation, threats to ecological balance, and the potential of multispecies design to offer new thinking and practices. The final part presents case studies from Mexico, illustrating how multispecies design can drive innovative solutions.

KEYWORDS | MUTIESPECIES, DESIGN, BIOINFRASTRUCTURE, MEXICO, DESIGN HISTORY

1. Introduction: changing towards the non-human

Understanding ecological systems and climate dynamics is now a matter of design (Nardi, 2019). But it was during the 1970s that several disciplines emerged to confront the environmental crisis. First were the biological and atmospheric sciences that influenced international environmental laws (Botkin & Keller, 1999; Gunningham, 2009; Krupp & Wann, 1994), that addressed transboundary pollution and protection of global commons (Bollier, 2013). The significant agreements, mostly during the 1980s, about our commons such as the Our common future report (Brundtland, 1987), Kyoto Protocol (Böhringer, 2003) and the Paris Agreement (Seo, 2017) placed sustainable development as a priority. Engineering disciplines adapted to these challenges by focusing on sustainable development efforts and green technologies, creating innovations in renewable energy, waste management, and sustainable infrastructure (Chan et al., 2022) which in most cases were anthropocentric.

Design disciplines began to integrate principles of ecology and sustainability, leading to the emergence of ecological design and sustainable design (Anker, 2010; Birkeland, 2002; Chapman & Gant, 2007; Egenhoefer, 2017) on the 1990s, which helped to minimize environmental impact through thoughtful material selection, energy efficiency, and lifecycle analysis (Andersen et al., 2022; Braungart & McDonough, 2009; Koltun, 2010) transforming industry and consumption at the beginning of this millennium.

Nowadays our understanding of how we relate to our environment places us to shift the sustainability paradigm (Boehnert, 2017). Today, at the design academy, we talk about biophilia (Rosley et al., 2014), biomimicry (Kellert, 2016), regeneration (Wahl, 2016), circular economy (Lofthouse & Prendeville, 2018), and very recently life-centered design (Borthwick et al., 2022) , non- human-centered design (Ooms et al., 2022), and ultimately multispecies design (Gionata Gatto & John R. McCardle, 2019). These terminologies are manifesting new intersections between ethology (Beaujouan et al., 2021), epistemology (Price & Chao, 2023) and post-

humanities (Forlano, 2017; Nicenboim et al., 2023) offering original arguments to think about worlds beyond humanity. Such transdisciplinary phenomenon suggests that design studies are approaching a new era.

Hence, this research is raising a question from the design academy and our current contemporary society: Why are we interested in understanding the conceptual genealogy of multispecies or more- than-human design? If every design seeks to solve or question a situation, problem or conflict, which is always political or challenges our conception of reality. Are we humans capable of changing our behavior in relation to other life forms? Why design, as discipline, is now making agency towards these life-meaning inflections?

Experts affirm that the current crisis needs a new language (Stibbe, 2020), looking to uncover a system that is constantly creating frictions and seeking to disassemble and reassemble the facts of the world (Ekomadyo & Yuliar, 2015; Latour, 2009), beyond cyborgs and hybrid networks (Fuller, 2021; Wilson, 2009).

This new era of kinship in which we are reinventing our relationships and meanings in a world of a more-than-human intelligence (Haraway, 2016; Tsing, 2021) is present in our everyday life with all their agency, complexity and knowledge. Our time of hyper intelligence is also called an era of enlivenment (Weber, 2019), novacene (Lovelock, 2019) or symbiocene (Albrecht, 2019) which denotes a change and moral behaviors towards a planetary ethic. Through such notions we do not seek to decentralize design for our human centredness or sensitivity to be humane but to expand the capacity of the designer; and along with other disciplines such as anthropology or biology to promote new capabilities, expand our collective intelligence towards the non-human.

It is an urgent need to create deep empathic relationships with other species in our built environment to face the multicrisis (Nathwani et al., 2021; Wijkman & Rockström, 2012) we are living in. To solve this several ecophilosophical and ecopedagogical precepts have already been incorporated into new educational schemes to build new forms of human action and mutualism. Such as the ecoliteracy movement (Kahn, 2010; Stone, 2017) or deep ecology (Anderson & Guyas, 2012; S. Harding, 2009; Sessions, 1995) where in some cases triggered the conformation of new schools, such as Schumacher College (S. Harding, 2011) or new educational programmes like Permaculture courses (Cassel & Cousineau, 2018; Zimmer, 2016) This brief 'localized' study aims to develop an understanding of these notions and what are the efforts we are making as academics. The following section (2) refers to the state of the art and which are the genealogies that place us on this kind of multispecies studies. Section 3 present Mexico as case study and Section 4. presents examples of what we can call bioinfrastructures and affordances. Our study is part of the Advanced Design Processes for Sustainable Transformation research group.

2. State-of-the-Art and Genealogy

2.1 Historically review

The state of the art of multispecies studies is at the same time very old, and very young and innovative. All human cultures have their own philosophies and cosmovisions about nature and non- human intelligences and interactions with them. In the Western tradition probably the first thinker on these issues was Aristotle, who was Plato's student but eventually departed from his teacher in important respects, because investigated areas of philosophy and fields of science that Plato did not seriously consider. Aristotle was a sharp observer of nature, and developed an early theory of biology, centered on his thoughts about change and form. His theory is very comprehensive, it covers everything from metabolism to information processing and inheritance. He wrote several books on biology, and they are about a quarter of his writing that exist today. They are the *History of Animals, Generation of Animals, Movement of Animals, Progression of Animals, Parts of Animals, and On the Soul. His student, Theophrastus, wrote Enquiry into Plants (Bos, 2010)*. The biology works of Aristotle were influential well into the beginning of modernity, when scientists like Galileo and William Harvey rejected his errors, but his observations about marine biology are well respected. He was the first who tried to explain the color changes in the octopus.

Multispecies design is an emergent field of study, with different points of origin, from biology, but also from anthropology, history, epistemology, ecology, geology and other disciplines. Design has been changing rapidly in the last century. Its name has changed too, from being industrial design to ecological and sustainable design, and more recently to biodesign and regenerative and multispecies design. More than trying to define each concept, we will present some works that we think have enabled this field to emerge, from the ideas of different sciences and disciplines.

Epistemology:

· Bogost, Ian. (2012) Alien phenomenology. University of Minnesota Press, Minneapolis. He explains very clearly how humankind is losing the center of philosophical thinking, develops an object-oriented ontology where everything can communicate their existence.

· Grusin, Richard. (2015) The Nonhuman Turn. University of Minnesota Press, Minneapolis. This is the first compilation of a wide array of current critical, theoretical, and philosophical approaches under the concept of the non-human turn. Non-human is understood in a variety of ways: in terms of animals, affectivity, bodies, materiality, technologies, and organic and geophysical systems.

· Other minds, by Peter Godfrey-Smith (2016). Animal intelligence studies have focused on mammals and birds, but late research has found a very high intelligence between cephalopods, commonly known as octopus. The author says that they are

the closets we will come to meet intelligent aliens on Earth. What we can learn from this is the enquiry into his work.

· Enfield, N.J.; Kockelman, Paul. (2017). Distributed agency. Oxford University Press, Nueva York. Presents an interdisciplinary exploration about the consequences and possibilities that opens a distributed agency in many systems.

· Ways of being. Animals, plants, machines: the search for planetary intelligence, by James Bridle (2022). What does it mean to be intelligent? Evidence grows that it is not only human property. These other intelligent systems (animals, plants, machines) are revealing their agency and how to think in an intelligent non-human world.

Social sciences and humanities:

· A green history of the world, by Clive Ponting (1991), presents a panoramic view of human history and environmental change.

· Tsing, Anna (2015). The mushroom at the end of the world. Princeton University Press. This already classic work shares multispecies ethnography, botanic studies to present a Japanese mushroom in a very different way, showing all the connections it holds.

· Staying with the trouble: making kin in the Chthulucene, by Donna Haraway (2016). The author proposes a feminist multispecies theory as response to the environmental crisis. She escapes from the idea of Anthropocene, to think of new more humbler ways to share the planet with other species.

· Art of living on a damaged planet, by Anna Tsing et al (2017). A compilation of different authors that explore the relationship between environmental degradation, anthropology and art.

Design, history and territory:

· Loren, BK. (2013). Animal, mineral, radical. Essays on wildlife, family and food. Counterpoint, Berkeley. Personal essays about placemaking, encounters with other intelligences and what does consciousness means.

· Brown, Frederick. (2016). The city is more than human. An animal history of Seattle. University of Washington Press. Seattle has changed from the 1850s to the present, from its foundation amid existing Indigenous cultures, to late 19th century livestock friendly to its pet-friendly modern existence. Animals have changed in categories and places, as a way of asserting power over them, and other people.

· Kirchberger, Ulrike; Bennett, Brett (2020). Environments of Empire. Networks and agents of ecological change. The University of North Carolina Press. The age of European high imperialism was one full of movement of plants and animals.

· Lutz, Damien. (2022) The life-centered design guide. And the non-human persona guide. (2023). Two practical guides from a pioneer designer about how to think design with and about non-humans.

· Metcalf, Daniel. (2022). Empathic multispecies design – Using empathy to design with animal perspectives in mind. Different approaches to rethink the design practice from animal perspectives. https://danimetcalfe.com/

2.2 A Multispecies Design Genealogy

Throughout history, humans have drawn inspiration from nature, integrating its principles into various forms of design and development. This timeline highlights key moments and movements where bio-inspired design has evolved, from early agriculture to contemporary life-centered design.

· Early Agriculture (c. 10,000 BCE) Sedentary life and trade marked a control mainly over plants. Domestication and fences appeared to be common.

· Ancient civilizations (c. 3000 BCE – 500 CE) Mimesis towards the natural world denoted a desire to express an artistic language in hieroglyphs (Egyptians), dances (Greeks) and architecture (Mayans). Animals and medicinal plants seem to be sacred.

· Middle Ages (500 – 1500). Premises of imitating the invisible. A lot of symbolism and expression of what is thought internally arose in crafts. Humility and simplicity before nature transformed into myths and new beliefs. Understanding the world and the emergence of cities.

· Renaissance (1500-1600s): Imitation of nature became an invention; Art imitates the laws of Nature rather than its appearances. The biomorphic and anatomic studies of Da Vinci (1452- 1519) represent the appreciation of natural forms.

· The enlightenment and Academies of Sciences (1700s). Nature begins to be reasonably verifiable.

· Industrial Revolution (1800s) Humboldt wrote on the harmonic order of the Universe, or “Kosmos,” a concept borrowed from ancient Greek philosophy (Von Humboldt, A., & Bromme, T., 1845) and Haeckel in 1866 coined the term ecology (Haeckel, 1866). At this time other life expressions were looked through the lenses of science but used art as a means for expressing its understanding from western society. Nostalgia for country life, Separation and specialization of disciplines promote Biology and Natural Sciences to catalogue nature.

· Arts and crafts movement (1880- 1920s): Machines diminished artisanal skills, country life and respect for nature and vernacular techniques became a norm.

· Art Nouveau (1890- 1914): Organicism, vegetal forms, and artisanal skills mixed with technologies denoted the appreciation of nature in interiors and architecture.

· Bauhaus (1919-1933) The school’s emphasis on form following function and its interdisciplinary nature can be seen as early precursors to bio-inspired design.

· Agroecology and Conservationism (1928-50) Restoring ecosystems, protecting and preserving natural resources and dynamics created new bioinfrastructures, such as the national parks (Nash, 1967; Wakild, 2015) and new policies for forest and agricultural management. (Besin, 1928).

· Bioinspired technologies (1940-74) The study of capacities of animals and plants to develop new inventions arose. Velcro developed by George de Mestral, (de Mestral, 1954) is a good example.

· Bionics (1950-1970). Term coined by Jack Steele in 1958 (Roth, R.R., 1983). Applications on electronics, the military and aerospace technologies represented the ingenuity of living organisms. Architectural applications also found a biomorphic presence. The works of Otto Schmitt (Barthlott et al., 2016) influenced the term.

· Modernism and Organic Design (1930-1960s) This period saw an increasing appreciation for the efficiency and beauty of natural forms, which influenced design aesthetics and functional principles.

· Gaia Theory and The Operating Manual for Spaceship Earth (1969-1971): Lovelock and Margulis (1972) and Buckminster Fuller (1969) Defined the Earth as a living organism with self- regulatory dynamics influenced ecological thinking. Papanek (1971) placed Design for the Real World and the need for ethical stance towards exploitation of “the environment”.

· Permaculture (1978-present) Observing nature, feedback and self-regulation with plants and animals’ cycles and patterns are included in its principles. Bill Mollison and David Holmgren (1978) still promote this movement.

· Biophilia (1980-present) Term introduced by Eric Fromm during the 1960s (Gunderson,2014) and further developed by biologist Edward Wilson in the 1980s (Wilson. 1990), the concept suggests that humans have an inherent affinity for nature. This idea has influenced architectural and urban design, leading to the incorporation of natural elements into built environments that improve human well-being by fostering connections to the natural world.

· Mexican Organicism (1980-1989). Over this decade a few active designers and architects embraced the crafts and vernacular ways of creating with local resources and the observation of natural landscape. Authors like Hagerman (Martí, 2019), Senosiain(2003) and Porset (Sheppard,2018) were notable.

· Sustainable Design (1985): The aspects of sustainability influenced the incorporation of the “environmental” aspect by integrating economy and society. Caring for Nature and reducing human impact are key.

· Ecological Design (1990s) Ryn and Cowan (1996) argued for a seamless integration of human activities with natural processes to minimize destructive environmental impact.

· Biomimicry (1990s-present) This

movement explicitly focused on studying nature's best ideas and emulating these designs and processes to solve human problems. Biomimicry advocates for sustainable innovation by learning from ecosystems and organisms that have evolved over millions of years. Connie Lange Merrill (The Complete History of Biomimicry (with Examples), n. d.) and Benyus (2002) are the main figures.

· Posthumanism (1990s-present) This movement challenge traditional human-centered (anthropocentric) perspectives, recognizing the value and agency of non-human life forms and entities. Decentering the human influenced a new posture in design disciplines on ethics and agency. Main promoters are Dona Haraway, Ana Tsing and Katerine Hayes.

· Organic Essentialism (2008) Ross Lovegrove (designboom,n.d) as promoter of this concept, recalls the term "organic" in material, form, process, etc., and use only what is needed.

· Bio-Design and biomateriality (2010s-Present) "An emerging and often radical approach to design that draws on biological tenets and even incorporates the use of living materials into structures, objects and tools" (Myers, 2012). Neri Oxman (2020) is one of the greatest exponents.

· Multispecies Design (2015). Multispecies Design is proposed and developed as a theoretical framework for supporting the shift to more biodiverse human and non-human habitats. Metcalfe (2015) published his work from a design perspective.

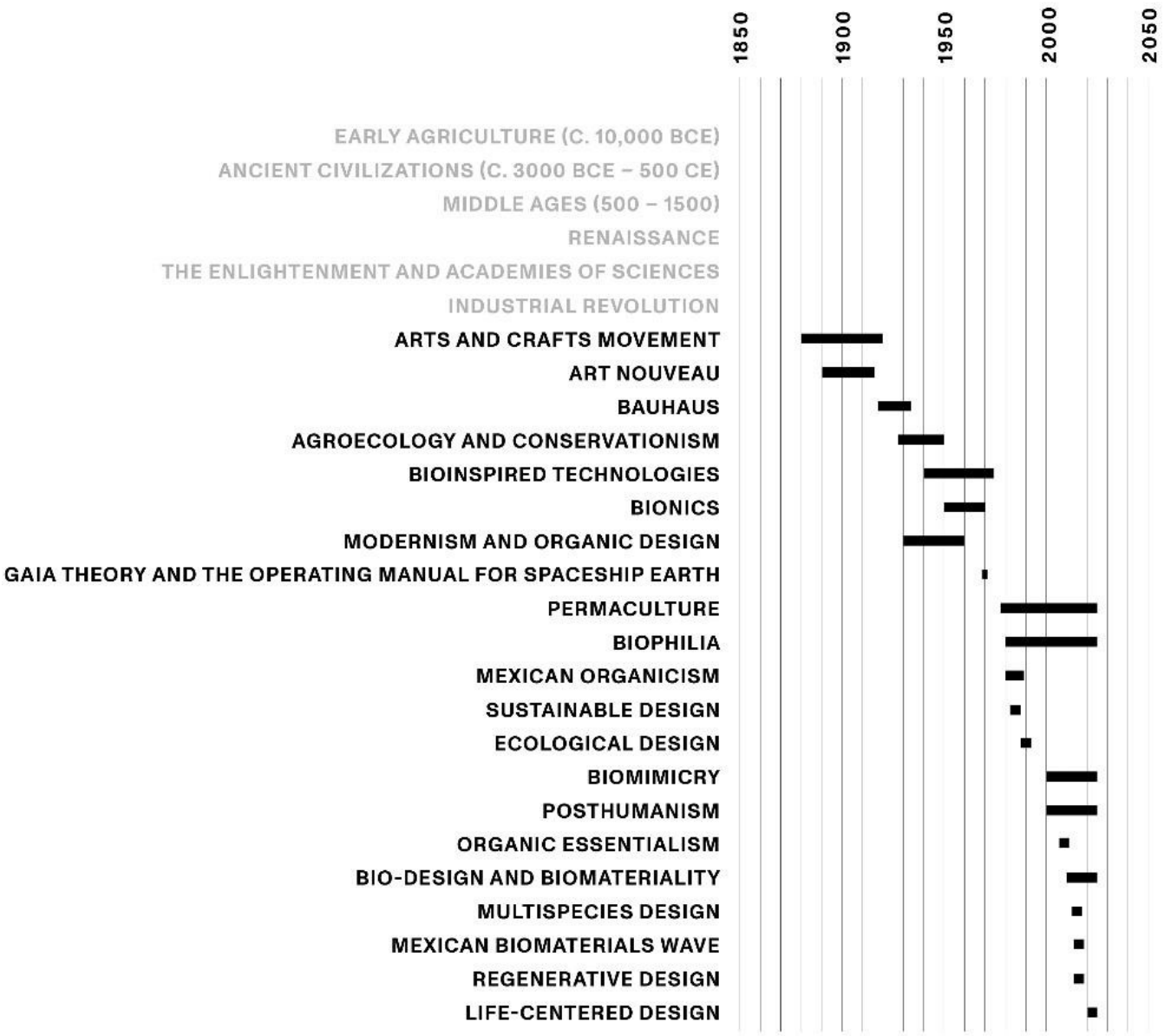
· Mexican Biomaterials wave (2016) Biology Studio (n.d), Polybion(n.d), Radial (n.d) and Fernando Laposse (n.d) epresent the use of vegetal fibers, bacteria and fungi.

· Regenerative Design (2016) Regenerative design goes beyond sustainability to focus on restoring and renewing ecosystems through design. This approach is rooted in ecological principles and aims to create living systems that are resilient, adaptive, and regenerative. Regenesis group (Mang et al., 2016) and Wahl (2016) were the main promoters.

· Life-Centered Design (2020-Present) Recently the importance of shifting human-centred aspects has been explored to a holistic perspective by Spoelstra (2022).

The following figure (See Fig.1) reveals this genealogy.

Figure 1. Genealogy of multispecies design defined as



timeline.

2.3 Integration of paradigms of life-centered design, non-human and multispecies design

In response to the modern capitalist world and its anthropocentric consequences, several alternative ways of thinking from all over the world are appearing that involve the seeking of a greater harmony with nature and minorities. This includes alternative approaches and models for more sustainable-regenerative development, such as degrowth theories, sufficiency, repairing, and sharing (Schranz, 2023).

Recent advancements in natural sciences, moral philosophy, and politics have increasingly questioned the rigid separation between human and non-human life that

underpins modern legal and human rights frameworks. Biologists emphasize the similarities between humans and other species, while moral philosophers delve into the concept of justice for animals. Ecocentric movements further dissolve traditional boundaries between humans and nature, challenging our conventional understanding and advocating for a more inclusive perspective (Rodríguez-Garavito, 2024).

These efforts are introducing transformative concepts to the design discipline. Escobar (2018) promotes a "pluriversal" understanding of life, emphasizing collaborative, sustainable, and indigenous wisdom, technologies, and thought systems that harmonize with nature. Watson's (2019) "Lo-TEK" highlights remarkable projects that intersect with radical indigenism and non-mechanical ecosystems, showcasing innovative solutions found in mountains, forests, deserts, and wetlands. These ideas are reshaping how we approach design by integrating diverse perspectives and ecological considerations.

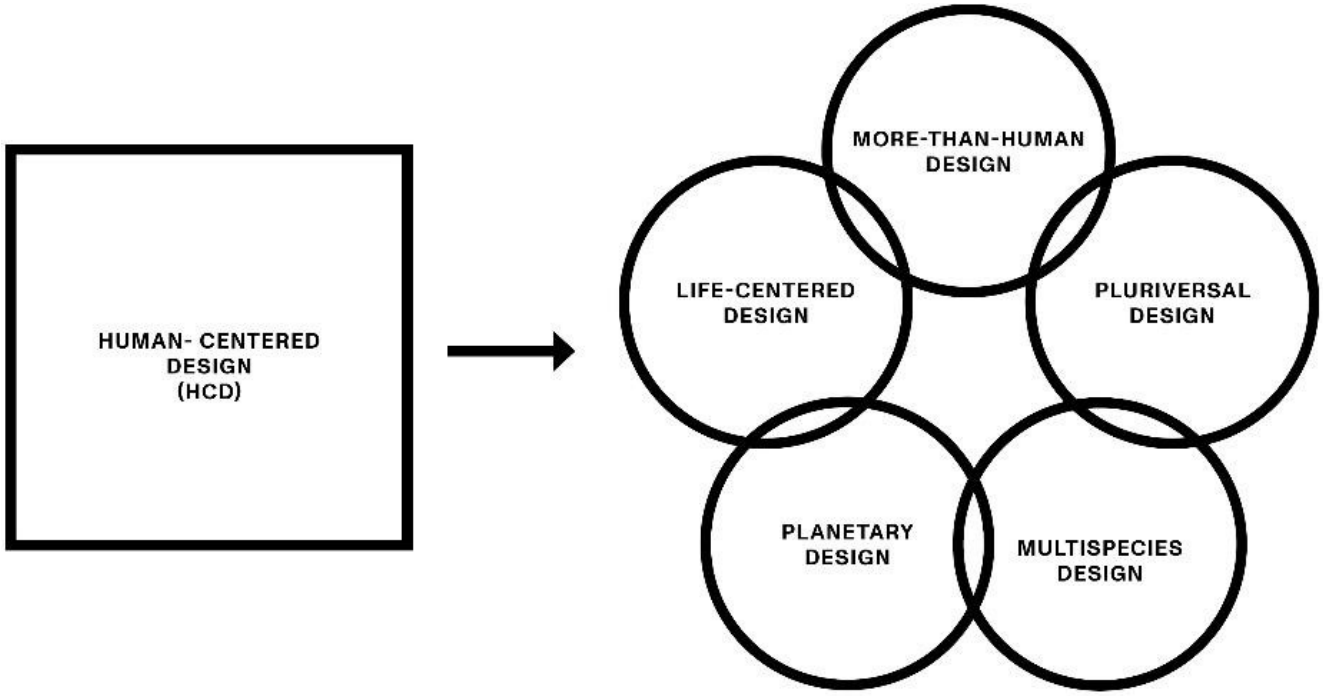
The American philosopher David Abram (1996) introduced the pioneering concept of the "more-than- human" world. He emphasized the profound interconnectedness between humans and the natural world, arguing that our sensory experiences and consciousness are profoundly shaped by our interactions with animals, plants, fungi, landscapes, and natural phenomena. Abram posits that modern societies have lost this essential connection, resulting in a diminished experience of the world. He advocates for recognizing the agency of non-human entities due to their significant influence on language and perception, suggesting that this acknowledgment can foster a deeper ecological awareness.

The "multispecies" concept (Castro et al., 2023) exposes artistic, speculative, and activist practices addressing this interconnection and proposes ways of thinking-with, doing-with, becoming-with, and forming kinships with non-human worlds. These practices stem from a perspective on situated futures, grounded in cultural and environmental histories, and emphasize the unique narratives of specific territories. This vision is interested in the epistemological, ethical, and political implications of recognizing the agency of myriad forms of life beyond human intentionality. This proposal embraces the idea that scientific knowledge cannot be the sole authority on the link between humans and non- humans, accepting the challenge of integrating various types of knowledge. The "Multispecies Constitution Project," launched in 2023, involves an innovative exercise drafting a speculative constitution that includes both humans and non-humans as political subjects. Their aim is to create a language that emphasizes multispecies mutualism instead of human exceptionalism and collective intelligences rather than individualized human knowledge (Berggruen, 2023). It's about shifting towards cross-species forms of knowledge production. This vast community encompasses all inhabitants of the biosphere: animals, plants, fungi, bacteria, and viruses. It includes rivers, seas, winds,

stones, and clouds that sustain and influence us. These living forces, our companions on the journey of time and existence, have much to teach us and have already imparted significant knowledge; our identity and survival are intrinsically linked to them (Bridle, 2022)

To understand the term “life-centered,” we must look to Edward Wilson and his book “Biophilia,” where he underscores the importance of not only understanding life but also preserving it. Wilson discusses the inherent affinity humans have for all living beings, the need to connect with other forms of life, and the sense of connection with nature. He highlights the emotional bond with other living systems, habitats, and surroundings, emphasizing the fragile connection that ties humanity to the earth. This heartfelt connection motivates those who strive to preserve the remaining environment and living beings (Wilson, 1984). Life is a far wider system, an incredibly complex interdependence of matter and energy among millions of species beyond (and within) our own skin (Bridle, 2022). Life- Centered Design (LCD) emerges as a design philosophy and approach that prioritizes all life forms, not just human needs. It advocates for the inclusion of biological ecosystems and non-user communities that have traditionally been excluded from the design process. The ultimate aim is to restore natural ecosystems by fostering new relationships between nature and society (Spoelstra, 2022). LCD and Planetary-Centered Design (PCD) are frameworks striving to replace the stagnant paradigm of Human-Centered Design (HCD). Figure 2 describes the current change and intersections.

Figure 2. Shifting the paradigm to multispecies design diagram.



2.4 Adoption and development in future designers.

With this previous framework, design must recognize the deep interconnections among all living beings, extending beyond human-centered concerns to include the broader ecosystem of life. This means embracing a holistic approach that values and respects the contributions and perspectives of all species. In practice, this design approach should emphasize the importance of rebuilding and nurturing our relationships with each other and the natural world. It calls for design solutions that are not only functional and aesthetically pleasing but also promote harmony with the environment, ensuring that human activities support the delicate balance of life on Earth. By doing so, design becomes a tool that enhances the well-being of the entire planet, reflecting a commitment to the seamless integration of life and design (Verhoeven, 2023). This new paradigm must reconcile our technological prowess and human uniqueness with an earth sensibility and attentiveness to the interconnectedness of all things (Bridle, 2022).

A non-human design discipline uncovers its own unique ecology, gradually shifting from the isolated confines of specialized practice and research towards a more expansive interaction with the wider world. This vision amplifies the perspective that everything is interconnected and all entities influence one another. It's a practice that allies with all forms of non-human intelligence, recognizing that wisdom and creativity are not solely human attributes. For instance, octopuses, known for their remarkable problem-solving skills and adaptability, offer insights into flexible and resilient design solutions. Fungi, with their intricate networks and ability to decompose and recycle nutrients, inspire systems of circular design that minimize waste and promote sustainability. Forests, as complex ecosystems, demonstrate the value of collaboration, diversity, and long-term thinking in creating sustainable and resilient environments.

The ecology of design is deeply concerned with the interrelationships between its praxis and the world it inhabits. In terms of materiality, designers must recognize that human-made artifacts are not isolated creations but are intrinsically connected to the more-than-human world through the materials used (Abram, 1996). For example, the wood in furniture carries the history of the tree it came from, embodying the natural processes and ecosystems it was part of. Similarly, synthetic materials, though man-made, are derived from natural resources like petroleum, a product of ancient biological matter. By acknowledging these connections, designers can create a heightened sense of responsibility and awareness of the broader ecological impact of their work.

3. Perspectives from Mexico

3.1 The Mexican context

Mexico is the link between Latin America and North America. It has many indigenous groups living with low human development indicators, and at the same the post NAFTA economy has integrated the Mexican economy with the US and Canada. The country has, because of its geology and climate, an extraordinarily rich biodiversity. All these factors combine to present today a complex socio- environmental problem. The country now has a population of 130 million, and by 2050 the OECD says that it may arrive close to 150 million. 2023 and 2024 were critical years for water supply in many regions. Climate change is present with different impacts: from severe drought to stronger hurricanes, like the case of Otis that went over Acapulco in October 2023 with a Category 5 strength. We think the present Mexican multispecies problematic – the increasing conflict between humans and non-human intelligences – can be understood looking for: a) bioinfrastructures b) affordances and c) design case studies.

3.2 Bioinfrastructures

The journal Roadsides of the University of Zurich published an issue dedicated to urban bioinfrastructures in autumn 2023. Raúl Acosta and Lukas Ley explain the concept in this way in the introduction: "Cities rely on numerous infrastructures that support their life: pipes, cables, antennas, roads, and other technologies that facilitate the distribution and use of water, energy, information, and people. Current theories of urban flows are integrated into infrastructure systems; however, they are often biased towards the perseverance of human life at the expense of other forms of life. Does this conceptualization of life limit our understanding of the true capacity for life that exists in urban infrastructure? The contributions to this thematic issue interrogate the sociological configurations of urban infrastructure that not only sustain life in the city but are in turn constituted, outlined, and modified by it." (2003: 1) The authors state that this problem "raises urgent questions about the multispecies design, appropriation, and direction of infrastructure, such as what qualifies as 'environmentally friendly' urban planning. Infrastructure is never just a single entity or object but rather an evolutionary set of multispecies and material relationships. As Maan Barua states: the "more-than-human intersections and mixtures with infrastructure, where corporeality and substratum merge and the habitat and habits of living beings become synonymous with infrastructural environments, point to a broader infrastructural ontology (2021: 1467)."

Acosta and Ley focus on the urban, but it is clear that there are also rural bioinfrastructures: monocultures are perhaps a great example. In Mexico they range from the tequila maguey fields in Jalisco, to the avocado cultivars in Michoacán or the vegetable fields in the Bajío. Everything connected to water, electricity, and logistics

transportation networks. The recent emergence of bioinfrastructures remains with little theorization. They claim that history shows examples of experiments where humans and non-humans have co-existed differently than today. Imagination applies to designing new futures, where humans and non-humans can not only co-exist but co-design in more fraternal ways. According to Google's Books Ngram Viewer, the use of the word "bioinfrastructure" – sometimes with the separate bio – began in 1990 but skyrocketed in 2008.

However, one of the papers that best begins to use it is that of Maria Puig de la Bellacasa (2013). She explains that we are dealing with a relational ontology, which links the human with the non-human:

"For this purpose, I am drawing from Susan Leigh Star's work on "residues" and "infrastructure" — developed particularly in different collaborations with Geoffrey Bowker and Karen Ruhleder. Surely, what comes to mind when we think of residual Categories within working infrastructures are mostly human-built technoscientific arrangements. But what happens if we approach a bioinfrastructure such as soil with Star's mode of attention? What kind of "invisible work" becomes visible? And at what cost? The material, cultural, and ecological significance of soil appears not only to be that of the final home to all residues but also of a vital, although disregarded, infrastructure of bios. In what follows I first discuss the changing significance of soil as "residue" through contrasting epistemic sites. Soil shifts from container of worlds to a world, showing how its worth—from residual to essential—is not fixed. Secondly, the notion of infrastructure acts as a revelatory of the "working" quality of this universe, opening into the perception of a whole world of invisible labors that are more than human." The author's premise is to make visible the invisible, in this case, the processes that link the human and the non-human, the living and the non-living, which in turn create a bioinfrastructure.

The Mexican case presents a paradox because at the same time, it is the country that invented the "milpa" - a biocultural ecosystem that peasants have designed for thousands of years, where corn grows next to tomatoes, varied species of chiles, beans, and wild herbs (quelites). Together they have been co-evolving with the people that have been in the territory that now is Mexico. The milpa adapts to every microclimate of every region. This bioinfrastructure has fed people for centuries. Milpa is probably the most important bioinfrastructure in Mexico because it has developed 60 distinct kinds of corn, that is also the most cultivated cereal in the world.

3.3 Affordances

In other hand, the country lives now a rapid environmental deterioration. This analysis wants to focus on one category of bioinfrastructures. The ones that have an operational function as an affordance. What is an affordance? It is the capacity that an object or a system to call for its use or function.

For instance, ergonomics is that capacity in many industrial design objects. But in nature, trees have that capacity, being the home and food supply of many species. “Landscape affordances, what the environment offers an animal, are inherently species-specific to the extent that each taxon has unique needs and responses to landscape characteristics”, say Niesner et al (2021).

The López Obrador government has engaged in a series of decisions that had a significant impact on ecosystems, from the tren maya in the Yucatan Peninsula to the signing of the latest version of NAFTA, that does not have provisions about climate change. These two policy decisions have a cascading effect on many others, provoking lock-in consequences that can last decades. They connect in a bigger trend: the nearshoring of global manufacturing, from China to North America, and that has been impacting many species. The rapid urbanization of the country, with the accelerating deforestation of territories because of the expansion of monocrops like the cultivars of avocado and agave for tequila production, are also transformation entire wild landscapes into human bioinfrastructure.

3.4 Cases from Mexico

In this section it is enlisted a few situations and conflicts involving bioinfrastructures and multispecies design questions which exemplifies the interspecies complexity in which Mexico is involved. The selection is situated in different geographies of the country and involves different scales, from the small objects and local urbanization conflicts to the geopolitical scale. A small section is dedicated to four exercises developed by students at Tec de Monterrey in the past few years.

3.4.1 Refugio

“Refugio” is a Mexican design project intended to foster a closer relationship between cities (humans) and nature (bees). This initiative was conceived initially as a series of objects that provide shelter, water, and food for various species of solitary bees (Calvillo, 2020). In 2023, Refugio started to collaborate with sylviculture communities of *Melipona beecheii* in Yucatan developing shelters and wax structures to help the bees kick-start their honeycombs. The project has been constantly developing and increasing in scale and impact, an example of this are the pollinator gardens and sanctuaries that have been implementing in Mexico City (2023, 2024).

3.4.2 Totomoxtle

“Totomoxtle” is a project created by Fernando Laposse in collaboration with the community at Tonahuixtla, Puebla. The project seeks to develop economic alternatives for the community, which was dedicated to corn production for generations and, because of the NAFTA agreements, the traditional milpa agriculture had to shift to GMOs, causing the depletion of the soil. *Totomoxtle* recovers native corn seeds and incentives its traditional production changing the commercial value of the corn from the seed to the leaf. The dry leaves are now transformed into marquetery

by the women at Tonahuixtla and sell as luxury objects and furniture abroad. The remaining corn seeds are then used as food for the community and as stock for next season's plantations. By returning to milpa agriculture, it also helps to regenerate the soil for future generations.

Fernando Laposse is a Mexican designer with a degree in product design from Central St. Martins. His practice is material driven and focuses on transforming humble natural fibers such as corn husks, sisal, or loofah into design pieces and new architectural materials. (s. f.). His website. https://www.fernandolaposse.com/totomoxle

3.4.3 Santa Catarina River in Monterrey

In June 2023, Nuevo León government deforested 13 hectares of the Santa Catarina River justified as necessary for the safety of the population against catastrophic droughts caused by hurricanes in the future years. This event triggered the biggest ecological movement in the history of the city: *"Unríoenelrío"*, which aims to unify the voices of activists, scientists, academics and public in general to look after the environmental stability of the city. The current primordial discussion (2024) centers in the future of the river and its riverbanks as it is disputed between real state companies, urban infrastructure development projects (originated by the exponential urban expansion and lately the 2026 football world cup) and the defense of one of the most important urban forests in the city which helps reducing the temperature in its surroundings approximately by 6 degrees Celsius and, as argued by specialists, reduces the waterflow significantly because of the drag resistance of the riparian vegetation.

3.4.4 Mayan honey from Campeche.

More than two decades ago, Mayan women from the state of Campeche began a beekeeping practice with a very singular species endemic to their region: *Melipona beecheii*, but that the Mayas name as Xunáan Kab, "the honey lady". These Mayan women formed the "Colectivo de Comunidades Mayas de los Chenes" and have learnt to deal with powerful corporate interests that have affected their beekeeping (Gómez Durán, 2020) . In 2012, the federal government gave permissions to Monsanto to cultivate GMO soy – without the legal consultation to the indigenous communities. This impacted their practice, because the bees produced honey that the traceability tests showed had pollen from transgenic soy, so their exportations to Europe were at risk. A product labeled organic loses its certification if it has GMO content. In 2015, the Mexican Supreme Court said the government had violated the rights of the indigenous communities. In 2017, the food safety agency cancelled the authorizations to Monsanto to cultivate GMO soy in seven states.

3.4.5 Academic Cases at Tec de

Monterrey

In 2019, the exercise “Animal Centered Design” (AXD) was implemented at the experience design course conducted for third year undergraduate level. A set of animal centered design (AXD) tools were developed, and specific objectives were assessed to develop a product to promote interaction with the chosen animal and their context, thus improving their quality of life. The students’ final submissions identified innovation attributes and socio-environmental achievements. The tools generated with this academic exercise can serve as a continuation and basis for designers, architects, and urbanists in the definition of multispecies design.

In 2022, Sonora Norte worked hand by hand with CRIFFS, a non-profit organization committed to the protection and conservation of Mexico’s native wildlife. The aim was that students co-create objects with the help of the volunteers that assist injured or vulnerable fauna like turtles’ nests and stranded cetaceans.

At CDMX Region four multispecies design exercises, led by Mariana Solis between 2022 and 2023, where developed focused on designing for a plant. “Diseño para una planta” aimed to develop sensitivity towards other forms of life, in this case one that is apparently inanimate and sometimes difficult to relate. The results express a clear empathy towards the necessities of the different plant species considering their biology and context within their interactions with humans.

In 2023, in collaboration with Isla Urbana, 4th semester students from Tec de Monterrey Campus Ciudad de México developed the project “Fuentes de re-abastecimiento”. This project researched into the fragmentation of wildlife habitats in Mexico City and its relationship with water scarcity both for humans and non-human.

4. Conclusions

Interdisciplinary approaches based on the study of human and non-human interactions have significantly reshaped our understanding of our current perception of sustainability and regeneration. From biological sciences to the integration of design, our proceed towards addressing the environmental crisis has become more holistic. The rise of concepts like biophilia, biomimicry, and multispecies design reflects a growing recognition of the need to transcend human-centric perspectives and embrace a more inclusive, life-centered ethic within our built environment. This shift is crucial as we face complex environmental and social challenges that demand innovative and empathetic solutions. This work highlights the importance of incorporating these paradigms into education and design practice, particularly in Mexico, that is facing an acute ecological and social crisis. We are witnessing the start of a process: pioneer ecofeminist movements, new biophilic entrepreneurs, the redesign of academic thinking. The current multicrisis will only be transformed with a new multispecies perspective acceleration, and

this will only be possible with the cooperation of other non-human intelligences – animal, vegetal, fungi and, even geological. We are only beginning to seriously listen to these other voices by fostering new forms of human design and mutualism, by changing the idea infrastructure to bioinfrastructures and the dynamics in everyday life affordances to interact with non-humans. These are efforts that can foster the way for a more resilient and harmonious relationship with our planet.

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EVENT-BASED EDUCATION IN DESIGN: A CASE STUDY ON FOSTERING CRITICAL THINKING AND SOCIAL IMPACT.

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ABSTRACT | Event-based education in design education is increasingly recognised as an effective learning mode (Page et al, 2016; Juraschek et al, 2020). It involves activity-based teaching strategies and learning processes in which knowledge comes through 'experiencing' tools and environments with which one learns the context, actors and relationships in design projects (Kolb, 2014). Incorporating agile prototyping and service learning enhances this model, fostering rapid development, innovation, and real-world application of knowledge.

This paper presents a case study of a five-day educational event for Bachelor of Arts (BA) and Master of Arts (MA) design students from the same institute. The event, conducted using systemic design approaches, involved the design of products, services and public benefit systems with public and private entities within the territory where the design school is located. The educational operation included the participation of students, organized into groups, the majority of the faculty serving as instructors, and a group of alumni acting as tutors.

The authors of this paper propose a qualitative investigation aimed at studying the "designer education" model implemented during a five-day event, approached from a lifelong learning perspective (Fischer, 2000; Freitas & Almendra, 2021). The study examined how knowledge, skills, and critical thinking abilities were imparted to students and explored how both students and educators can effectively address contemporary, complex, and multidisciplinary challenges in a critical, technological, and ethical manner (McCoy, 2003; Davis, 2011; Noël, 2020) within a short timeframe.

The learning environment of the dissemination event itself was an objective of design and validation, aimed at studying its pedagogy and determining the appropriate learning space for today's designers. This approach emphasizes the "how" and the "why" of designing, aiming for social, environmental, economic, and cultural impacts (Rowe, 2020). Qualitative data was collected. For qualitative data, pre- and post-event attitudinal research, questionnaires, in-depth interviews, and focus groups with students, faculty, tutors, and external entities were employed. This paper presents the results of the research on the multigenerational and multidisciplinary working method applied during the 5 days event, as well as the study of the teaching model implemented. The collected data validated the pedagogical model and provided insights into monitoring and tutoring methods applied during the event. Furthermore, data analysis identified several recommendations for managing transdisciplinary relationships among academic, public, and private sectors in similar events. Innovative approaches to fostering a more empathetic relationship with stakeholders and increasing awareness of the impact of their projects are essential tools for helping young designers strengthen their values and create a more cohesive team-building environment among faculty, tutors, students and stakeholders.

The authors conclude by suggesting an improvement of this educational model. It identifies research avenues for co-designing new pedagogical and organizational methods to enhance the critical capacity of both students and faculty, and to improve cooperation between design schools and local community. These efforts aim to increase public benefit impact through such collaborations and service learning.

KEYWORDS | EVENT-BASED EDUCATION, ACTIVITY-BASED TEACHING, CRITICAL THINKING, DESIGN PEDAGOGY, SOCIAL DESIGN

1. Introduction: The Evolution and Impact of Design Education in Contemporary Society.

As society undergoes significant cultural and technological transformations, design education is undergoing a process of evolution in response to these changes (Nöel, 2020; Pontis & van der Waarde, 2020). The quintuple helix model emphasizes the importance of academic institutions engaging in collaborative endeavors with a diverse range of stakeholders, including representatives from government, business, civil society, and the environment (Carayannis et al., 2021). This model encourages the creation of creative and innovative environments for research and organizational development (Carayannis et al., 2021), prompting a re-evaluation of traditional educational practices in order to align them with the demands of a complex modern world. The capacity to cope with complexity is a foundational driver of change in design education (Morin, 1999; Davis, 2011). The field of design offers a distinctive set of competencies, including systems thinking, the visual representation of information and processes, effective communication, planning, creativity, and empathy for stakeholders (Montt-Blanchard et al., 2023). These skills are of paramount importance as designers increasingly move beyond the confines of traditional specializations and disciplinary boundaries, thereby contributing to a more comprehensive and integrated methodology for problem-solving.

Significant developments in design education, particularly in pedagogical approaches, have been driven by the necessity to align the content of education with the requirements of professional practice and of society more widely. This evolution requires the ongoing enhancement of knowledge and skills in order to address emerging challenges effectively (Kuure & Miettinen, 2017). The overarching objective of contemporary design education is to produce responsible, knowledgeable, and skilled professionals who are able to assist individuals in achieving their desired outcomes in a more effective manner.

Nevertheless, conveying this concept within the educational context remains a significant challenge, as students frequently prioritize the acquisition of fundamental technical skills over pursuing critical enquiry (Tovey, 2015; Pontis & van der Waarde, 2020).

There is a challenging trade-off between the refinement of existing skills and the development of competencies that may become more important in the future (Redström, 2020). It is imperative that design education adapts to the prevailing changes and continues to provide future generations of designers with a robust foundation of knowledge, tools and skills (Pontis & van der Waarde, 2020). The current transition in design education requires the development of a pedagogical model that enables novice designers to navigate external shifts and rethink traditional modes of education (Tovey, 2015). Conventional design education frequently relies on emulating professional practice, although there is a growing tendency towards experiential methodologies (Rowe, 2020). Event-based education instead provides students with the opportunity to engage with a diverse range of stakeholders, including individuals, locations, and communities. Such engagement is of critical importance for the professional development of designers, equipping them with the skills to transition from the role of expert to that of facilitator (Montt-Blanchard et al., 2023).

It is essential that learning experiences instill a sense of motivation to contribute to the creation of a resilient and sustainable context (McCoy, 2003). Motivation is of paramount importance for effective creative and analytical thinking, which are essential soft skills in today's world. A significant number of institutions now offer project-based learning that is firmly rooted in realworld problems (Pontis & van der Waarde, 2020). This approach has the advantage of enhancing student-teacher interaction and ensuring community-wide participation, including students, faculty, governance, and alumni.

It is important that students receive learning experiences that adequately prepare them for the complex, large-scale, and interdisciplinary challenges that they will inevitably face in their professional lives (Rowe, 2020). As well, students should receive the necessary support not only to secure employment, but also to enable them to flourish as the discipline progresses and evolves. Designers should exemplify the complexities and ambiguity inherent in the workplace, demonstrating the ability to navigate systemic change and transformation with discernment. One of the most effective pedagogical approaches for community engagement in design education is experiential learning (Kolb & Kolb, 2006). In fact one of the principal objectives of design education is to inculcate in students the understanding that design is about creating possibilities (Danzico, 2011). It is the responsibility of academic institutions to innovate and maintain an approach that is open to experimentation and free from the constraints of business logic. One area of experimentation is the design of the educational experience itself, with

the objective of fostering an environment conducive to the flourishing and innovation of future designers.

The incorporation of experiential learning, agile prototyping and real-world engagement into novel forms of academic events has been demonstrated to be highly beneficial for the personal and professional growth of design students (DeJaeghere, 2009; Lizzio & Wilson, 2004). Such approaches not only equip students with the requisite skills to personally grow and navigate the complexities of the design profession, but also foster a deeper understanding and motivation to contribute positively to society.

2. Theoretical framework

The theoretical framework of event-based education is gaining recognition as an effective pedagogical approach within the field of design education. This format encompasses brief, intensive events, typically spanning a period of between one and five days, with a primary focus on innovation and educational pursuits (Juraschek et al., 2020). The objective of such events is to address challenges, complete design tasks, develop concepts, convey learning content, build skills, share knowledge, create visions, disseminate best practices, and build communities (Blume et al., 2015; Juraschek et al., 2020).

These experiential and challenge-based learning opportunities confer significant benefits upon design education, as they permit students to engage in design activities within a controlled and secure environment (Kolb & Kolb, 2017). This reduces the barriers of abstraction that may otherwise arise from the abstract nature of the subject matter, by enabling students to apply their learning in a real-world context (Juraschek et al., 2020). For example, Page et al. (2016) argue that hackathons foster a sense of personal fulfillment among participants by facilitating collaboration with individuals from diverse backgrounds. This form of event-based experience has been demonstrated to be an effective teaching tool in design education, where knowledge is created through practical engagement and experience.

Three key frameworks underpin event-based learning in design education: experiential learning, collaborative learning, and sprint design.

In their 2006 study, Kolb and Kolb posit that experiential learning represents an efficacious pedagogical approach to enhance teaching and learning in higher education. This cyclical approach alternates activities that involve different cognitive attitudes, including concrete experience, observation, conceptualisation, and active experimentation. In the context of design education, concrete experience frequently manifests as project-based learning, which entails the resolution of authentic challenges through a process of investigation, research, data collection and interpretation, design, and the communication of results (Kokotsaki et al., 2016).

Lizzio and Wilson (2004) posit that this type of learning is a significant contributor to the development of students' professional skills within a lifelong learning (LLL) framework (Fischer, 1999). From this perspective, it is of paramount importance to promote metacognitive abilities that encourage reflexivity (Field, 2000) and transversal competencies, such as the capacity to "learn to learn" (Hoskins & Fredriksson, 2008).

The collaborative aspect is of paramount importance in event-based education. Collaborative learning is an educational approach whereby students with varying abilities work together in small groups to achieve shared objectives, address challenges, or undertake collective project design. In contrast to competitive methodologies, collaborative learning encourages consensus through the collective efforts of all group members (Laal & Ghodsi, 2012). A comprehensive list of the benefits of collaborative learning, as identified by Johnson and Johnson (1989) and Pantiz (1999), has been summarized by Laal and Ghodsi (2012) into four categories: social benefits, psychological benefits, academic benefits, and alternative assessment techniques for students and teachers.

The temporal aspect is another defining feature of event-based learning, frequently addressed through the sprint design methodology (Winfield et al., 2022). The design sprint, which originated in the field of IT development, has been introduced into the academic context through the incorporation of design thinking practices (Dell'Era et al., 2020). Knapp (2007) proposes a framework based on iterative cycles compressed into five days, which stimulates rapid and flexible decision-making and facilitates the development of knowledge management skills in both teachers and students (Bates, 2022). This is especially advantageous for those engaged in knowledge work within volatile, uncertain, complex, and ambiguous (VUCA) environments (Adamson, 2012).

While the theoretical framework provides a robust foundation for proposing event-based education as an effective training model, the specific knowledge gap this study aims to address is the lack of empirical research on how event-based education, specifically using design sprints, impacts long-life learning (LLL) skill development and stress management in students.

Additionally, this study seeks to investigate how the deceleration of design sprint processes can foster deeper reflective practices in educational settings. For instance, while the design sprint methodology is an effective approach, it requires considerable energy and focus, which could potentially lead to stress and impact the development of LLL skills (Knapp, 2007). Moreover, the implementation of design sprint approaches in an educational setting may necessitate the utilization of a decelerated model to facilitate reflective processes (Schell, 2023).

In conclusion, event-based educational formats, which incorporate agile prototyping

and realworld engagement, are of significant value for the personal and professional development of students. Such approaches equip students with the requisite skills to navigate the complexities of the design profession, while fostering a deeper understanding and motivation to contribute positively to society. This study will investigate these knowledge gaps through the case study of the Rome Design Experience (RDE), using a combination of qualitative and quantitative methods to deepen the understanding of how event-based education can best foster student development in design professions.

3. The Roma Design Experience (RDE): A Case Study in Design Education and Stakeholder Innovation

The Rome Design Experience (RDE) is a five-day educational event promoted by a public design institution in Italy, serving as the case study for this research. Now in its sixth edition, the RDE occurs annually, temporarily suspending regular teaching activities and involving Bachelor (BA) and Master (MA) design students from across the institution. All students at the school participate, organized into mixed working groups according to their interests, covering a range of topics and stakeholder challenges. Each group, comprising 15 to 20 students of varying ages and academic levels, includes participants from first-year BA students to undergraduates (Table 1). These groups are facilitated by

Degree	Year	Course	Average Age	Amount of students
BA	I°	Design	20,36	51
BA	II°	Design	21,84	46
BA	III°	Design product oriented	22,21	13
BA	III°	Design communication oriented	22,21	15
MA	I°	Systemic design product & services oriented	24	26
MA	I°	Systemic design communication oriented	24,13	30
MA	II°	Systemic design product & services oriented	24,95	22
MA	II°	Systemic design communication oriented	24,92	27
			23,0775	**230**

Table 1.Student demographics.

an internal professor, a tutor, and either an internal or external expert in the relevant field.

Each group collaborates with a stakeholder from the private or public sector, who provides a project brief and engages in ongoing dialogue with the group to monitor project progress. At the conclusion of the event, a public presentation is held for the relevant organization and the school. Stakeholders are selected from local or national institutions, companies, foundations, associations, non-profit organizations, or entities involved in cultural, social, environmental, or care fields (Table 2).

The potential outcomes of each group include future scenarios of physical or communication products, facilities, and services designed with a systemic approach, aiming for territorial growth and the empowerment and involvement of all system actors (Carrino & Spera, 2021). The mission of the RDE is to create a link between academia and the real world, bringing students into contact with local workplaces and providing stakeholders with an environment for fast and proactive innovation (Salvatori & Datti, 2024).

The RDE functions as a pedagogical laboratory where participants face challenges in managing time, resources, and relationships, contributing to their social, environmental,

Type	Sector
Public	Cultural Heritage, Education
Public	Cultural Heritage, Tourism
Public	Cultural Heritage, Urban Planning
Private	Social Innovation, Circular Economy
No profit	Social Services, Education
Private	Digital Transformation, Industry 4.0
Public	Public Communication
Private	Cultural Heritage, Arts
Public	Cultural Heritage, Humanities
Private/Public	Financial Services, Artificial
Public	Scientific Research, Scientific Dissemination
Public	Cultural Heritage, Tourism

Table 2. Mapping of stakeholders' type and sectors selected for the sixth edition of the Rome Design Experience (RDE6).

economic, and cultural understanding. This approach fosters the personal, relational, and professional development of students by integrating experiential learning, collaborative problem-solving, and sprint design methodology. By incorporating real-world challenges provided by stakeholders, students are exposed to the complexities of designing sustainable solutions that address not only immediate needs but also long-term impacts.

Projects emerging from the RDE exhibit a strong connection to the local social and cultural context, aiming to create positive territorial growth. These projects prioritize long-term, sustainable solutions that reflect environmental and economic resilience, involving the collective engagement of key stakeholders in co-creating outcomes that are both innovative and contextually relevant. The collaborative process fosters a willingness to compromise and adapt to real-world constraints, helping students understand the intricate balance of social, environmental, and economic factors in design.

Additionally, significant aspects of the RDE learning process include both formal and informal monitoring, flexibility in renegotiating objectives, and guidance from an experienced facilitator, ensuring that the projects align with the overarching goals of sustainability and stakeholder empowerment (Massari, 2024). This process encourages students to engage in reflective practices, allowing them to explore the cultural impacts of their design solutions while addressing the economic and environmental realities of the local context.

3.1 Aswsessing social impact

While the RDE primarily focused on developing students' critical thinking and design skills, the assessment of broader social impact remains an important consideration. Although no formal social impact assessment framework was employed in this study, future evaluations could incorporate the Social Return on Investment (SROI) methodology. This widely recognized approach quantifies the social, economic, and environmental outcomes of a project by measuring the value created for stakeholders and communities. Additionally, the use of a Theory of Change (ToC) framework could help map the pathway from project activities to both short- and long-term social outcomes, such as community empowerment, local economic development, and stakeholder engagement.

Though specific methods were not used to measure these impacts, qualitative feedback from stakeholders indicates positive social benefits, particularly in community involvement and collaborative work. Implementing these methodologies in future studies would provide a more comprehensive and measurable assessment of the social impact of the RDE, allowing for a clearer understanding of its outcomes.

4. Research study

The research focuses on the sixth edition of the event-based design program (RDE6), which included the participation of 150 students, 24 faculty members, 24 tutors, and 12 institutions, organized into 12 workshops centered around three themes: technological innovation, social impact, and cultural heritage. The event spanned five days, culminating in a final public presentation held four months later (Figure 1). The final event comprised a day of exhibition and presentation of the outcomes achieved during the five-day workshop. This open-to-the-public event featured presentations to local institutions, dialogues, and roundtable discussions focused on the three core themes around which the workshop activities were clustered. The event predominantly attracted students and faculty, alongside family members, friends of the students, stakeholders, and relevant actors from related fields.

The event included interactive corners where attendees could provide comments and feedback, as well as areas dedicated to collecting interviews and media material for the follow-up of the fiveday workshop. These components facilitated comprehensive feedback collection and documentation of the entire experience, supporting a thorough evaluation of the results and guiding future initiatives.

This five-days workshop and the follow-up event were included in the research to gather

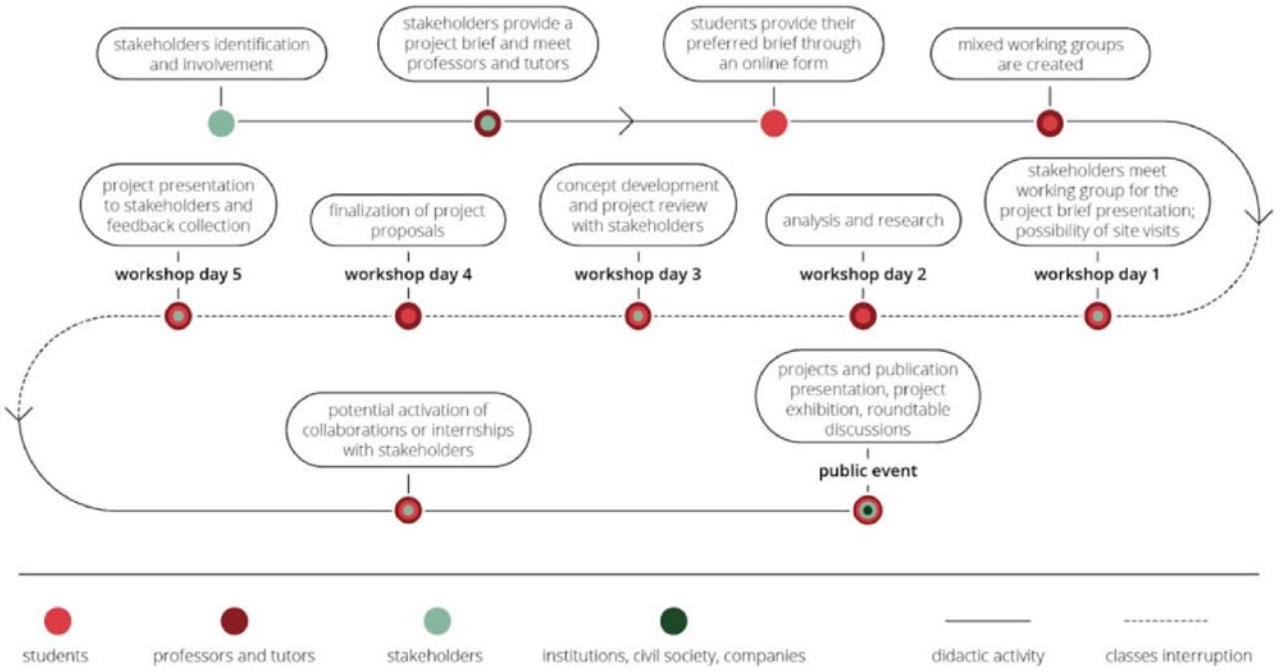

Figure 1. Organizational architecture of the Rome Design Experience.

comprehensive data. A mixed-methods approach was employed, predominantly utilizing qualitative techniques targeting students, institutions, faculty, and tutors. The objective was to assess the impact of the RDE teaching and learning experience on the knowledge, skills, and professional development of the participating students through diverse research methods, including online questionnaires, focus groups, semi-structured interviews and citizen science data collection.

4.1 A mixed-methods approach

Students were given an online questionnaire to complete before and after RDE6. The aim was to enable self-assessment of knowledge, skills, and work autonomy, to understand any changes during the educational event. The theoretical framework for the survey was based on the National Qualification Framework (NQF), aligned with the European Qualifications Framework (EQF) (ANPAL, 2022). The NQF and EQF aim to enhance the quality of training and skill development from a personal, civic, social, and professional growth perspective within a European framework. The framework comprises eight levels, defined by descriptors based on three dimensions:

- Knowledge: Skills ranging from the assimilation of theoretical or practical information to critical and interpretative abilities.
- Skills: Cognitive and practical abilities to apply knowledge to complete tasks, solve problems, develop ideas, and engage in social interactions.
- Autonomy and Responsibility: The ability to apply knowledge and skills independently and responsibly, including the capacity to coordinate and supervise.

The practical implementation of the questionnaire referenced the NQF levels' summary table, which provides a taxonomic profile of each EQF level, using the revised Bloom's taxonomy (Krathwohl, 2002) for

descriptors (Table 3.).

Table 3. Descriptors for self-assessment of qualification level in relation to Skills, Objectives and Context, reformulated on the basis of the National Qualifications Framework (NQF), European Qualifications Framework (EQF) and Cognitive

	Skills	Objectives	Context	Cognitive Process	Knowledge
1	Concentrate and memorise	Perform a task within the prescribed parameters	Perform tasks under direct supervision	Remember (Recognising, Recalling)	Factual Knowledge
2	Interact and participate in processes	Coordinate with other people	Perform tasks in a structured context with a variety of situations	Understand (Interpreting, Exemplifying, Classifying, Summarizing, Inferring, Comparing, Explaining)	Procedural Knowledge
3	Make logical connections	Achieve expected results	Cope in a structured context with changing situations	Apply (Executing, Implementing)	Procedural Knowledge
4	Cooperate in multitasking	Integrate activities and results of others	Cope with a predictable context, but subject to unforeseen changes	Analyze (Differentiating, Organizing, Attributing)	Procedural Knowledge
5	Manage critical issues	Plan revision and improvement interventions	Coordinate a determined context subject to recurrent changes	Analyze (Differentiating, Organizing, Attributing)	Conceptual Knowledge
6	Synthesise and motivate	Reschedule objectives and implementation methods	Coordinate a non-determined context subject to recurrent change	Evaluate (Checking, Critiquing)	Conceptual Knowledge
7	Manage complex social interactions	Integrate knowledge and elaborate strategies	Manage a non determined context subject to unpredictable changes	Create (Generating, Planning, Producing)	Metacognitive Knowledge
8	Plan within a systemic vision	Promote innovative processes, foreseeing scenarios and solutions	Design an innovative context, not comparable with already known contexts	Create (Generating, Planning, Producing)	Metacognitive Knowledge

Process and Knowledge Dimensions of Revised Bloom's Taxonomy.

Additionally, the questionnaire included a self-assessment section for the following soft skills, based on the twenty competencies identified by Freitas & Almendra (2021) that included the three competencies highlighted by the OECD (2018) for tackling 21st-century challenges:

Communication, Critical Thinking, Creativity, Problem Solving, Curiosity, Research and Exploration, Decision Making, Open-Mindedness, Systematic Thinking, Empathy, Collaboration, Participation, Flexibility/Adaptability, Learning to Learn, Teamworking, Self-direction/ Selfmanagement, Ethic/Compromise, Judgement, Leadership, Entrepreneurship .

An online post-event questionnaire was also sent to external organizations participating as stakeholders to identify whether their expectations were met and to gather insights on the strengths and weaknesses identified by their representatives. They were asked to evaluate the projects proposed by students and the educational format used, offering suggestions for improvement. A section of this questionnaire focused on the hard and soft skills (Freitas & Almendra, 2021) deemed important for a professional designer.

After RDE6, a focus group with participating students was organized to delve deeper into the data collected through questionnaires. The aim was to assess the transformative value of the event and understand the perceived social impact of their collective work. Techniques such as “If it were...” (e.g., “If RDE were an animal, what would it be?”) were used to facilitate the discussion. Simultaneously, participating stakeholders were involved in a focus group during the dissemination event to identify strengths and weaknesses of the five-day educational event and stimulate debate, exploring certain responses from the online questionnaire and uncovering additional insights. Techniques such as the metaphorical comparison of the educational event to a “journey” were used to facilitate discussions.

Semi-structured interviews were conducted with at least one faculty member and one tutor from each workshop to gather evaluations on the learning environment. The interviews utilized both a set of questions and narrative interview techniques (Atkinson, 2007) to generate anecdotes and impressions on the work process, its impact on institutions, and student engagement. Additional in-depth semi-structured interviews were conducted during the dissemination conference with faculty who participated in the five-day educational event to gather insights on pedagogical challenges, group management, and achievement of working group results. Techniques such as narrative reification processes, using “If it were” and “How might we” frameworks, were employed.

During the dissemination conference, a citizen science installation was developed, to gather data from all event participants, including RDE participants and visitors. The objective was to explore the future role of design in society and evaluate the RDE learning environment. Activities were designed to be simple and playful, providing bottom-up data.

The data collection involved:

- A four-quadrant matrix where participants placed adhesive markers according to their opinions. To facilitate

the clustering of the data in the collection analysis, the markers were distinguished with a color code assigned to each type of expected attendee at the dissemination event: students, faculty, stakeholders and others (Figure 2).

· Five postcards with statements such as “A designer is afraid of,” “A designer does not have,” “A designer only designs when,” “A designer aspires,” and “A designer believes that.” Inspired by the Empathy Map tool in design thinking methodology (Gray et al., 2010) , these incomplete statements were used to assess designers’ fears, aspirations, opportunities, ideals, and perceived threats regarding their professional role. Using the cloze test technique (Lucisano & Salerni, 2022), participants were asked to complete the postcards with a phrase, word, or drawing, and then place them in collection boxes. The anonymous data collection method encouraged participants to engage freely without fear of discrimination or prejudice (Figure 3).

This mixed-methods approach allowed for a comprehensive evaluation of the RDE6 edition, highlighting its impact on students’ knowledge, skills, and professional development while assessing stakeholder satisfaction and identifying areas for improvement in the educational format.

The research methodology employed in this study involved a detailed collection and analysis of both quantitative and qualitative data. Quantitative data was gathered through questionnaires, focusing on key variables aligned with the study’s research objectives. Specifically, participants were asked to provide self-assessments of their skills before and after the event, using Likert scales to measure abilities in areas such as collaborative problem-solving, design thinking, and project management. Additionally, the questionnaires sought to capture participants’ perceptions of the Rome Design Experience’s (RDE) impact on their professional development, particularly in relation to acquiring practical

Figure 2. Citizen Science Data Collection Installation: Participants discuss in front of the four-quadrant matrix.

Figure 3. Citizen Science Data Collection Installation: Participant inserting postcard into a box.

knowledge relevant to the design profession. Engagement levels and satisfaction with the event's structure, including the clarity of briefings and the quality of stakeholder engagement, were also assessed. The data collected was analyzed using descriptive statistics, allowing us to identify patterns and trends in participants' responses, which in turn helped evaluate the overall effectiveness of the RDE in achieving its educational and professional development goals.

Citizen science data collection was limited to the dissemination event, as this marked the culmination of the RDE, providing participants with the opportunity to reflect holistically on their experiences. This timing allowed us to capture feedback on the educational impact of the event, the challenges encountered, and how participants addressed them, as well as the practical application of the skills they developed through engagement with stakeholders and real-world problem-solving scenarios. Focusing on the dissemination event provided more comprehensive, reflective responses that spanned the entire learning process, from initial ideation to the final project presentation. Although this approach provided valuable insights, a longitudinal study with follow-up data collection could further enrich the findings, and this is an area for potential future research.

The data collection methods included both quantitative questionnaires and qualitative focus group discussions. While the questionnaires provided structured, quantifiable data, the focus group discussions allowed for a more in-depth exploration of the students' experiences, especially in relation to collaboration and the application of design thinking methodologies. The analysis process for the quantitative data involved statistical methods, such as calculating mean scores and standard deviations, to highlight shifts in participants' self-reported skills and perceptions. The qualitative data from the focus groups was transcribed and subjected to thematic analysis, which revealed recurring themes related to the educational model of the RDE, stakeholder collaboration, and alignment with professional development objectives.

This comprehensive approach to data collection and analysis strengthens the study's alignment with its research objectives, providing valuable insights into the RDE's impact on both students and stakeholders.

4.2 Results

The data collected in this study are not intended to be exhaustive. The value of the mixedmethods approach lies in its ability to cross-reference and contextualize data, leading to a more nuanced understanding. For example, some data gathered through questionnaires were further clarified and elaborated upon during focus groups and interviews. A significant limitation of the questionnaire results is the response rate. A total of 103 students completed the pre-RDE6 survey, whereas only 50 participated in the post-RDE6 survey. This discrepancy affects the reliability of the results and highlights

the need to employ additional data collection strategies and to analyze the data through a cross-sectional lens.

The student questionnaire results suggest that participants made substantial progress during the five-day event in their ability to manage complex situations characterized by a multitude of variables and unexpected scenarios. Insights gained from interviews and focus groups corroborated that the environment of the five-day event necessitated and fostered this ability, which was crucial for achieving the desired outcomes. Notably, there was a marked improvement in the students' capacity to adapt to unforeseen changes and to plan subsequent actions in a more organized and systematic manner, a finding that emerged from both student selfassessments and focus group discussions. However, most of the remaining self-assessment subdescriptors completed by students showed a slight decline. The impact of the RDE on critical thinking (ANPAL, 2022), for instance, is particularly intriguing and warrants further investigation, as even the focus groups failed to pinpoint the cause of this decline in self-assessed competency. A long-term follow-up study, conducted some time after the event, might provide deeper insights into how students perceive and define critical thinking.

Regarding feedback from stakeholders, 7 out of 12 respondents completed the survey. Their responses indicate a high level of satisfaction with the RDE outcomes and alignment with the project briefs. Stakeholders' evaluations of the RDE results and the group work were overwhelmingly positive. The skills deemed most important by stakeholders included creativity, teamwork, and problem-solving. In contrast, entrepreneurial skills and decision-making abilities were not considered as high priorities. This finding is particularly noteworthy in light of the RDE's goal to foster innovative processes within participating public and private organizations.

These findings underscore the need for further investigation to enhance the impact of the RDE on the development of critical and entrepreneurial competencies, which are essential for promoting integrated innovation between academia and the real world. Additionally, the results highlight the necessity of implementing measures to ensure a higher response rate for post-event evaluations, thereby facilitating the collection of more comprehensive data. Overall, the data collected emphasize the significance of experiential learning in a collaborative setting, while time emerges as a variable closely linked to the unexpected.

The focus groups yielded significant insights into students' perceptions and experiences during the event. Despite initial feelings of helplessness regarding their ability to effect concrete changes, students demonstrated a profound potential for growth and impact. One student observed, "I should be attuned to social issues, yet I am not; I am unaware of them, and they seem remote from me." However, this sentiment evolved in a positive

direction as another participant shared the following: “I had not previously believed that designing for social issues could have a tangible impact.”

It became evident that the role of the stakeholders was of paramount importance in determining the success of the project. As one participant observed, the effectiveness of the project depends on adopting a stakeholder-oriented approach. In the context of social projects, the process is of greater consequence than the outcome. It necessitates the involvement of the user, the stakeholder and the designer in a mutual exchange and joint exploration. This emphasizes the significance of collaborative processes over hierarchical relationships, as they foster democratic interactions that promote innovation and respect for all parties involved.

It was determined that the use of narration and experiential learning (Kolb & Kolb, 2017) were instrumental in fostering student engagement and comprehension of the project theme. These techniques facilitated an emotional connection to the issues at hand, which was identified as a crucial element in the success of social projects. It was generally agreed that to ensure the success of social projects, it is essential to transcend traditional power dynamics typical of commercial projects. This approach was seen to promote open exchanges that are innovative, respectful, and constructive for all stakeholders.

Another focus group discussion engaged 6 of the 12 institutions involved in RDE6. The feedback from these sessions indicated a favorable perception of the event and its outcomes, particularly in terms of the rapidity and efficacy with which innovative scenarios were generated. It was emphasized by participants that the RDE experience was pivotal in providing a multiplicity of perspectives and in identifying hitherto unconsidered strategies and resources. One participant described the RDE as “a journey of surprise and discovery about how we are perceived,” while another stated that the RDE “allowed us to embark on a new journey that we hope to extend to other citizens”. These remarks illustrate the transformative influence of the RDE on institutional perspectives and strategic planning (Juraschek et al., 2020; Carayannis et al., 2021). With regard to the subject of educational models, a particularly noteworthy observation was made. The RDE provided a clear path to follow, enabling the translation of a spontaneous activity into a replicable educational process. This highlights the role of the RDE in the formal structuring of innovative and spontaneous activities. Furthermore, feedback was provided regarding the schedule of the event. Some participants proposed extending the duration of the workshop, with intermissions between the intensive activity days. This recommendation emphasizes the necessity for a balanced scheduling approach that optimizes productivity while facilitating reflection and recuperation.

In the analysis of interviews conducted

with faculty and tutors, 16 individuals were interviewed, the majority being faculty members. The interviews focused on the influence of the learning environment and the effectiveness of different pedagogical strategies. Faculty members noted that workshops incorporating physical visits during the research phase or hands-on activities during the prototyping phase resulted in greater student engagement. Tutors highlighted that clearly explained phases of activities enabled students to self-organize more effectively. Tutors themselves played a crucial role in linking subgroups within each working group, facilitating communication and collaboration. Regarding the skills necessary for students working on projects with real clients, tutors emphasized the importance of the ability to interpret and critically analyze the challenges and briefs provided (Pontis & van der Waarde, 2020). Stakeholders underscored the heightened sense of responsibility and the adrenaline associated with designing for real-world contexts, such as an oncology department in a hospital. The opportunity to demonstrate the transformative potential of design in public service settings was found to be highly motivating. However, risks identified included hierarchical modes of operation (academic model: professors, tutor, students), performance anxiety, and the impact on the relationship with the partner organization or stakeholder.

The citizen science installation collected 187 responses to the scenario canvas and 127 completed postcards. The mapping of future scenarios for the role of the designer revealed that students envision a future designer more aligned with the roles of a creator and facilitator. Stakeholders, on the other hand, perceive the future designer as more of a scientist, while faculty responses were varied but leaned towards seeing the designer as a facilitator.

Key insights from the installation include:

- Designer Fears: The most common fears among designers are related to failure, such as “designing something insignificant” and “lack of inspiration.”
- What Designers Lack: Frequent responses indicated that designers often lack time and a work-life balance.
- When Designers Design: Responses highlighted the value of inspiration and ideological or economic stimuli as motivations for design.
- Designer Aspirations: Predominant responses focused on the desire to create change for societal improvement and personal well-being.
- Designer Beliefs: Half of the responses expressed the belief that designers have the tools to change society for the better.

These insights from the interviews and the citizen science installation provide a comprehensive understanding of the dynamics within the RDE6 event, shedding light on the perceived roles, motivations, and challenges faced by design students,

tutors, and stakeholders. The data emphasize the importance of practical, real-world engagements and the critical role of facilitation

in educational design projects (Figure 4).

Figure 4. Citizen Science Installation: Four-quadrant matrix with results. Students are pink, faculty is orange, stakeholders are violet, others are light blue.

5. Conclusions

This study presents a case of RDE (Event-Based Education) as an educational approach centered around event-driven learning. The case study concretely demonstrates how design education can effectively employ experiential and collaborative methods within a limited timeframe, leveraging challenges derived from external, non-academic sources (challenge-based approaches). The mixed-methods data collection process allowed for a nuanced analysis, revealing that this fiveday event successfully implemented multigenerational and multidisciplinary work methods in an educational context. The collected data enabled the authors to analyze the relationship between the projects developed by student groups and the pedagogical model employed, thereby validating the effectiveness of the proposed educational framework within the RDE.

While there was a notable improvement in students' competencies, particularly in time management, organization, and adaptability to unpredictability, the data confirm that the pedagogical framework is still evolving and requires further refinement. The findings provide insights into potential methods for more concrete monitoring and mentoring, particularly in assessing both the acquired competencies and the critical and responsible approaches developed by students.

Moreover, the analysis identified the strengths of such events in managing transdisciplinary relationships among the academic, public, and private sectors. Innovative approaches emerging from this study suggest promising avenues for research aimed at fostering stronger empathetic relationships with stakeholders and increasing awareness of the social, economic, and environmental impacts of design projects. These elements are crucial for helping young designers consolidate their values and create a cohesive team-building environment among educators, tutors, students, and stakeholders.

While the academic literature extensively documents the efficacy of design sprints within industryuniversity partnerships, their impact

on innovation projects and the public sector remains relatively underexplored. Therefore, the RDE presents a promising case for further study and pedagogical improvement. The implementation of collaborative learning experiences within the RDE demonstrated potential for mitigating hierarchical influences; however, the results indicate that educational models like RDE require robust coordination and time management strategies to ensure the inclusive participation of all students and stakeholders. This calls for further investigation into the role of educators and tutors as facilitators of the learning environment. Additionally, interviews highlighted the need to enhance the continuous evaluation and monitoring of the entire academic community's engagement (including faculty) to more accurately assess the efficacy of these educational experiences across all competencies, not just those of the students.

The authors propose the integration of this educational model into lifelong learning contexts within design education. This approach outlines research pathways for the co-design of new pedagogical and organizational methods aimed at enhancing the critical capacities of students and educators, and improving cooperation between design schools and local communities. These educational efforts aim to amplify the social impact of design through collaborations and servicelearning initiatives, which can lead to a greater understanding and appreciation of designers' actions by local actors and stakeholders across various fields and sectors.

Discussions in focus groups with stakeholders highlighted the success of event-based education in providing new perspectives and structuring educational processes towards innovation, focusing more on relationships (both social and professional) rather than strictly on entrepreneurship. The feedback underscores the need to optimize programming by balancing time dedicated to teambuilding with educational activities and stakeholder interactions, thus improving the overall experience of future iterations of the event.

Indeed, the results from various research methods suggest the need for measurement approaches that link social outcomes, unlock shared value among educators, stakeholders, and students, and develop scalable solutions in social and public contexts. Design pedagogy should adopt approaches that promote empathy and impact awareness, particularly within social ecology projects, to achieve changes at the individual, interpersonal, organizational, and societal levels. Empathy plays a crucial role in enhancing communication and understanding between individuals, strengthening community ties, stimulating cooperation and social collaboration, and promoting equity and social justice.

In the Rome Design Experience (RDE), fostering empathetic relationships with stakeholders and increasing students' awareness of the impact of their projects are achieved through several key methods. First,

collaborative design sprints allow students to engage directly with stakeholders in iterative, hands-on processes that prioritize frequent feedback and alignment with real-world needs. Second, stakeholder co-creation workshops encourage mutual understanding by involving stakeholders in the early stages of problem definition and ideation, ensuring that students consider their perspectives from the outset. Additionally, structured reflective practices guide students in critically assessing the social, economic, and environmental impacts of their work through individual and group sessions, facilitated by professors and tutors. The RDE also incorporates real-world scenarios and challenges, where students work on concrete problems provided by stakeholders, enabling them to understand the tangible impact their designs can have on local communities, PA and industries. Finally, ongoing stakeholder feedback throughout the event ensures that students remain responsive to stakeholder needs, fostering deeper empathy and refining the relevance and impact of their projects. These methods are integral to the RDE's pedagogical approach and ensure students are equipped to create designs that are both empathetic and impactful (Figure 5).

These methods are fundamental to the RDE's pedagogical approach and guarantee that students are equipped to create designs that are both empathetic and impactful. IHowever, it It is essential to explore how these practices can be applied in other educational settings. Event-based education, as demonstrated by the RDE, should be applied in various institutions and fields to promote greater impact awareness and empathy. Design schools in other countries should adopt similar methodologies to encourage a deeper connection between students and local communities. Similarly, universities in non-creative fields must use similar approaches to make their courses more oriented toward social and environmental impact.

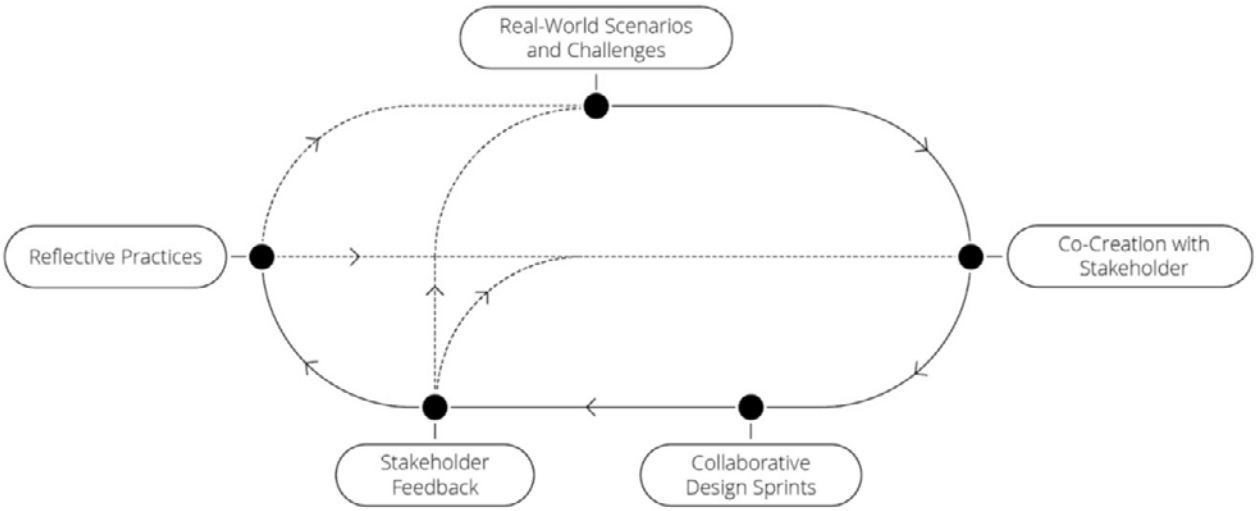

Figure 5. Rome Design Experience education model.

The RDE approach can be adapted to different educational settings by customising design sprints and workshops based on the specific needs and characteristics of various stakeholder groups. Furthermore, reflective practices and continuous feedback must be implemented in various academic programmes to enhance students' critical awareness and engagement with the impacts of their actions. Event-based education is a versatile and adaptable model that can and should be expanded to contribute to a more robust and responsible educational preparation across various fields and sectors.

In this context, event-based education appears to be a promising model for helping students develop personalized pathways based on impact awareness and empathy, even when these pathways diverge from traditional curricula and qualification frameworks. In today's rapidly changing social landscape, the role and responsibilities of higher education in creative fields are undergoing significant evolution.

Systemic design approach provides students with the tools to advance sustainable development goals through interaction, community building, and knowledge sharing. The relationship between design and society is both profound and multifaceted: design influences how individuals interact with their environment, fosters emotional connections, and promotes positive social change. Such understanding can be applied in a variety of educational contexts to foster global positive change.(Massari, 2024).

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EMPOWERING DESIGN: A FRAMEWORK FOR STIGMA-FREE DESIGN AND HUMAN AUGMENTATION.

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ABSTRACT | Designing assistive devices extends beyond clinical and technical considerations to include emotional aspects such as social stress, stigma, and shame, which are often neglected. Users of these devices frequently encounter subtle biases due to cultural stereotypes, challenging their self-reliance. This paper explores Product-Related Stigma (PRS) and how design can mitigate stigma, transforming perceptions from disability to extra-ability and human augmentation. We investigate the social constructs of warmth and competence, essential in social cognition and interpersonal perceptions, as defined by Fiske et al. Our proposed framework aids in creating stigma-free, human-augmenting products, featuring two design tools: the Product Intervention Model for Stigma (PIMS) and the Design Method for Human Augmentation (DMHA). PIMS includes 14 stigma-reducing design cards that inspire positive solutions by emphasizing warmth, fostering feelings of friendliness and approachability. The DMHA introduces designers to human augmentation, encouraging innovation in enhancing human capabilities and effectiveness, garnering respect and admiration while considering ethical implications. This dual-method approach, validated over five years in educational settings, has shown positive effects. By addressing both warmth and competence, these tools help promote empathy among design students, showcasing concepts that strengthen userproduct attachment, empower users, and enhance collective well-being.

KEYWORDS | INCLUSIVE DESIGN, STIGMA, HUMAN AUGMENTATION, DESIGN ETHICS

1. Introduction

A product-related stigma occurs when the product is the causal factor of social rejection or stigma. Due to their appearance and reinforced by existing stereotypes, people can link a product's appearance or certain visual features to an existing social stigma, resulting in a stigma-eliciting product (Vaes, 2014). When a product with specific visual features has the potential to elicit stigma, it is not the stigma that is present in the product itself, but only the capacity to elicit stigma. The immediate situation and the culture in which the interaction occurs greatly affect the actual eliciting of this stigma potential and the force of its impact. As such, product-related stigma is confined to a product's meaning and significance. Product-related stigma can initiate a stigmatization process in which people (bystanders in various contexts) externalize these stigma meanings, so they can be observed and experienced by the product user or wearer.

Some assistive, protective, or medical products carry a long history of 'rejection,' while others become questionable or unaccepted as soon as they move out of their intended context. People who use or wear assistive, protective, or medical devices are often confronted with subtle, clearly visible, or even invisible reactions of bystanders or passers-by (Vaes et al. 2010, 2013). As such, an encounter with a person and their stigma-eliciting product is an impactful experience that results from the aesthetic and functional aspects of the artifact itself, the individual experiencing the stigma, the observing bystanders, and the cultural context in which the situation is set.

Stigma-free design is an approach to creating products that aims to counteract such negative attention to a user's condition. Additionally, design for human augmentation aims to improve human abilities not only for people with a temporary or permanent impairment but also for healthy individuals looking to improve their current capabilities. At its core, human augmentation is about empowerment. Hence, products designed with this concept in mind should not only make users feel stronger and more capable but also reinforce their personalities by providing intrinsic value and meaning.

The framework presented in this paper comprises two toolkits that aim to inspire user empowerment and extra-ability, instead of social stigma and disability.

2. Universal dimensions of social cognition: warmth and Competence

To understand Product-Related Stigma (PRS), we examine the social constructs of warmth and competence (see Figure 1). These dimensions, delineated by Fiske et al. (2007), are reliable across stimuli, cultures, and time and are essential in social cognition, addressing competition, status, and interpersonal perceptions. Fiske et al. state that individuals perceived as warm and competent elicit uniformly positive emotions and behaviour. In contrast, stigmatized groups are often negatively stereotyped on competence and/or warmth across cultures. These dimensions reflect answers to two basic survival questions: first, does the other intend to harm or help me (warmth)? Second, does the other have the ability to enact those intentions (competence)? Distinct types of discrimination result from each warmth-by-competence combination. The warmth dimension pertains to perceived friendliness, trustworthiness, and goodwill, with warm individuals eliciting positive emotions and being perceived as approachable. As the primary dimension, warmth predicts active behaviours: active facilitation (helping) versus active harming (attacking). Conversely, the competence dimension concerns perceived capability, intelligence, and effectiveness, with competent individuals garnering respect and admiration. As the secondary dimension, competence predicts passive behaviours: passive facilitation (association) and passive harm (neglect). These dimensions, universally applicable across various stimuli, cultures, and temporal contexts, offer insights into how bystanders perceive a product user and their stigma-sensitive product. Depending on the target group and demographic, designers can enhance social image by emphasizing warmth (friendliness), competence (capability), or ideally, both.

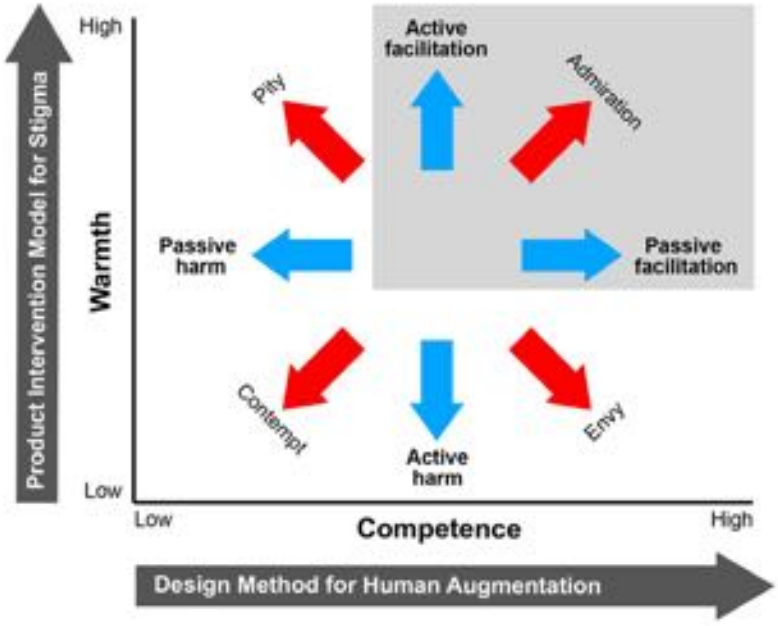

Figure 1. Behaviours from intergroup affect and stereotypes (BIAS) map (Fiske et al. 2007).

In Fiske et al.'s theory on the universal dimensions of social cognition, the four behaviours - contempt, pity, envy, and admiration - are positioned based on combinations of perceived warmth and competence. Applying these behaviours to the design of assistive devices can provide insights into user reactions and how to address them effectively.

Contempt: Low Warmth, Low Competence
Contempt arises when a person or entity is perceived as neither warm nor competent. This behaviour involves feelings of disdain or disrespect. Bystanders may view a user and their assistive device with contempt if it is seen as poorly designed (low competence) and lacks empathic communication (low warmth). Users might avoid using the device, spread negative word-of-mouth, and express frustration.

Pity: High Warmth, Low Competence
Pity occurs when a person or entity is perceived as warm but not competent. This behaviour involves feelings of sympathy or condescension. Bystanders may pity a user and their assistive device if it appears to have good intentions but fails to perform effectively. Product users might use the device out of necessity but with low expectations, possibly seeking alternatives.

Envy: Low Warmth, High Competence
Envy arises when a person or entity is perceived as competent but not warm. This behaviour involves feelings of jealousy or resentment. Bystanders may envy a user and their assistive device if it is highly effective but lacks user-friendliness or empathy. Users might rely on the device for its capabilities but feel disconnected or frustrated by its lack of warmth. Integrating more personalized and empathetic interactions and make the device more approachable and supportive.

Admiration: High Warmth, High Competence
Admiration occurs when a person or entity is perceived as both warm and competent. This behaviour involves feelings of respect, approval, and admiration. Bystanders admire a user and their assistive device that is both highly effective and user-friendly, radiating empathetic communication. Users are likely to have a positive experience, feel satisfied, and recommend the device to others.

Understanding these behaviours allows designers to strategically position their devices within the high warmth and high competence quadrant, fostering admiration and positive user engagement

3. The Framework for Empowering Desing

To battle product-related stigma and strive towards admiration (High Warmth, High Competence), the framework for empowering design operates along the two dimensions described above and preferably in a segmented approach.

We first apply the **Stigma-free design method (PAMS & PIMS)**. The implementation of both PAMS and PIMS can positively impact

the warmth dimension, helping to reduce negative perceptions associated with certain products. By emphasizing warmth, designers can create products that evoke feelings of friendliness and approachability.

In a second step, we apply the **Design Method for Human Augmentation (DMHA)**. Human augmentation refers to device-based technology designed to improve human abilities as an extension or integration of the human body. It can replicate, supplement, or exceed the user's physical, sensory, cognitive, and social capabilities, delivering true intrinsic value and meaning. Primarily applied in product design and engineering, human augmentation aims to transcend conventional design principles for (dis)ability (De Boeck, 2024). The DMHA introduces product designers to the field of human augmentation, encouraging exploration and idea generation for future advancements in human capabilities and prompting reflection on the ethical considerations of their conceptual designs. As such, the DMHA impacts the competence dimension, enhancing human capabilities and effectiveness, garnering respect and admiration while considering ethical implications. Competent products can be perceived as effective, innovative and reliable, advancing human capabilities beyond traditional disability-focused design solutions. Adding human augmentation elements assists in developing tools for users to cope with stigma. The user not only identifies with the product but feels empowered by it. When properly integrated, human augmentation can turn a user from a passive victim into an active challenger of stigma.

We will now elaborate on both tools of the framework.

3.1 Stigma-free design method (PAMS & PIMS)

3.1.1 PAMS – the Products Appraisal Model for Stigma

The best way to gather input on assistive devices is through actual immersion, by observing and questioning the user. Establish an empathic understanding with the user, observe and ask questions, and challenge your own assumptions. Immersive workshops in which designers and developers get to try and use these devices themselves are ideal to challenge one's own assumptions. Additionally, and prior to any design task, it can be useful to 'theoretically' delve into the context of the specific stigma-eliciting product, identifying the primary sensitivities for the product itself, the user, individuals they interact with, and society at large. To facilitate this exploration, we propose a checklist of 27 questions known as PAMS (Vaes, 2019) to uncover stigma pitfalls and social conflicts associated with the product.

The PAMS presents a systematic way of recording these insights. The PAMS questions are organised into three sets of nine, following a three-step sequence, from sensing (product perception), through

acting (product use), to meaning (reflection on product use). Within each set of nine questions, the standards, attitudes, and goals of three stakeholders involved in the human-product interaction are evaluated: the user, the bystanders, and the cultural context. The social pitfalls, conflicts, and challenges that emerge from the PAMS can be useful to pinpoint shortcomings of an existing product solution or they can be considered prior to the design of a new product solution. However, failure in addressing the important issues brought up by the PAMS could lead to product rejection by the stakeholders.

PAMS Matrix 1: Questions assessing appraisals related to product perception.

In this matrix, we assess how stakeholders perceive a user of an assistive device through all their senses. Completing this matrix will reveal tensions between the sensory product appreciations and the concerns of the three stakeholders. The designer needs to consider all sensory incongruities that might upset others or cultural norms and values. Products can be more than just sensory repellent to their users; they can represent sensory discomfort to their surroundings and can even go against cultural tastes. Additionally, the perception of a product and its user might conflict with the goals of bystanders, potentially distracting or influencing their behaviour. The sensory qualities of products may conflict with the stakeholders' values and standards, which can express personal or cultural value or significance and are variable in time and place. When assessing the goal appraisal, one should also reflect on how the sensory aspects of a product can motivate its user to wear or use the product. Obligatory product use or dependence on a product has never been a rewarding motivation for product use.

PAMS Matrix 2: Questions assessing appraisals related to product use

This matrix evaluates stakeholders' intentions regarding physical interaction with the product and examines how this interaction aligns or conflicts with their standards, goals, and attitudes. It addresses usability aspects, the distinction between obligatory and desired use, and the impact of use on various stakeholders. When users assess whether a product meets their standards during use, they consider any uncomfortable episodes and how these episodes make them feel. Additionally, to achieve certain goals, the product might require additional functionalities, such as being waterproof, dustproof, or adjustable.

From the perspective of bystanders, this matrix reveals whether the product in use is likely to negatively stereotype its user or hinder the bystanders from achieving their goals. What is comfortable and efficient for the product user might obstruct the goals or freedom of the bystanders. On a cultural scale, product use can indicate undesirable social behaviour and conflict with societal norms regarding decent behaviour.

PAMS Matrix 3: Questions assessing appraisals related to consequences of product use. This matrix represents the cognitive interpretation area where stakeholders evaluate their expectations of product and user behaviour, and assess whether these meet their standards, goals, and attitudes. These nine questions relate to stakeholders' perceptions of the product and its user, and the 'meaning' of these interactions.

Reflecting on the interaction, users can determine whether the product met their goals and whether they tolerated the interaction out of necessity or enjoyed certain aspects. On a higher level, we question whether the interaction conflicts with the user's expectations and beliefs. How do bystanders perceive our user after the interaction, and does this affect them mentally? These perceptions can extend to the cultural level, where users may be stereotyped by cultural values, even when they are not engaged with the product.

It is important to note that not all questions in the PAMS need to be answered. Depending on the product and context, some questions might even be irrelevant. The questions intentionally overlap and present slightly different perspectives, so it is not crucial which specific questions reveal the necessary insights. What matters is that all questions are considered and that the necessary stigma sensitivities are addressed. Some users of the PAMS have reported this overlapping nature as an important quality of the model, stating that it challenges them to delve deeply and report even the slightest variations in human behaviour.

The stigma specific sensitivities, conflicts, and challenges that are revealed through the PAMS can serve as input for the next design tool, the PIMS (Product Intervention Model for Stigma), which proposes stigma-reducing design interventions that seek to 'heal' the product of its stigma content. In this publication, we do not elaborate on the PAMS tool.

3.1.2 PIMS – The Product Intervention Model for Stigma

In a second step, we provide 14 inspirational stigma-reducing design cards shown in Figures 2 and 3 (Vaes, 2019). The purpose of these cards is to inspire designers to develop concepts that not only address the defined stigma challenges, but can also enhance user-product attachment, user empowerment, and collective wellbeing.

Re-shaping the meaning of the product

The context that is best understood by designers is the appearance of the product. Aspects such as shape, material qualities, and other sensory aspects all belong to the physical product context.

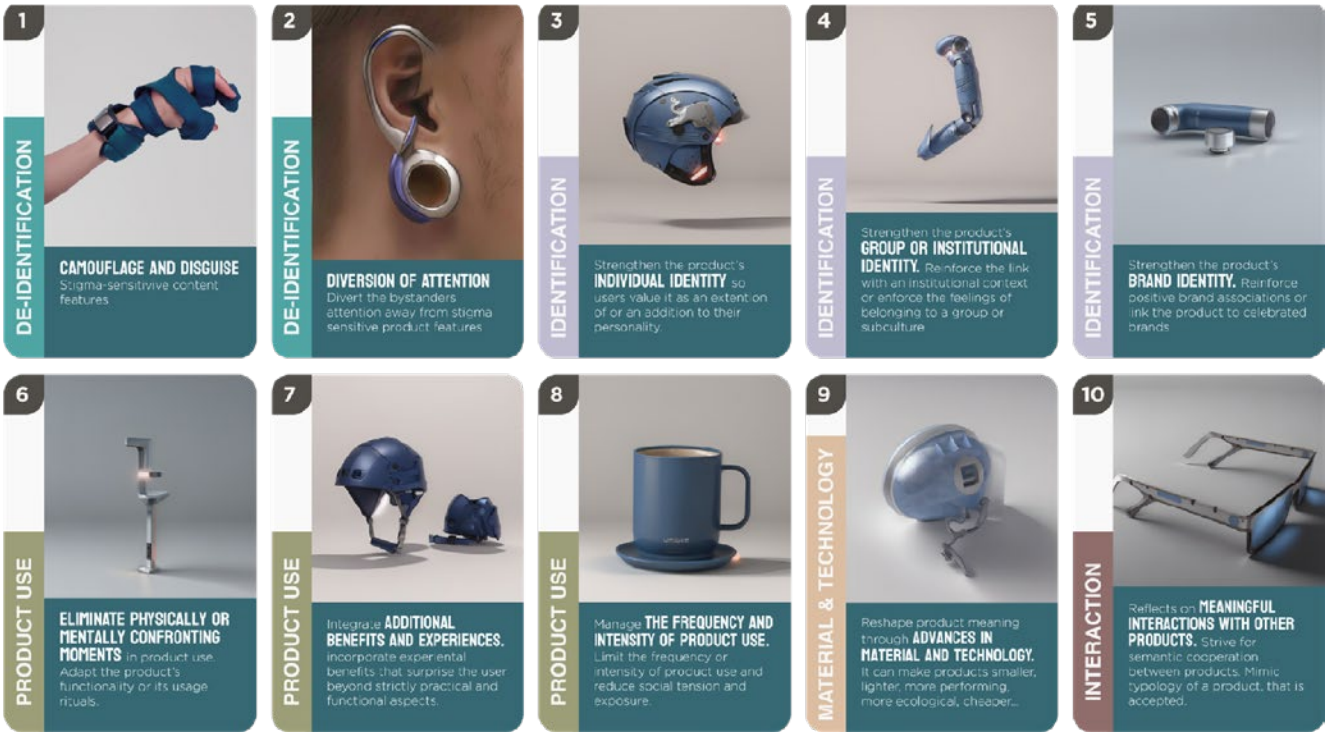

Figure 2. PIMS - Ten design interventions that aim to re-shape product meaning.

- Intervention 1: Camouflage or disguise stigma-sensitive product features. Use translucent or skin-coloured materials to hide obtrusive design features, potentially rendering a product invisible. This can signal product undesirability and increase user vulnerability, potentially reducing assertiveness in social settings.
- Intervention 2: Divert attention from stigma-sensitive features. Redirect attention to more appealing or eye-catching features to detract from stigma-sensitive aspects.
- Intervention 3: Strengthen the product's individual identity. Communicate individuality or personality through design aesthetics, allowing users to incorporate their own 'creative mark' via mass customization or personalization.
- Intervention 4: Strengthen the product's group or institutional identity. Design products to evoke feelings of belonging to a social group or subculture, providing emotional support, social validation, and a sense of community.
- Intervention 5: Strengthen the Product's Brand Identity. Reflect the identity of a positively perceived brand in the product, disconnecting from any negative brand affiliations to enhance user experience.
- Intervention 6: Eliminate confronting moments in product use. Adapt the product's functionality or usage rituals to avoid physically or mentally confronting moments.
- Intervention 7: Integrate additional benefits and experiences. Incorporate experiential benefits that pleasantly surprise the user during product operation, beyond practical or functional aspects.

- Intervention 8: Manage the frequency and intensity of product use. Reduce the frequency or intensity of product use to limit social exposure, providing mental alleviation or physical freedom.
- Intervention 9: Advances in material and technology. Utilize new materials and technologies to transform the product, making it lighter, stronger, more ecological, cheaper, and more accessible.
- Intervention 10: Aim for semantic and meaningful cooperation with other products. Design products to interact cooperatively with other products, combining positive traits to improve acceptance. Products can mimic the shape of accepted objects or complement each other's typology for strong design outcomes.

Empowering the user against product stigma

- Intervention 11: Endow the product user with extra-abilities. Instead of adding disabilities, enhance the user's abilities beyond those of 'abled' users. This intervention should inspire users to engage in meaningful and stigma-challenging activities, further expanded in the DMHA.
- Intervention 12: Boost the user's social skills. Encourage users to compensate for stigma by enhancing their social skills, becoming visually or verbally more assertive to overcome product-related stigma challenges.

Reshaping the social and cultural context

- Intervention 13: Reshape the product's cultural meaning. Challenge designers to reshape the product's cultural meaning through campaigns or interventions that educate or change public views. Consider design interventions in public spaces to promote interaction or appropriate behaviour.
- Intervention 14: Increase positive social visibility and product endorsement. Reshape the product's cultural meaning by increasing its positive social visibility. Endorsement by influential figures can significantly impact acceptance.

Figure 3. PIMS - design interventions that aim to empowering the user against product stigma and aim to reshape the social and cultural context.

It is important to mention that the interventions aim to inspire designers and suggest a general design direction. Applying the appropriate intervention is a creative and generative process that requires both expertise and practical experience. A properly designed stigma-free product is often the result of several and often overlapping interventions that create positive impact on bystanders, user-product attachment, and collective well-being.

3.2 Design Method for Human Augmentation (DMHA)

Human augmentation aims to transcend conventional design principles for (dis)ability. Primarily and increasingly applied in product design and engineering, a new design method has been developed to address the unique challenges and opportunities involved in enhancing human capabilities. Accordingly, the DMHA enhances the competence dimension by improving human capabilities and effectiveness, earning respect and admiration while addressing ethical considerations.

The DMHA was developed to introduce product designers to the emerging field of human augmentation, aiming to stimulate innovation while ensuring the ethical development of future design concepts for the augmented human. This design method was translated into a functional tool to enable validation through workshops. Figure 4 shows the structure of the human augmentation tool, which is subdivided in three educational learning goals or levels: an exploration, an ideation, and a reflection level.

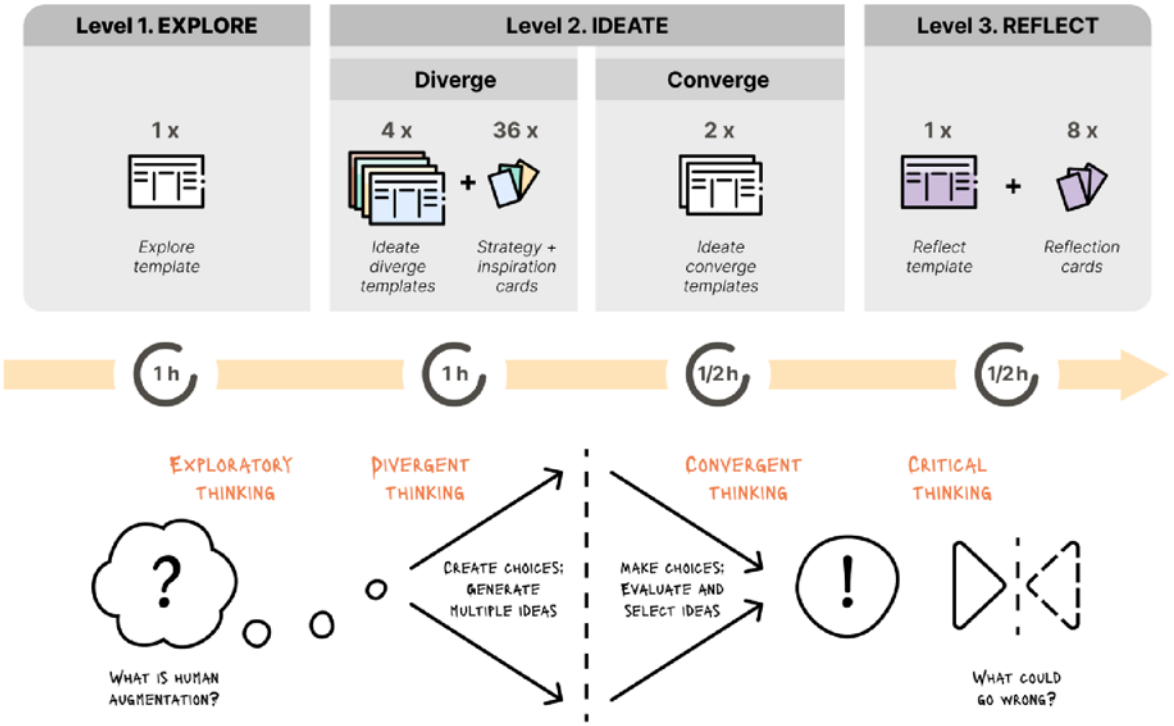

Figure 4. Structural model of the human augmentation tool

The human augmentation tool aims to facilitate various approaches to designing for the future human. Accordingly, the first level focuses on igniting exploratory thinking and introduces a framework that expounds the categorical and dimensional classifications of human augmentation identified in the literature. As depicted in Figure 5, human augmentation consists of three different dimensions i.e., replicating, supplementing, and exceeding a human ability, and four different categories i.e., physical, sensory, cognitive, and social augmentation. The framework was developed to help product designers better understand and characterize the type of human augmentation product they are designing by identifying its location(s) in the framework. As such, participants start by selecting an existing body-near product, providing a clear description of all its functions and locating them within the framework. As an initial exploration, they are then encouraged to consider the other categories and dimensions, brainstorming about additional possibilities and innovative features that could improve their initial product.

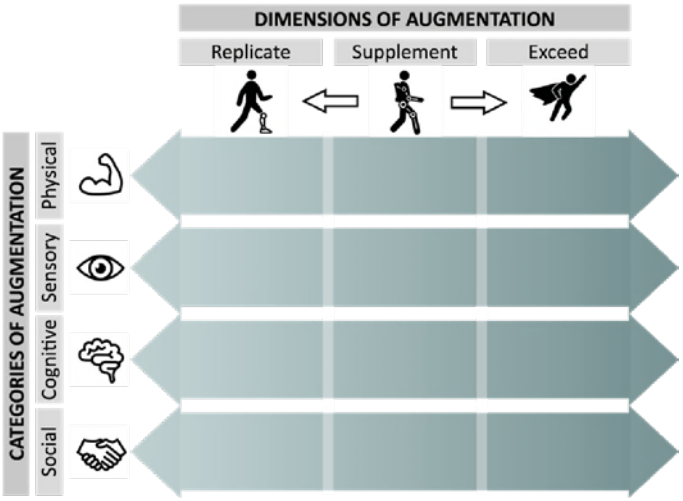

Figure 5. Human augmentation framework, presented in the first level of the tool.

The second level consists of two subparts. Within the first subpart, participants are encouraged to engage in divergent thinking using design strategy card sets, which are designed to prompt the generation of new ideas. Each set of cards corresponds to one of the four categories, with the back of each card providing an example to guide participants. The tool comprises a total of twenty-three strategy cards that were identified through a systematic analysis of 123 student projects (De Boeck & Vaes, 2024). These include seven for physical, four for sensory, six for cognitive, and seven for social augmentation. Additionally, a few extra inspiration cards are included to further stimulate creativity. The sets of cards are visually represented by an exemplary card in Figure 6. The second subpart involves convergent thinking, where the generated ideas are discussed, evaluated, and refined to create cohesive and innovative concepts. This process involves identifying creative product proposals as a team, highlighting the importance of solution identification, decision-making, and teamwork in the development of human augmentation products.

Figure 6. Design strategy cards and inspiration cards, presented in the second level of the tool.

Finally, the third level challenges participants to reflect on potential ethical issues that could arise from their newly developed concepts. Using eight reflection cards, participants are guided to consider worst-case scenarios, helping them identify how seemingly promising future concepts might encounter ethical concerns. The themes on the cards (listed in Figure 7) are drawn from literature, where many academics have discussed ethical issues related to human augmentation (Caon et al., 2016; Forlano, 2017; Naughton & Daly, 2020; Oertelt, 2017; Record et al., 2013). Again, the back of each card provides an example to further clarify the issues to the participants.

Figure 7. Reflection cards, presented in the third level of the tool.

4. Conclusions

The presented 'design for empowerment' framework challenges designers to break stereotypes and think beyond better ergonomics, pure functionality, and legal and technical restrictions. Properly integrating this framework can boost user involvement and enhance abilities, surpassing those who do not use the product. The framework applies to a wide range of products and services

aimed at improving the lives of individuals with situational impairments, those who are differently or temporarily abled, and anyone needing care through an assistive product or service. Ultimately, this framework may become universally applicable, as everyone will experience some form of impairment or need for care at some point in their lives.

Over the past five years, the Stigma-Free Design Toolkit has demonstrated its value in educational settings and as part of research and validation projects in the field of Inclusive Design. Initially perceived as complex, the PAMS model prompted 59% of students and users to engage in high levels of abstract thinking. By displacing designers into the context of the user, PAMS allows them to systematically uncover the challenges and realities faced by people with disabilities and their assistive devices. Thus, PAMS should complement personal immersion, observation, or empathic understanding, synthesizing and structuring insights derived from actual user contact and real-life challenges.

Both students and design teams have noted that the PIMS intervention cards assist designers in reducing negative perceptions associated with certain products. Reducing product-related stigma positively impacts the perceived warmth of the product user, evoking feelings of friendliness and approachability. A properly designed stigma-free product typically results from several overlapping interventions.

Instead of focusing on de-identification interventions that may increase users' mental vulnerabilities and conflict with the need for a strong social presence, it is more beneficial to invest in interventions that foster social confidence, optimism, and competence in social contexts. Aligning product identity with individual preferences and broader group, institutional, or brand identities can enhance product attachment and evoke feelings of pride, joy, status, and belonging. While effective, identification interventions that add ego-enhancing features provide extrinsic benefits and may not inherently strengthen users, potentially increasing their vulnerability in the absence of these features.

Interventions aimed at reshaping product use should focus on eliminating physically and mentally confronting moments to make product use more enjoyable. Designers can enhance this experience by adding benefits or managing social exposure through the frequency and intensity of product use. Considering new materials and technologies is essential, as they can lead to significant advancements, making products lighter, stronger, more ecological, and more capable. These innovations enable the exploration of design solutions that enhance the body's abilities, allowing users to transcend disabilities. The final product intervention, where less accepted products incorporate elements from more celebrated ones, has inspired many designers and students, showing promise in acceptance and innovation.

The PIMS model also emphasizes user-focused interventions aimed at empowering users, transforming them from passive recipients to active challengers. Enhancing users' abilities and social skills can protect and boost self-esteem, enabling them to overcome negative societal reactions. This empowerment extends beyond individual users, benefiting others with similar stigmatizations. Additionally, efforts to change cultural attitudes towards disability and assistive devices, such as campaigns and structural interventions, are crucial in supporting these design endeavors. In conclusion, we trust that, in the hands of a trained designer, the Stigma-Free Design Toolkit has the potential to alleviate the effects of stigma surrounding assistive devices and increase both user-product attachment and collective well-being.

In addition, the human augmentation tool has been conceived through the analysis of 123 student projects and was implemented in an academic context for two consecutive years for validation. Student feedback on this tool, gathered through an online questionnaire, highlighted several key aspects of its usefulness. In perfect alignment with our goals, one student stated that human augmentation "can leverage someone's impairment to a higher level, transforming it into an asset." Another student described the tool as "an efficient way to quickly generate high-quality concepts," emphasizing its ability to produce valuable ideas in a short time. It was also credited with "broadening their scope," suggesting that the tool expanded their field of creative thinking. Moreover, praised as "a complete set that taps into creativity," the tool provides comprehensive support for idea development. Students found it helpful for "finding their way in chaos," indicating its utility in navigating complex creative processes. Furthermore, they appreciated the "strong foundation at the start of the design," making it highly "deployable in a team." The tool strikes a "perfect combination between realistic thinking and more imaginative idea generation," blending practicality with creativity to enhance the design process.

As human augmentation can be made for anyone, including users who may or may not face an impairment, it pursues to go beyond stigma-free design by focusing on empowerment and making any user feel more capable (De Boeck & Vaes, 2024). With the rapid advancement of technology, there has been a growing interest in not only restoring but also surpassing human abilities. The growing importance of human augmentation technologies, the novelty of the proposed research field, and the significant practical and ethical considerations involved, have contributed to the drive of this study and the development of the human augmentation tool. By providing a tool that enhances capabilities, product designers can empower individuals and positively impact their self-perception. When individuals feel more capable, they are likely to project this confidence in social

interactions, which can influence how others perceive their competence. Overall, as human augmentation has the potential to significantly influence perceptions of competence by enabling individuals to exceed typical human limitations, it can reshape how society views capability and (dis)ability.

Within previous research, we also discovered that social augmentation has not been as thoroughly studied as the other categories, despite its significant potential value for empowerment. Social augmentation aims to improve social skills by supporting collaboration, communication means, and interaction, which can positively influence how individuals are perceived in terms of their competence. During the implementation of our tool in academic settings, we observed that student product designers frequently overlooked the aspect of social augmentation. By also broadening this perspective, the human augmentation tool has the potential to significantly contribute to social empowerment, which in turn can improve perceived competence.

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Kristof Vaes is professor inclusive design and design for interaction. With prior experience in design teams, his academic work focuses on developing products and services that enhance individual performance and well-being and foster social participation in our diverse society.

Muriel De Boeck, a PhD student in Product Development at the University of Antwerp, researches a framework for human augmentation products that empower users while enhancing their individual and contextual identity, adhering to ethical standards and respecting social values.

DESIGNING A PARTICIPATORY PROCESS TO IMPLEMENT TECHNOLOGY-BASED PROJECTS IN VULNERABLE COMMUNITIES.

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ABSTRACT | The state of Chihuahua is characterised by being a mainly arid ecosystem, where the effects of climate change are contributing to create new conditions of extreme vulnerabilities (Janssen 2006; Ribot 2011). This aspect, together with the rapid socio-environmental changes, brings to the need to understand how design could evolve to face the new challenges in the vulnerable communities of this region (Brown 2017; Giorgi 2022; Wen 2020). Contrary to the vision that considers technological development and community approaches as antithetical themes, the main research question that addresses this paper is: how design can facilitate community appropriation of interventions based on accessible technological resources, in order to improve the built environment, quality of life, and climate change? The research project is an ongoing project and the outcomes here presented have been developed between 2022-2024. The project which is based on a strong connection between researchers and communities' members, were developed following these methodological stages of participation (Winter 2019; Groat 2013): (1) semi-structured interviews; (2) walks; (3) co-mapping; (4) definition of indicators; (5) project reflection; (6) definition of technological resources. By implementing a process of participation with communities' members, six projects were defined whose objectives are to generate, through accessible technological resources, a change in the local community towards sustainable, socially and financially viable models. The six projects developed can be summarised as follows: PASO DEL NORTE – Mobility HUB: Implementation of an electric bicycle network to improve accessibility to urban services in the neighbourhood, with a focus on training residents to transform traditional bicycles into electric bicycles and promoting entrepreneurial activities. PASO DEL NORTE – Technology HUB: Transformation of a kiosk into a technology center equipped with solar energy, Wi-Fi, projector, tablets, aimed at improving educational activities and reducing the digital divide in the community.

NUEVAS DELICIAS – Agri HUB: Installation of smart greenhouses and water and solar energy collection systems to experiment with new forms of sustainable agriculture and address the water deficit in the region.

JULIMES - Water HUB: Implementation of water filters to remove arsenic and fluoride from wells, along with awareness activities to improve the quality of life of residents.
BASASEACHIC – Environmental HUB: Environmental awareness through the installation of greenhouses, solar panels and biodigesters in a secondary school, as well as the distribution of air quality meters to monitor, with community science processes, pollution in homes in the region.
BASASEACHIC – Tourism HUB: Development of a tourism project focused on promoting night tourism for stargazing, through training students in the use of telescopes and drones. Based on the framework above described, this paper introduces results by: (1) introducing design responses that resulted from the process described in each of the six categories, (2) explaining how the design of these spaces has been embedded with the communities' members, (3) providing details about construction process, level of community engagement, use, and budget, (4) based on previous experience developed by the authors in China, Italy and Mexico, this paper provides explanation and comparisons on how this methodology can be applied in other cities.

KEYWORDS | URBAN VULNERABILITIES, VULNERABLE COMMUNITIES, TECHNOLOGY-BASED PROJECTS, RESEARCH BY DESIGN, DESIGN FOR VULNERABLES

1. Introduction

In a society that sees increasingly frequent and disruptive radial changes, urban-architectural design cannot remain outside the discussion on what its role should be in the present. If we consider "vulnerability" as that condition in which a factor external to a system can put the wellbeing of the system itself at risk, it is clear that these current changes more easily put vulnerable realities into crisis, and it is precisely in these conditions that deeper reflections must be made in terms of the role and responsibility of design (Jonas, 1985). Considering, moreover, that these conditions of vulnerability depend on the political, economic and technological power that the realities possess, it is interesting to analyze in particular how it is precisely the "new" technological sphere that can activate important thoughts in terms of new vulnerabilities, unexplored potentials and processes of technological acceptance in vulnerable communities (Aftergood, 2016; Anders, 1980; Galimberti, 2012).

In this context, the research project "Design for Vulnerables" is developed, which aims to define a design methodology capable of facilitating the acceptance of accessible technological resources in vulnerable communities to reduce the very conditions of vulnerability and the digital divide. This methodology is based on citizen participation processes that, although very fashionable in recent years, remain a topic of debate in terms of methodologies, objectives and even definition (Groat, 2013). In particular, if the concept of "participation" sounds attractive to government or philanthropic entities that carry out interventions in communities, participation is often limited to listening to problems or expectations. The research project presented here combines the challenges related to the acceptance of technological resources to eradicate conditions of vulnerability and the challenges related to participatory processes (Brown, 2017; Janssen, 2006). The study of these challenges is carried out in contexts of vulnerability in a semiarid region of Mexico.

1.1 Challenges, Vulnerabilities and the semiarid region

The "Design for Vulnerables – Technology Challenge" research project is currently being conducted in four distinct communities situated in the state of Chihuahua, Mexico (see Fig.1). These communities were selected due to several compelling factors: (1) their residents are facing local vulnerabilities stemming from both human-made and natural challenges; (2) each community possesses untapped potential for sustainable and regenerative development; (3) these communities are dealing with significant impacts from climatic and environmental changes prevalent (Ribot, 2011) in a semi-arid region such as Chihuahua; and (4) each community represents a unique setting —urban, peri-urban, rural, and forested— which serve as models for other regions exhibiting similar contexts.

1.2 Paso del Norte (Chihuahua, Chihuahua) — Urban Community

Paso del Norte (28°67'41.77" N, 106°06'90.05" W) is a semi-formal urban community situated within the municipality of Chihuahua. Established in the 1970s, as a solution for families migrating from rural areas seeking housing in the city. The main characteristic of Paso del Norte is its geographical setting: it is perched on the slopes of a mountain range that restricts urban expansion and is divided from the formal urban area by an urban highway and the Sacramento River. This geographical isolation poses challenges for residents, contributing to feelings of exclusion and insufficient access to essential services. Accionética, a local association led by Virginia Aceves, has dedicated the past seven years to work within the community, focusing primarily on organizing recreational and educational initiatives for children and youth. Through comprehensive analysis and mapping of community assets and challenges, two prominent issues have been identified by residents: (1) improving accessibility to and from the community, and (2) enhancing access to technological resources that facilitate learning activities promoted by Accionética.

1.3 Nuevas Delicias (Chihuahua, Chihuahua) — Peri-Urban Community

Nuevas Delicias (29°07'19.96" N, 106°25'16.02" W) is a peri-urban town within the municipality of Chihuahua, founded after the Mexican Revolution (circa 1910-1920) to redistribute land from wealthy landowners to poorer populations. The Union Agrícola y Ganadera of Nuevas Delicias primarily oversees the management of communal resources and production sites. Moreover, this community is very important in the region since it is home to several educational institutions that attracts students from surrounding agricultural region, encompassing an elementary school with 300 students, a secondary school with 250 students, and a high school with 100 students. Moreover, organizations like the "Club del Abuelo" actively collaborates on various initiatives within the community. However, climate change and the mismanagement

of water resources, pose serious threats to the sustainability of agricultural practices in Nuevas Delicias. During community workshops, participants highlighted the urgent need to address these environmental challenges and water consumption sensibility.

1.4 La Regina (Julimes, Chihuahua) — Rural Community

La Regina (28°24’45.1” N 105°27’05.3” W) is a rural community located within the small municipality of Julimes, with a strong agricultural focus thanks to the relative abundance of water sourced from the Conchos River. Despite this availability of water, the community faces severe contamination issues—particularly with arsenic and fluoride levels—which jeopardize the health of its residents. Although both state and municipal public authorities, alongside private sector interventions, have made tremendous advances to mitigate water quality issues, some problems persist and the current methodologies to make water drinkable, such as reverse osmosis systems, lack effectiveness. Although numerous socio-economic emergencies exist, predominantly linked to extreme poverty, community members unanimously identify water quality as the paramount issue needing immediate and comprehensive attention.

1.5 Basaseachic (Ocampo, Chihuahua) — Forest Community

The community of Basaseachic (28°12’14.1” N 108°12’34.5” W) is nestled in the municipality of Ocampo, located in the western Sierra Madre, commonly referred to as the Sierra Tarahumara.

The region’s natural resources and scenic landscapes render the Sierra Tarahumara one of Mexico’s premier tourist destinations, with Basaseachic renowned for hosting the highest continuous waterfall in the Americas. Despite its natural allure, the local tourism industry suffers from a lack of visitor retention. Moreover, the community’s ecological and social frameworks are under threat from excavating operations, combined with the negative impacts of climate change and a general apathy towards environmental conservation. During community workshops, two critical themes surfaced, indicating the residents’ desire to engage actively on these issues: (1) fostering greater environmental awareness among the population, and (2) developing innovative and sustainable tourism offerings within the municipality.

Figure 1. The four locations of the research project: Paso del Norte (urban), Nuevas Delicias (periurban), La Regina (rural) and Basaseachic (forestry).

2. A six-step participative process

To optimize the results of community participation, the work was structured according to six main phases of collaboration with the community, preceded by two phases for preparing the environment to the implementation of the six-steps. The following six steps have been:

1. Activity 1. Semi-structured interviews (Screening)
2. Activity 2. Walk around the neighborhood (Screening)
3. Activity 3. Mapping
4. Activity 4. Definition of indicators and vulnerabilities
5. Activity 5. Development of shared strategy / HUB
6. Activity 6. Definition of tech-based project

2.1 Preparing the process

As first activity, to prepare the process, a phase of knowledge of the contexts by the research group took place: in this pre-workshop, field visits were carried out and videos were recorded to document the territorial context of the four communities. In addition, the objectives of the

"Design for Vulnerables" (Dv) project and the structure of future methodological activities were presented to the stakeholders. Field visits were carried out in the communities, during which each expert conducted non-participatory observations, collecting video material on the socioenvironmental contexts of each area. The videos produced were shared among the team of experts to better define and understand the vulnerability of each community.

The second activity regarded the involvement of the main actors active in the context: the purpose of the "Design for Vulnerables" project was explained to the stakeholders along with the structure of future methodological activities, confirming the interest of the community. Prior to this activity, stakeholders expressed their willingness to voluntarily participate in the formulation, presentation and implementation of the "Design for Vulnerables" project.

2.2 Activity 1. Semi-structured interviews (Screening)

With the main actors, that is, those actors who first joined the project, semi-structured interviews were conducted to allow (1) to gain a deeper understanding of the context, analyzing those aspects that emerged in the initial approach to the community; (2) to begin to establish a relationship between researchers and residents that is deeper than those that are created in activities with many people. Without a doubt, this first activity allows for a very important awareness of the main themes to be studied.

2.3 Activity 2. Walk around the neighborhood (Screening)

In order to create an even deeper bond between the research team and the residents, as well as to have a deeper knowledge of the context, several field visits were organized with interviews and informal meetings between the main actors. The main objective of this activity remains the possibility that, by walking through the context, the residents could better express the concerns and hopes that characterize their normality.

2.4 Activity 3. Mapping

Participatory cartography workshops were held in each community for mapping and prioritization, lasting approximately two hours. The process was documented through photographic and video recordings, both with prior verbal approval by the participants. The activity consisted mainly of community mapping of vulnerabilities, potential for change, and factors that influence access to technology using a satellite image (map) of each territory printed in large format. Each community located social, environmental, and/or territorial problems on it. The identification, choice of symbology, and location of these problems was carried out through dialogue among participants and

with the guidance of technical facilitators (interdisciplinary experts). Colored labels, markers, and colored pencils were used for the symbology.

2.5 Activity 4. Definition of indicators and vulnerabilities

The fourth activity represents the last activity of this first "analysis" session and is about the community prioritization of vulnerability indicators in each community (Valderrey et al., 2023). A printed questionnaire was used containing the 50 ecological and social indicators proposed by the academy that are related to the six dimensions of vulnerability analyzed in the Project. The participants used a three-point Likert scale (0-not at all important; 1-somewhat important, and 2-very important) to assess their importance. Without a doubt, the main objective of this activity is to reflect, starting from a scheme of vulnerabilities defined by the academy, on the most relevant needs of the context with the results of (1) raising awareness about situations of vulnerabilities and (2) opening the reflection to the generation of ideas and proposals for the strategies to be implemented.

2.6 Activity 5. Development of shared strategy / HUB

Thanks to the list of vulnerability conditions developed in the previous activity and the reflection that the list generation produced, this review of the intervention strategies proposed by each community was developed. Then the team of experts structured the strategic lines of technological intervention based on the contextual characteristics of each community. These strategies have undoubtedly been the result of an imaginative process that wanted to propose a vision of radical change in the communities, without considering the specificity of each intervention or the technical aspects.

2.7 Activity 6. Definition of tech-based projects

Based on the definitions of the strategies, the projects to be implemented and the technological approaches that each of these should have began to be defined in joint work between multidisciplinary experts and community actors. Thanks to the support of experts in different disciplines and experts in technological resources, six projects were defined that contribute to the realization of the visions defined above. All the projects (Fig. 2) have an important technological component that facilitates the realization of activities that contribute to the objectives of each project.

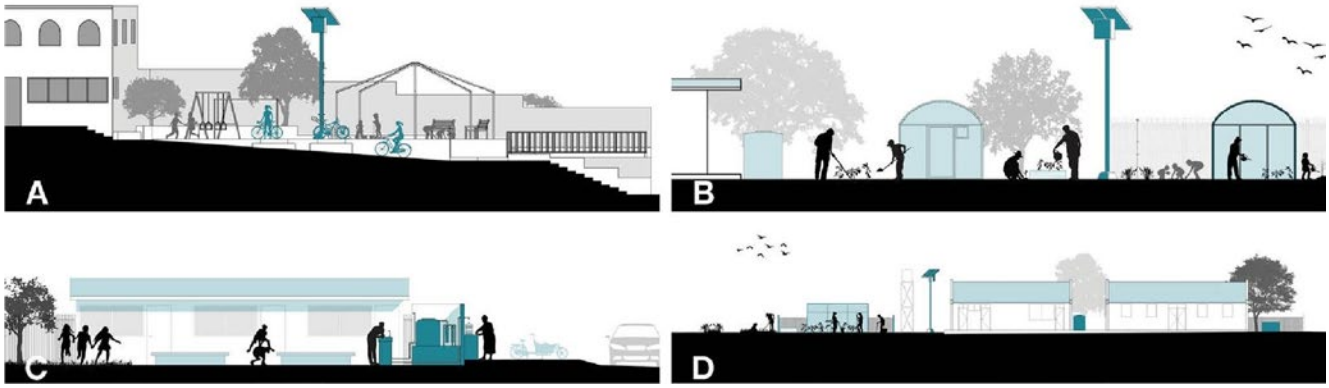

Figure 2. The designed interventions for the four communities (more drawings and pictures on the webpage www. designforvulnerables.com).

3. The six projects

During a period of 6 months (September 2023 to March 2024) the six projects planned with the communities have been implemented and the first activities supported by these projects took place. Here, we present the six projects and in the following section of “results” the main common characteristics will be underlined, so to present some final conclusions, which are the answers to the main question of this research.

Together with the communities, we decided to call all these projects as “hub” with the assumption that these interventions could be a first step where to generate and think about following steps toward a common shared vision of local sustainable development (Fig.3).

3.1 Paso del Norte – Mobility Hub

To facilitate the connection between the community and the formal city, an electric bicycle system that facilitates access to the community and urban services is being implemented. The initial phase of the project involved some public activities to make people “fall in love” with the technology. Then, according to the willing and the levels of participation, four bikes have been assigned to some families. At the same time, a workshop to modify traditional bikes to electric bikes has been organized, led by a professor in mechanical engineering. So, other four bikes have been assigned to other families which created their own electric bike. The main goal of theses phases was to introduce the technology in the community, showing the benefits and the facility to create it.

The second phase involves the installation GPS to other electric bicycles with the aim to leave them freely in the community and create a connection from the main square of the community to the Tecnologico de Monterrey campus, where the main transportation lines of the city pass.

The last phase (hopefully) is to support the community's entrepreneurial initiative for the generation of an electric bicycle service in other vulnerable communities.

3.2 Paso del Norte — Technology Hub

To facilitate the activities of the association and limit school dropout, an existing kiosk has been transformed into a high-tech public element: (1) a wifi router brings Internet to the community; (2) a projector, a screen and speakers allows residents to organize shared cinema activities; (3) tablets and 3D viewers allows Accionética to organize educational activities, together with experts or by themselves, for children, youths and women of the communities. All these electronic devices are supported by a solar panel that has been installed in the main square and which supports also the recharge of the electric bikes.

3.3 Nuevas Delicias — Agricultral Hub

In order to raise awareness about the importance of sustainability in agriculture and to promote new forms of agricultural production, the following projects have been implemented: (1) two "intelligent" greenhouses for the production of vegetables (high school) and flowers for sale (club del abuelo) have been installed together with a solar panel to make the sensors, computers and pumps work; (2) cactus cultivation for new techniques of fodder for livestock (in the secondary, a cactus garden was already been planted); (3) drip irrigation systems, with solar panels to sensibilize about water saving and humidity; (4) composting system for recycling food waste (in the primary school); (5) a drone system to supervise the maintenance of water resources and the surveillance of livestock, saving time, fuel and water. The five systems work in a circuit, so that the compost products are used for the greenhouses and gardens that feed the school canteens.

3.4 La Regina — Water Hub

To allow residents to access water supplies without having to resort to contaminating reverse osmosis systems and to avoid high energy consumption, five slow filtration filters have been installed in public spaces: one in the main public square and four within primary and secondary schools, with faucet installed inside and outside the schools' fences. These filters, developed by a local company, can remove significant amounts of arsenic and fluoride (all of them have been approved by the public authorities and are under periodical controls by the local health system). Moreover, to create understanding about the importance of filtering the water, some educational activities have been implemented with the schools and water quality testers have been distributed within the community.

3.5 Basaseachic — Environmental Hub

To raise awareness of the importance of caring for the environment and the social opportunities associated with environmental activities, the Basaseachic Secondary School and CONANP (National Commission for Natural Protected Areas) work together

with the “Environmental HUB”: (1) biodigester to recycle food waste from the canteen and heat classrooms with gas instead of firewood; (2) intelligent greenhouse to produce vegetables for local consumption and mushrooms for selling; (3) a scientific laboratory on air and water quality.

3.6 Basaseachic – Tourism Hub

To think about new possibilities for tourism and to offer a new digital image of Basaseachic (as a natural area with many tourism opportunities) a project with the high school and hoteliers has been implemented. In particular, the project works in the direction to promote a new offer for touristic activities in Basaseachic: taking advantage by the fact that this are of Sierra Tarahumara is one with the best region in Mexico to observe the starry sky, the high school proposes activities focused during night time, giving the opportunity to promote one-night stays in the local hotels.

Figure 3. The six projects developed within the project: (A) electric bike network in Paso del Norte; (B) technological gazebo for educational purposes in Paso del Norte; (C) agricultural hub in Nuevas Delicias; (D) public filters for potable water in La Regina (Julimes); (E) the environmental hub in the secondary school of Basaseachic; (F) the tourism hub, with the high school of Basaseachic.

4. Results

4-1 Design responses

A first result to highlight is related to the ability to involve the local community. Objectively, to date, it has not been possible to involve all the actors of interest for the participatory process: the public sector remains almost completely excluded from the urban project of Paso del Norte and the participation of society does not exactly reflect the population of the colony. This second fact can be related to the important role played by Accionética which focuses its work on the youngest segment of the population and on women's groups.

On the contrary, in the projects of Nuevas Delicias, Julimes and Basaseachic, there has been a strong participation of the educational sector (all levels of basic education) and an important participation of the local public administrative sector (Unión Agricola in Nuevas Delicias; the municipality, the Civil Protection and the State Health Secretariat; the municipality in Basaseachic). Objectively, the participation of the schools has made it possible to plan the projects, carry out the interventions and manage them.

It should be noted again that the lack of educational services in Paso del Norte does not allow a school to be involved as easily as in other contexts.

4.2 Design of spaces has been embedded with the communities' members

The implementation of the projects had important implications both in the physical spaces of the communities that were modified to allow the projects to be executed, and in the ephemeral organizations of the communities.

The changes in the spatial sphere are already distinguishable in section 2 "A six-step participative process" (Fig.2), where we see how: (1) the public square of Paso del Norte had to undergo modifications to install the solar panel, the technological kiosk and facilitate the use of bicycles; (2) the external spaces of the schools of Nuevas Delicias had to be rethought to accommodate the vegetable garden, the greenhouse, the rainwater collection tanks and the solar panel; (3) the spaces of the schools of La Regina had to internally accommodate water filters and the fences saw the emergence of these points of sharing with the external community; (4) the secondary school of Basaseachic made a significant modification of the land to better accommodate the greenhouse, all the connected systems and create the vegetable garden.

Beyond the new activities that associations and schools carry out thanks to the interventions, the changes in the ephemeral sphere mainly concern the changes that schools have made in their educational

programs: in Nuevas Delicias, the primary and secondary schools have made changes in the educational program to introduce the use of technological resources in teaching activities. The secondary school of Basaseachic has done the same, with very interesting results, by introducing an ecological laboratory in the various levels of teaching and the bachillerato has introduced a sustainable tourism class.

4.3 Applications of this methodology in other cities

In the years in which the "Design for Vulnerables" research project has been carried out (2021 – today), one consideration always appears very clear and indisputable: the conditions of vulnerability are contextual (Wen, 2020; Winter, 2019). For this reason, it would be unthinkable to propose these same solutions a priori in any other community, even if it were a community 5 kilometers from those currently involved. This fact sheds an important light on the role that the methodological process plays in tackling a design path together with a community of residents. As explained previously, even in a single project like this, the spectrum of participants is not uniform in the four communities due to different characteristics of the social fabric. Therefore, it is even less uniform in radically different social and cultural contexts. Therefore, the ability to observe and map – in the first instance – who are the main actors in a context, and try to be able to count on a balance of participation, without losing the presence of the main actors and without forgetting the less impactful ones, becomes an extremely relevant aspect. Which these are (whether public, educational, administrative, private, academic, associative, etc.) cannot be defined without knowing the context.

Secondly, an important aspect that emerged from the implementation of the six-step methodology concerns the importance of sensitivity, typical of the architectural discipline, to be able to read and interpret together with the community, the characteristics of a territory thanks to different means of communication and reflection. Now, since vulnerabilities are contextual, there is nothing more important than these processes of participatory reflection, which allow us to highlight the peculiarities of a territory, allowing, at the same time: (1) to bring the design group closer to the context, (2) to facilitate dialogue with the community, (3) to document a process rich in ideas that can prove important when introducing new actors, and (4) to reflect together with the community on the potential and vulnerabilities of the context, facilitating the emergence of visions that go beyond the normalization of reality and the rise of phenomena of awareness.

5. Conclusions

The process presented and developed during this project highlights that design has a fundamental role in the ability to create awareness. That is, it has always been

highlighted how the participatory collaboration between the research group and the community allowed communities to reflect on some issues specific to local vulnerabilities and that residents often know, but do not associate with conditions of potential and vulnerability. This consideration opens an interesting area of possible development linked to how the design process can be first and foremost - in certain contexts and needs - a promoter of awareness.

A further consideration is linked to the importance of being able to count on economic resources to be able to carry out the projects planned with the communities: a research on participatory processes that ultimately did not lead to the realization of some project would raise important concerns, beyond the ethical sphere, of continuity and depth of analysis: it would not be possible to thoroughly analyze the impact of participatory design, as we plan to do in this project, starting in the next few months.

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Author 1 add an author bio that describes research interests and main achievements in a maximum of 40 words. [LEAVE BLANK UNTIL FINAL ACCEPTANCE] [_P/RoD Author Bio and Acknowledgements]

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ARCHITECTURE OF DEGROWTH: A SPECTRUM

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ABSTRACT | Urban development projects are determined by current neoliberal economic policy values, the trajectory of growth, and these values are reflected in our public spaces. As a result, the value systems behind sustainable plans are often overridden. The reason, as asserted by scientific works focusing on the spatial aspects of degrowth (Kallis and Vansintjan, 2017; Lehtinen, 2018; Nelson and Schneider, 2019; Xue, 2022), is that these models originated within the paradigm of growth. Therefore, there is a need for a new theoretical foundation surpassing the scope of sustainable development, one that capitalism is unable to assimilate and that lies beyond the logic of growth imperative. Although there is not yet an all-encompassing, consensus-driven architectural, urbanistic, and design strategy, numerous studies outlining operational conditions and methodologies demonstrate that science generates the established knowledge necessary for degrowth to become tangible for practicing designers (De Castro Mazarro, Kaliaden, Wende, Egermann, 2023, p. 2). This study aims to modestly contribute to this process by (i) presenting the Architecture of degrowth as an interpretative spectrum and (ii) by comparing the Urban Sustainable Development Goals (USDGs) and the degrowth objectives. In the (i) section "The Spectrum of Architecture of Degrowth", the paper is situating Architecture of degrowth within the field of Architecture without Building (Yona Friedman, 1958), Architecture without Architects (Bernard Rudovsky, 1964), and Speculative Architecture (Liam Young, 2017) - at the same time distinguishing it from them. As the crisis of civilization and ecology have since taken even more extreme directions, these conceptual projects serve as real reference points for examining the spatial aspects of degrowth. The focus of the analysis is not the historical context but the compatibility of these early avant-garde examples with the current principles of degrowth. The investigated authors and studios do not reject architecture itself, but rather reject the conditions of their time. In this respect, these works align almost entirely with the contemporary principles of the Architecture of

degrowth. In section (ii) this paper proposes seven criteria that categorize and compare sustainable urban development and urban degrowth strategies, concluding that there are more commonalities than differences between the two strategies. Continued growth remains the one paradigm that represents the most significant impediment to sustainable and degrowth initiatives. From the perspective of urban development, a significant difference is that the USDG model increases the density of globally growing (by population), but shrinking (in available space) cities to enhance energy efficiency and accessibility. The objectives of degrowth are exactly the opposite: degrowth considers proportionate, human-scale, and liveable cities desirable. To conclude, the study offers an overview of the status of the Architecture of degrowth in Hungary, delving into a few significant publications (Lányi, 2020; Schneller, 2015) and highlighting some poetically beautiful realized works and plans (Baló, 2020; GUBAHÁMORI, 2022, AUW, 2022).

KEYWORDS | DEGROWTH, URBAN DESIGN, CRITIQUE OF SDGS, CLIMATE CREDIBILITY

1. Introduction To The Sence of Enough

The slogan, movement, and scientific literature of degrowth all stem from a new societal proposition born from the critique of growth, aiming to increase human well-being and improve environmental conditions by reducing production and consumption (Schneider, Kallis, Martinez- Alier, 2010). While its goals exhibit a kinship with the concept of sustainable development, degrowth envisions a fundamentally different trajectory toward the equitable distribution of resources or the enhancement of community self-determination in the realms of economics, the humanities, and the arts. This study primarily focuses on the architectural—particularly urbanistic—aspects of degrowth. The development of the theory of degrowth has already begun in various scientific fields, and although we are far from having a coherent model or dominant paradigm, representatives of the movement agree that degrowth—or a similar setup—is inevitable (Dombi and Málovics, 2015, p. 217). The concept of degrowth (décroissance) can be approached from three interpretive frameworks—slogan, movement, scientific theory— which, although not independent of each other (Kuslits, 2012), this study primarily deals with the scientific approach.

The theory, originating from the French movement, traces its roots back to Nicolas L. S. Carnot[1], who formulated the second law of thermodynamics (Latouche, 2011, p. 17). However, scientific research tends to place the antecedents of the theory in the fields of environmental economics and ecological economics, particularly emphasizing the works of John Stuart Mill, Karl Polanyi and Herman Daly. The forebear of green economists Mill, argued in his 1871 book, Principals of Political Economy, that the stationary state of capital would not imply stationary state of human improvement but on the contrary, if minds are no longer engrossed by the pursuit of economic gain, there would be a much greater likelihood of advancing the art of living and even the industrial arts (Mill, 1871). Ecological economics reject the existing of an economic necessity independent from social connections. To disprove the anthropological bases of this approach Polányi emphasises in his work The Great Transformation (Polányi, 1944/1975) that profit-based market exchange does not arise from unchanging human nature and is not the cause but the effect of capital-based economy. He proves that the two most important conditions of production, human work capacity and natural resources, are not capable of following the fluctuations of supply and demand, because they exist not for the purpose of sale but according to the order of life – the order of nature. Since then, his nightmare of market mechanisms being the sole director of the fate of human being and their natural environment causing social exposure, defiled

1 "In nature, most processes proceed in one direction and do not spontaneously reverse (although external influences can reverse the process). Such processes are termed irreversible."The ecological sciences frequently reference this principle in relation to the tipping point of ecosystems. Environmental processes can be simulated only up to a certain point; however, beyond a specific global average temperature (calculations vary) or a natural event (such as the cessation of the North Atlantic current), these processes become irreversible and unpredictable.

landscapes, and polluted rivers has become reality. The market rates do not reflect the multitude of species and habitats destroyed by the economically completely reasonable and wonderfully profitable exploitation. This is not due to prices but to the fact that nature is incapable of behaving like a product (Lányi, 2022, p. 45). Critics of growth have highlighted since the early 1970s that the finiteness of resources makes continuous economic growth unsustainable (Meadows et al., 1972). Moreover, in the long term, it incurs greater costs than benefits, as the relentless pursuit of monetary gain results in profound social inequalities and significant environmental degradation. Herman Daly who was the first to develop an economic model capable of ensuring increasing wellbeing without the growth of economic throughput (energy and material) (Dombi and Málovics, 2015, p. 202), and argued that the increased traffic of materials does not produce an increase in wellbeing, security or satisfaction (Daly 1973, 1996). "The more, the better" only applies to the economics of profit, while economics of subsistence seeks right measure: what is just enough. Since the turn of the millennium, contemporary critics of capitalism and growth have extensively examined the economic possibilities of degrowth (Kallis, 2018; Hickel, 2020). One theory of degrowth economic policy, the modern monetary theory, citing John Maynard Keynes, asserts that "What we can actually do, we can afford" (quoted by Pogátsa, 2023, p. 202), meaning the state can create money for public goods and services without the threat of inflation. Critiques of the theory highlight that actors of the market continue to produce even when resources are depleting – why would they choose to make the right decisions when the monetary resources are almost infinite?

The core principle of degrowth, likely borrowed from environmental ethics, can be summarized as follows: the need to halt growth is not only necessary (for environmental reasons) but also desirable (for social reasons). The tangible experience of destruction wrought by industrial and technological societies gave birth to ecological ethics. While early treatises on animal suffering have existed, it was the 20th century's recognition that human-induced environmental degradation threatens human existence that brought this issue to the forefront. "The time of history has met the time of evolution in our age." (Lányi, 2020, p. 161) Thus, ethics could no longer avoid making statements about the relationship between humans and nature. The animal liberation movement expanded species boundaries, paving the way for pathocentric (Ryder, 1996) and bioegalitarian (Taylor, 1981) views. Amongst others, Aldo Leopold, Arne Naess, and Holmes Rolston has put down the bases of ecological ethics. By introducing Land Ethics (Leopold, 1949) Leopold states that it is not the individual living beings but the living communities and the entire biotic community that hold moral value. Leslie Paul Thiele's most important conclusion is that neither the biocentric

approach, which attributes rights to nature and thereby limits the freedom of human civilization, nor the sociocentric approach, which strives to extend the freedom of human reason and personality beyond the human world, contributes to solving the environmental crisis (Varga, 2001, p. 100). Humans are just one among many species on Earth and only equal to them. Moreover, the Deep Ecology movement (Naess, 1989) states that moral consciousness implies the obligation to care, not privilege. From a designer's perspective, perhaps the most crucial guideline is that the intrinsic value of nature should compel us to treat the living world carefully, in accordance with our intellectual abilities, regardless of whether this is painful or comprehensible to them (Hale, 2011) in order to be "the shepherd of being" (Heidegger, 1985).

2. The Spectrum of Architecture of Degrowth

2.1 Precursors in History: Mixed Scale

According to Kallis (2011), Architecture of degrowth can be understood as an umbrella term that encompasses the critique of architectural philosophy and education, the institutional critique of the construction industry, moral objectives of architecture, and concrete proposals for feasibility. The development of these facets requires a multidisciplinary, and even transdisciplinary, approach, as it involves social inclusion and activism. This study argues that the Architecture of degrowth is not synonymous with the concept of "non-building" prevalent in professional jargon, but rather represents an interpretive spectrum that includes its architectural precursors as well as the exploratory models found in the latest scholarly literature (Fig. 1).

In the mid-20th century, system-critical groups, anti-war protests, the sexual revolution, and civil rights and feminist movements began to influence the arts, including architecture. The plight of the masses migrating to cities gained increasing public visibility, highlighting the chasm between high-end architecture and social needs (Frampton, 2009, p. 378). Some designers responded to phenomena such as value erosion, the threat of nuclear war, the space age, and rampant production and consumption with radical theoretical works. Given the increasing extremity of the ecological and civilizational crises, these conceptual projects serve as real reference points for examining the spatial aspects of degrowth. The following section compares the work of prominent figures in radical, avant-garde architecture and theory with the criteria of Architecture of degrowth (Table 1). The examination focuses not on the historical context but on the applicability of degrowth principles.

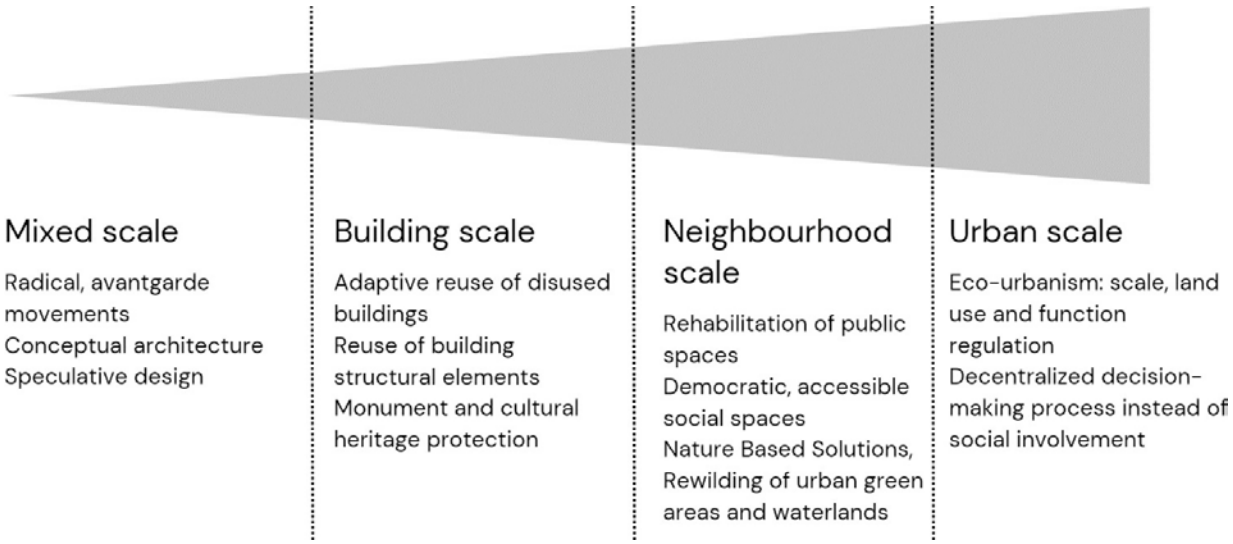


Fig. 1. The Spectrum of Architecture of Degrowth. Source: De Castro Mazzaro et al. (2023), Kallis and Vansintjan (2017), Lehtinen (2018), Nelson and Schneider (2019). Created by the author.

R. Buckminster Fuller created the first version of the Dymaxion house in 1927, designed from accessible materials and continually improved over decades. He extended the concept to the Dymaxion car, intended as an affordable alternative for transportation. In 1932, in response to the economic crisis, he proposed converting the vacant offices of skyscrapers into emergency housing (Frampton, 2009, 316). This idea holds particular relevance today in light of the ongoing construction of high-rise buildings in the U.S., which remain unoccupied due to real estate speculation, and the concurrent housing crisis (Schmied, 2021). In his 1969 book Operating Manual for Spaceship Earth, Fuller offers solutions to unemployment caused by automation, criticizes the continuous extraction of non-renewable resources, and questions whether material wealth metrics truly reflect human well-being.

Similarly, Yona Friedman proposed different solutions in his 1956 manifesto L'Architecture mobile, which envisions a flexible and mobile infrastructure accommodating an ever-changing lifestyle. This framework allows for free home creation, extending the right to build to the broadest societal strata. In his Spatial City plan, buildings minimally touch the ground, and residential units are freely modifiable and movable, responding to changing needs. According to Friedman, the supporting structure is neither definitive nor predetermined (Friedman, 1958). In 2011, a retrospective exhibition of Friedman's work, "Yona Friedman: Architecture without building," was held at the Ludwig Museum in Budapest. The museum quoted Friedman:

"We are building too much. We have overbuilt the Earth without providing suitable shelter for everyone. This overbuilding (like overdesigning and excessive agricultural cultivation) leads to environmental catastrophe. This is not a professional error of architects but partly

due to a misinterpretation of architecture. Architecture is not merely the art of building: it is the art of organizing space." (Friedman, Ludwig Museum, 2012)

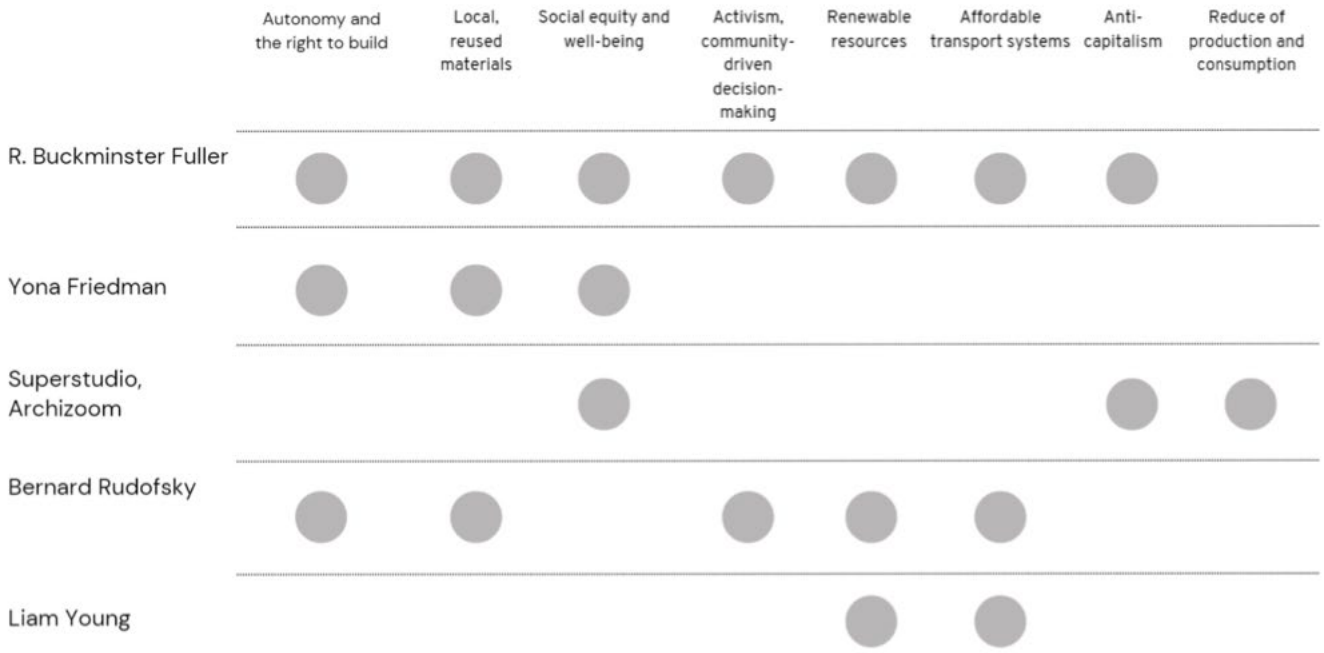
The exhibition likely contributed to the identification of Architecture of degrowth with the concept of non-building. However, as the quotation and his entire oeuvre suggest, non-building (or even anti-architecture) does not imply zero action. On the contrary, organizing space remains a necessary task.

Techno-optimistic yet anti-futurist and peaceful utopias were also envisioned by the Italian Superstudio group. They imagined a world without products and waste, where there is no need for architecture, only the manifestation of spirit (Frampton, 2009, p. 378). In 1971, founding member Adolfo Natalini wrote that "as long as design remains another reason for consumption, architecture merely legalizes ownership, and urban planning manifests social injustice, there is no need for design or architecture—whose task should be to satisfy real needs" (Didero, 2017, p. 290). Superstudio's radical anti-architecture thus rejects not the act of building itself but the conditions of its time, aligning almost perfectly with the contemporary principles of Architecture of degrowth (Fig. 2). The group often exhibited alongside other conceptual architects, including Peter Eisenman, Archigram, and Archizoom. While Archizoom advocated for radical democratization of architecture, rejecting even image creation, Archigram had concrete visions for the future world. Although essential in avant-garde architecture, Archigram's techno- optimistic, flexible architecture, while ideologically aligned with Fuller and Friedman's plans, led to the creation of resource-intensive, complex systems that produced dehumanizing spaces, making no statements about well-being or humanity's relationship with nature (Frampton, 2009, p. 368-371).

A significant reference point for the Architecture of degrowth is Bernard Rudofsky's book Architecture Without Architects (1969), which discusses anonymous, traditional architectural forms and techniques developed independently of formal architectural education and institutions. The book emphasizes the richness of vernacular architecture and its sustainable, practical solutions across various climatic and cultural contexts. Rudofsky's approach aligns with the principles of degrowth, which recognize and draw upon indigenous knowledge.
Although not a historical precedent, the speculative architecture and design fiction represented by Australian architect and filmmaker Liam Young can be seen as a consequence of conceptual architecture. His films explore the complexity and consequences of technological development and urban futures, critically reflecting on social, environmental, and ethical issues. Often using utopian or dystopian narratives, his works highlight future challenges of human-machine interactions, sustainability, and urban living. Despite its dystopian and techno-optimistic tone, his short film The

Great Endeavor presents a positive vision where the world's nations implement planetary-scale carbon-capturing machines justly, emphasizing social equality and traditional values.

Table 1. The Intersection of Architecture of Degrowth and Its Historical Precursors. Source: Fuller (1969); Friedman and Orazi (2015); Didero, M. C. (2017); Rudofsky (1969); Frampton (2009), De Castro Mazarro et al. (2023); Liegey and Nelson (2020). Created by the author.



2.2 Contemporary Explorations: Urban Scale

While ecological economics, social sciences, and other disciplines have been advancing the theory and feasibility of degrowth for over two decades, this concept represents a relatively recent development within the field of urbanism. A Routledge study on housing relations within degrowth was published in 2019 (Nelson, Schneider, 2019), and a 2022 study outlining the goals, principles, and tools of degrowth-based urban planning refers to the topic as a missing debate, identifying at least three areas requiring further elaboration (Xue, Keblowsky, 2022, p. 397). Based on published studies and case studies, we gain a more detailed picture of the spectrum and conditions of Architecture of degrowth. It remains unresolved whether universally applicable principles are necessary or whether the strength of degrowth lies in its heterogeneity and locality. The volume, through international case studies and theoretical works, aims to delineate an interpretive field that includes tangible solutions for urban planning practitioners while inviting detailed debate among professionals.

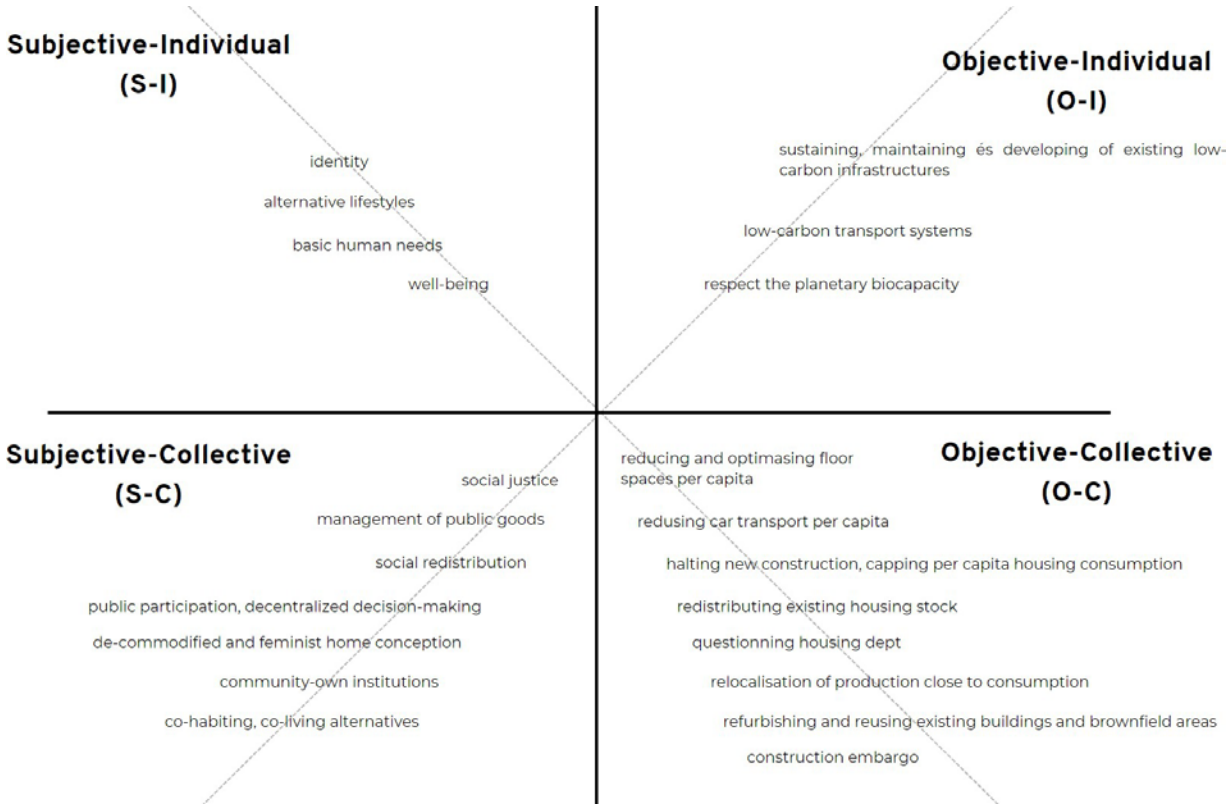


Fig. 2. Integral Perspective Diagram of the Spatial Aspects of Degrowth. Sources: Xue (2022); Brenner, N., P. Marcuse, and M. Mayer (2012); Chertkovskaya, E., and A. Paulsson (2022); Ferreira, A., and K. C. von Schönfeld (2020); Lehtinen, A. A. (2018); Martinez-Alier (2010); Cattaneo and Gavaldà (2010); Kallis (2011); Wilber (2009). Created by the author.

Based on the integral map's systematic diagram (Wilber, 2009), authors within the degrowth paradigm articulate claims in urban contexts regarding individual well-being (S-I), the relationship with nature (O-I), social justice (S-C), and public policy-economic systems (O-C). In urban contexts, the Architecture of degrowth emphasizes individual wellbeing (I-S) and meeting real human needs, which, in addition to the basic necessities for subsistence, includes the criteria for a dignified life, such as freedom, meaningful work (where skills can be practiced), and recognition and acceptance by the social group. The spatial representations of the process reclaiming the right to a normal life, referred to by Lányi (2020, p. 33) as environmental ethics, involve convivial tools (Illich, 1973) that promote social and cultural integration beyond economic rationality. Chertkovskaya and Paulsson introduce the factor of "identity," arguing for the importance of the continuity of urban landscapes that are "dear" to their inhabitants (2022, p. 444). Emphasizing the role of place in identity formation resonates with the concepts of place attachment in environmental psychology (Dúll, 2006) and oikophilia in green philosophy (Scruton, 2018, P. 208). The social quadrant (S-C) includes the collective values corresponding to the above, such as establishing democratic and inclusive public spaces and institutions, community forms free from market logic, like alternative housing solutions

or the feminist home concept (Martínez Alonso, 2022; Cucca and Friesenecker, 2022). Regarding the relationship with nature (O-I), degrowth urban authors primarily propose solutions that support the maintenance and reparability of low or zero carbon-emission construction and transportation systems—within the planet's carrying capacity. This emphasis is crucial as sustainable urban development strategy sets nearly identical objectives but places much greater importance on market-driven technological development on the path to achieving them, as will be seen in the next chapter. One of the most radical concepts in the administrative and economic quadrant (O-C) is reducing the per capita built-up area (Xue, 2022) and implementing construction embargoes. Several cities experiment with partial embargoes based on areas (e.g., city centers) or types (e.g., shopping centers), yet investor logic often overrides these efforts, as seen in Budapest. Degrowth authors emphasize that the housing crisis should and can be addressed not by building new areas but by renovating and redistributing the existing housing stock—even if this requires greater financial investment from the state. This is closely related to questioning housing loans.

2.3 What is the difference?

Various urban development projects are determined and planned by the value system of current economic policy, which is reflected in our public spaces. The iceberg model, used in systems thinking (Senge, 1990), shows that the main drivers of visible events are the underlying network of values. If the tip of the iceberg represents our visible world, what do our public spaces reveal about our society, shared values, and relationship with the natural world? What mindset lies beneath the iceberg whose tip is marked by a European capital's newest, tallest building belonging to an oil company (Budapest) or lithium mines opened on cemeteries (Serbia)? The answer, of course, lies in the neoliberal economic system, where the compulsion for growth inevitably dictates urban development, capable of overriding the values underlying sustainable plans. The concept of sustainable development (Brundtland, 1987), tautological as it is, has faced numerous criticisms even before its inception (Meadows, 1972; Illich, 1977; Lányi, 2010). Nevertheless, the UN based its 17 goals (SDGs: Sustainable Development Goals) and the resulting urban sustainable development framework (USDG: Urban Sustainable Development Goals) on this concept. While the sixteen SDGs reflect a considered, morally grounded systemic perspective, the mentioned influence is still apparent (8th SDG: Decent Work and Economic Growth), or as Latouche puts it, "growth disguised under the mask of sustainability" (2011, p. 107).

Proponents of degrowth oppose the sustainable development system, pointing out that despite numerous international conferences (COP 1-27), agreements (Stockholm 1972, Rio 1992, Kyoto 1997, Paris 2015), and institutions (IPCC 1988), real carbon dioxide reductions were only observed temporarily during the 2008 global financial crisis (Kallis, 2011) and the COVID-19 lockdowns. In other words, the idea of sustainable development (and green growth) has failed. However, there are more commonalities than differences between the goals of degrowth and sustainable development. When categorizing and comparing urban development strategies by seven criteria (Table 2), it becomes clear that reducing consumption, supporting local producers, using renewable resources instead of hydrocarbons, transitioning to a circular economy, and increasing inclusive, equitable social spaces are shared goals, albeit with different emphases.

There is partial overlap in the issue of local autonomy: while the USDGs highlight civil participation in urban decision-making processes, the principle of degrowth advocates for the decentralization of decision-making, suggesting community-driven public space planning. The growth paradigm is, of course, the most defining difference. The USDGs aim for economic growth realized in parallel with ecological and built environmental sustainability. Authors advocating for degrowth emphasize the physical impossibility (Meadows et al., 1972; Bailey et al., 2010; Jackson, 2016) and even cynicism of this (Lehtinen, 2018, p. 10). From an urban development perspective, a significant difference is that the USDG model aims to increase the density of globally growing (but shrinking) cities to enhance energy efficiency and accessibility, while degrowth's objectives are precisely the opposite: aiming for proportionate, human-scale, and livable cities. Despite goals concerning the support of local communities and social equality, the sustainable development vision for rural areas is limited to supplying cities, although supporting rural communities, the circular economy.

Table 2. The growth-based urban development model, the Urban Sustainable Development Goals (USDGs), and the goals outlined in the Degrowth Manifesto, highlighting the comparative analysis of the latter two in terms of compatibility. Sources: Daly (1996); UN SDGs (2015); UN- Habitat (2013, 2023); GEO-6 (2019); De Castro Mazarro et al. (2023); Liegey, Nelson (2020). Created by the author.

Categories	Capitalist urban development	Urban Sustainable Development Goals (USDGs)	Degrowth Principals of Urban Development	Allignement Y (yes) P (partial) N (no)
Growth paradigm	Prioritizes economic growth, infrastructure expansion, and population increase	Achieving economic growth while ensuring environmental sustainability and social inclusion	Prioritize sustainability, well-being, and quality of life over continual expansion	N
Scale and density	Focus on increasing density to accommodate a growing population efficiently	Enhance urban density to improve resource efficiency and accessibility	Questions high-density models and propose right-sizing cities to create more sustainable and livable urban environments	N
Consumption and production	Promotes consumption-oriented lifestyles and expansive infrastructure	Include measures to reduce resource consumption and promote eco-friendly practices	Reducing material consumption, promoting local production, and fostering resilient communities	I
Community Well-being	Enhance community well-being through improved amenities and social services	Improve the well-being of urban communities through better infrastructure, services, and social inclusion	Importance of community well-being, suggesting that smaller-scale, locally-oriented developments can contribute to stronger and more connected communities	I
Resource usage	Not explicitly address resource depletion concerns	Emphasizes sustainable resource use and reducing the ecological footprint of cities	Reevaluating resource use, favoring sustainable practices and circular economies	I
Local autonomy	Focus on local empowerment but may still be embedded in a growth-oriented framework	Include elements of local empowerment and participation in urban planning processes	Advocates for greater local autonomy, decentralization of decision-making, and community-driven urban planning	R
Social equity	Often include objectives related to reducing social inequalities within cities	Aiming to address urban inequalities	Underscores the importance of social justice, addresses and rectify existing urban inequalities	I

3. Spatial Literacy

Our visible world, encompassing both the built and natural environments, is shaped by principles, values, beliefs, and fears. The deeply rooted convictions of a given era's society—often its narrowest elite—underlie the construction of temples, the regulation of rivers, the clearing of forests and reeds, as well as the development of inclusive public institutions and climate-adaptive cities. Various associations within society reflect this, with their physical manifestations (or events) occurring in public spaces. Society is not merely a collection of individuals but a system, characterized by relationships among its components that serve specific purposes (Meadows, 2008). This ever-changing web of relationships dictates its functioning. Thus, a city is not merely a collection of buildings; it is defined by the public spaces (connections) that exist between these buildings.

The necessity for accessibility has created intersections and squares, transforming this infrastructural network into social spaces. Certain sections and nodes have become prominent, requiring careful planning. Traditionally, public space is the negative space between buildings, reflecting a society's values, economic status, and possibilities in all directions. Muddy medieval streets at some point transitioned to paved surfaces, particularly around temples and town halls. Protection, enclosure, and communal use characterized these spaces, with public institutions forming dominant parts of the space's boundaries. The irregular spatial forms offered varied vistas, which remain appealing today. The old towns are the most beloved tourist destinations in European cities due to their human scale and the dynamic nature of the space boundaries, encouraging exploration and interaction. In contrast, Renaissance spaces are composed, serene, often square-shaped, and although not naturally formed through use, they are highly functional. Thanks to 18th-19th century urban planning, European cities have geometrically designed classical squares. These squares are larger, with open corners, airy, adorned with centrally placed monuments and statues that embellish the city. Early 20th- century urban developments were abruptly halted by world wars, and socialist realism did not continue this tradition (Szövényi, 2021, p. 15-18). Postmodernism recognized the value of returning to 19th-century public spaces, where one could stroll, see, and be seen, but consumer culture demanded the construction of shopping malls. Malls created artificial promenades and plazas, providing only consumption and services among the myriad functions offered by urban spaces. Early shopping centers (based on U. S. models) featured ice-skating rinks as their central plazas, but in newer malls, these have been replaced by kiosks, and in suburban outlets, by parking lots.

At the peak of the previously mentioned Iceberg Model (Senge, 1990) are visible events. Below these are the patterns and trends shaped by the behavior and functioning of systems. However, it is not the system that is the starting point, despite the frequent mention of "well or malfunctioning systems," but rather the underlying mental models. The search for origins can, of course, continue indefinitely. Sometimes, the tip of the iceberg influences the deeper layers, as seen with significant events like wars and natural disasters impacting multiple generations' thinking. Systems thinking research seeks the causes of observable phenomena in the deeply embedded network of mental models. Systems do not "malfunction"; they operate according to the value-based conditions established for them. The advantage of systems thinking is its neutral evaluation of cause-and-effect relationships. For example, if a city prioritizes automobile infrastructure for ninety years, it will see a radical increase in heat island effects and air pollution. These are not side effects but probable outcomes, alongside frequent bus services, thousands of annual injuries, rapid emergency services, and the exponentially increasing number of private vehicles. The system functions perfectly, even if we did not

anticipate or want some consequences. If different results are desired, systems thinking recommends interventions at high-leverage points (Meadows, 2008, p. 145).

Such an intervention is design focused on the Architecture of degrowth. Contrary to analysis, design involves the designer setting goals according to their and the client's values. To set these goals, we must understand the changes in social space in relation to human-nature and city- ecology dynamics. Designer responsibility means morally acceptable goal-setting, a commitment to uncovering the connections between causes and consequences, while being aware that the complexity of systems prevents full knowledge of all outcomes, necessitating the utmost caution.

Capitalism colonizes sustainable models and corrupts decision-making processes. The institutionalized certification systems of greenwashing (LEED, BREEAM) provide shameful evidence of this, issuing sustainability certificates for building complexes constructed through environmental degradation and with life cycles of less than twenty years. For instance, the MOL (Hungarian Oil Company) Campus in Budapest, inaugurated in 2022, unsurprisingly holds both certifications, achieved through solar panels, rainwater recycling, 160 bicycle storage spaces for 2500 employees, and bird feeders (MOL Campus, 2022). Despite the sad comedy of this list, it is undeniable that the building operates energy-efficiently. However, the flag of sustainability obscures important environmental and wellbeing issues. Specifically, why was the building constructed at all? What was and could have been on its site? Whom does it serve, and what are the impacts of its construction and operation? Which building regulations had to be altered, and why did this happen? What message does it convey to the city's residents who will see it from every point of the city?

This last question is particularly significant as it dissolves the usual distinction between private and public investments. The city silhouette, the visual aspect, is part of both the public and social space. Thus, any significant change to the city's appearance is a public matter. The all- seeing and omnipresent yet "introverted skyscraper" (Gehl, 2014, p. 5) alters the city silhouette, aiming to insert monumental grandeur into everyday environments without creating genuine urban centers. "It disrupts the traditional values of the city without creating new urban quality" (Schneller, 2015, p. 119). Regarding spatial perception, Szövényi notes that while the upper boundary of an urban space is perceived as twice the height of the tallest building forming the space boundary, in the case of skyscrapers, this upper limit can be perceived as multiples of the tall building's height (Szövényi, 2021, p. 12). The cityscape is also significantly influenced by suburban areas, new parcels, and residential parks—all raising similar questions. However, the greatest current threat to Budapest and all the metropolises of the world lies in the government and—occasionally—city-supported developments that irreversibly change the capital's face, causing unforeseen environmental damage while exacerbating social inequalities.

4. The Context of Degrowth in Hungary

The first international degrowth conference was held in Paris, followed by events in several major cities across Europe and overseas, and in Budapest in 2016. In addition to Serge Latouche's seminal works, the book Prosperity Without Economic Growth (Liegey, 2013) was translated into Hungarian. One of its co-authors, Vincent Liegey, a prominent figure in the degrowth movement and spokesperson for the French Degrowth Party, resides in Budapest and is the founder-coordinator of Cargomania. Numerous Hungarian researchers address the economic aspects of degrowth, either directly or indirectly. These include Alexandra Köves (Köves et al. 2023), Zoltán Pogátsa (Pogátsa 2023), András Takáts-Sánta (2000), and Zoltán Bajmócy and Judit Gébert (Bajmócy and Gébert, 2014a). In the humanities, András Lányi's contributions are particularly notable, with several books dedicated to critiquing unsustainable sustainability.

4.2 The State of Architecture of Degrowth in Hungary

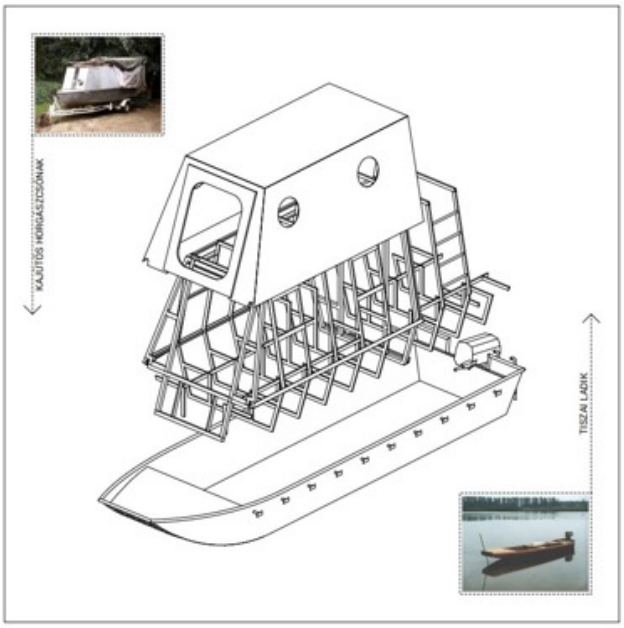
In Hungary, theoretical works on Architecture of degrowth can trace their lineage to István Schneller's collection of essays and studies titled The Qualitative Dimension of Architectural Space (2005) and selected chapters from Ákos Moravánszky and Katalin M. György's study collection (2007). Although these authors do not explicitly advocate for degrowth, they belong to a generation of creators who were active before the Great Acceleration and attribute the devaluation experienced in the 2000s and the rise of real estate speculation to globalization and the compulsion for growth. The topic is partially addressed by the projects of the Contemporary Architecture Centre (KÉK), the book The Power of Civic Ecosystems by Levente Polyák and Sophie Bod (2021), and the study Mapping Architectural Practices Associated with the Economic Program of Degrowth, published under the auspices of the BME Doctoral School, which presents the 2019 Oslo Architectural Triennial focusing on degrowth (Horváth-Farkas 2020).

While the practical architectural profession includes a niche segment whose works reflect the principals of degrowth, these endeavors remain partial, with only specific projects, rather than entire portfolios. Besides a few realized projects, most contributions are ephemeral, consisting of installations or conceptual works. This study highlights a few notable examples.

Dániel Baló captures the essence of degrowth through transformation as a design act (Fig. 3-4.). He views the challenging legacy of the Hungarian countryside, including the uniform cubes and other heterogeneously constructed buildings, as opportunities, with his executed works demonstrating energy optimization and a sound moral foundation.

Figures 3-4. Dániel Baló: Long Cube House 2020. Photo: Dániel Baló.

Tamás Bene's Bait houseboat blends the aesthetics of a cabin fishing boat and a skiff typical at River Tisza (Fig. 5-6). This modest and gentle "holiday home" is a result of sophisticated design. Bait's passengers do not forgo distant shores but instead discover the hidden nature of their homeland, offering opportunities for connection.



Figures 5-6. Tamás Bene: Bait. Boat on River Tisza. Photo and axonometry: Tamás Bene.

The Architecture Uncomfortable Workshop (Lukács Szederkényi, Dénes Emil Ghyczy) was one of the exhibitors at the aforementioned Oslo Architectural Triennial. They presented the House of the Spring Wind, which they have erected every spring since 2013. The House of the North Wind, similar to its Hungarian counterpart, was constructed through a ritualistic process (Fig. 7). The large canvas mounted on the archetypal house-shaped frames is shaped and completed by the wind, also functioning as a gate that visitors pass through to interact with nature.

Figure 7. AU Workshop: House of the North Wind 2019. Photo: AU Workshop.

In Hungary, cube houses situated on valuable plots are typically demolished, but this family chose a different approach. The expansion of the existing cube house was shaped by the constraints imposed by new building regulations. For AUW, however, these limitations acted as a catalyst for creativity. As a result, HouseLove (Fig. 8-9), an innovative addition was developed that not only functions effectively but also optimizes the use of financial resources, materials, and energy for the owners.

Figure 8-9. AU Workshop: HouseLove 2021. Photo: AU Workshop.

Nest box designed by BIVAK is a gentle yet effective intervention serving the nesting of birds (Fig. 10). In Hungary it is common to perforate utility poles in order to reduce their weight. Human intervention often appears on the mass erosion. Regularly the holes in reachable height can be used as trashcan, shelf or billboard. The nestbox placed in 2 meters height is an intervention which allows nature to connect with an infrastructural element, giving it a new function. Inserting the box causes no harm in the utility pole and does not change its condition or function. It can be taken out and cleaned easily by twisting the leg. The surface of the durable material (acacia) is treated with oil to sustain the weather conditions. 3 prototypes were placed in Budapest waiting for the nesting season.

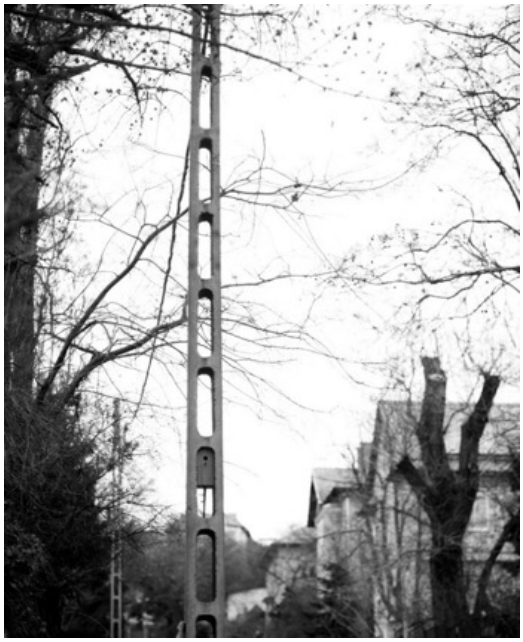


Figure 10. BIVAK: Nest box 2019. Photo: BIVAK

Sándor Guba and Péter Hámori's project proposal aims to suggest a transformation of human needs along the shores of Lake Balaton. According to the plan, the large grassy, paved beach with its service facilities will be removed, and instead, a network of internal lakes and meadow- like areas, featuring reed beds and both dry and wet grasslands, will be reconstructed. The few service pavilions will be constructed from the materials of the demolished buildings and slide structures, thus reducing construction waste. The railway side facing Lake Balaton will be transformed into a car-free zone to minimize noise and air pollution impacting the natural environment. Access to this zone will be permitted only with micromobility vehicles. Due to the reduced human presence and sound effects, it is expected that the characteristic animal species of the area will return, similar to what was observed during the quarantine periods of the COVID-19 pandemic.

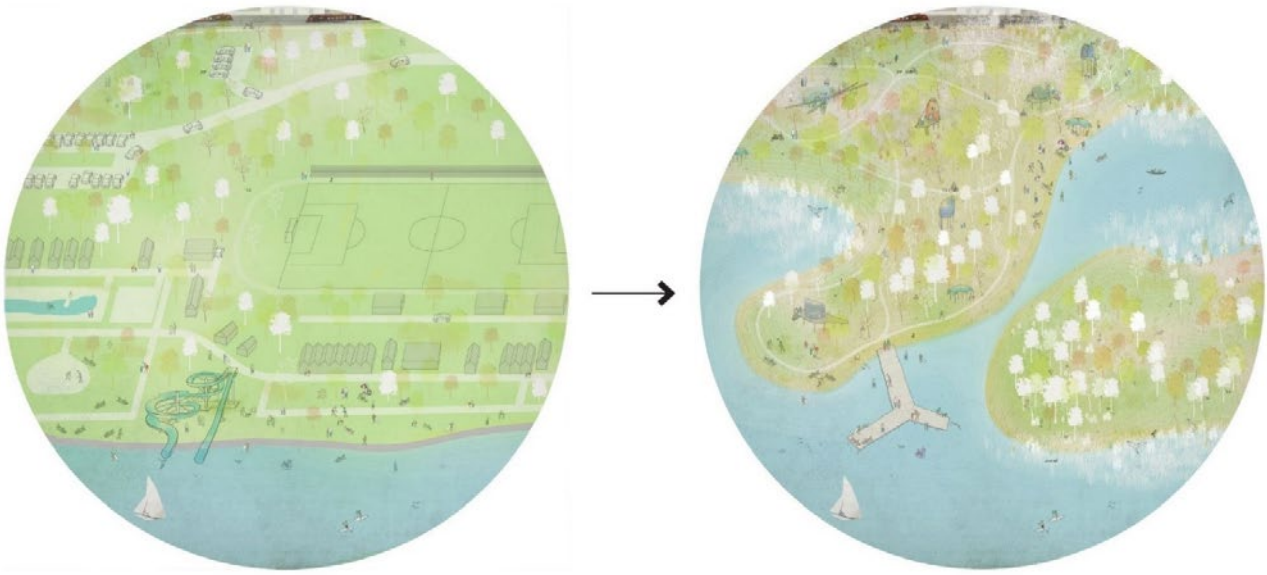


Figure 11. GUBAHÁMORI: Waterfront Development at Lake Balaton 2020.

5. Conclusion

Proponents of degrowth concur in rejecting the hegemonic paradigm of economic growth, opposing the instrumental valuation of living and non-living entities, and challenging individualism and globalism. They strive for a society that operates within ecological limits, in a just and democratic manner, prioritizing human wellbeing. Despite the shared goals, the origins of degrowth are complex and transdisciplinary, encompassing various visions and social movements (Xue, 2022). Although the foundational principles of a steady-state economy were articulated by early precursors in the 19th century, it is only in the last two decades that various academic disciplines have begun to rigorously explore the framework and feasibility of such

an economy. In the fields of architecture and urban planning, there is an ongoing process of conceptual clarification and practical implementation, which necessitates the informed engagement of policymakers and urban populations. Policymakers need to be convinced through economic and environmental rationality—recognizing that change is inevitable—yet more crucial is the cultivation of urban citizens' awareness regarding the desirability of this change. This endeavor requires a redefinition of the concept of a good life, emphasizing the recognition that fundamental human needs have remained unchanged over the past twenty thousand years, encompassing not just basic sustenance, but also a life imbued with meaning and a sense of belonging within an accepting community. The dogmas of belief in progress have led to the degradation of knowledge into mere utility (diminishing our capacity to understand others and ourselves), the reduction of freedom to consumption, and the conflation of creation and work with production. The means have become the ends. In fact, we do not find our lives to be authentic and fulfilling when technological services relieve us of intellectual and physical effort, but rather when we have the opportunity to exercise our abilities and achieve excellence in doing so. (Lányi, 2022, p. 23). The concept of degrowth, therefore, is not primarily about environmental or animal protection, economic and technological innovation, or feminist or children's rights movements, but rather an all-encompassing and insatiable desire to recreate the conditions for a life worthy of Homo sapiens, the wise human being. Network biologist Ferenc Jordán reassures his readers with a profound observation:

"Pension systems, capitalism, Roman law, the network of international relations, or even democracy itself are extraordinarily complex systems, but each is vastly simpler than, say, a cell." (Jordán, 2023, p. 237.)

This remark encourages us that human-made systems can indeed be altered by humans.

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THE FUTURE EVOLUTION OF DESIGN-ORIENTED PRACTICES IN THE CONTEXT OF HUMAN AND NON-HUMAN COLLABORATION

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ABSTRACT | The complexity of the social, environmental and institutional challenges facing by contemporary culture needs collaborative, multidisciplinary and intercultural actions to foster a changing process towards a more sustainable and collective future. With the acceleration of technology, the proliferation of data, approaches and digital tools has revealed multiple characteristics of relation with technical field, finding also several criticisms from a social and environmental point of view. In this context, the design space is evolving into a multi-agent and mixed-initiative system where human and non-human agents collaborate and co-perform shaping multidisciplinary and multimodal creative processes, offering practices beyond human-centric cooperation to identify more democratic and inclusive scenarios. Collaborative practices become interaction methods capable of overcoming critical issues and limitations highlighted by technological systems, with a focus in artificial intelligence models and virtual environments topics. The research aims to introduce an analysis of the collaborative aspects which allow this hybrid relationship and the definition of methods in which this cooperation can take place. These conceptual aspects will be applied to the analysis design-driven approaches developed in a series of university projects, in which the human-non-human practices contribute in observing the transformation of hybrid processes and the figure of the designer himself, who acquires the features of the transitional designer.

KEYWORDS | HUMAN NON-HUMAN COLLABORATION, DESIGN-DRIVEN APPROACH TO TECHNOLOGY, ARTIFICIAL INTELLIGENCE, EXTENDED

1. Design-driven technology approach

1.1 Introduction

The complexity which characterizes those global challenges defined as 'wicked problems' by Hornst Rittel and Melvin Webber in 1973 has become an observable aspect of today's society. The specificity of these challenges is multi-scalar, multi-causal and interdependent (Formia et al., 2021) and are represented by complex social dynamics involving different types of actors and acquiring different forms and characteristics depending on the spatial, cultural context within which they are embedded.

Together with these aspects, another fundamental issue emerges in the analysis and representation of the current social system: the influence and application of digital technologies and tools has acquired a social value and represents a vector of change in modes of relations, habits, flows, approaches to production and consumption, generating new forms of knowledge and cultural processes (Beer, 2017).

These tools turn into socio-technical agents, i.e. complex systems that have a relevant impact in the political, ethical and environmental fields and interact with human agents (Vermaas, 2011) in a hybrid, heterogeneous and collective relationship (Latour, 1987).

The concept of the 'Technosphere', coined by Peter Haff, fits within this research framework and emphasizes the speed with which the relationship between human agents and non-human agents, i.e. technological and environmental elements, has developed: the 'Technosphere' is the physical representation that encompasses the enormous extension of technological and digital networks. This term is also intended to represent aspects of how anthropic occupation also proceeds through progressive infrastructural colonization (Antonelli et al., 2019). The representation of this artificial layer (Haff, 2014) represents the impact that the development and acceleration in technological production is having on social, cultural and environmental transformations. In this context, a heterogeneity of human actors, such as individuals from civil society, public administration, businesses and

researchers, find themselves interacting and collaborating daily with technological tools and systems that have rapidly acquired a relevant role in everyday activities.

Currently, several human actions are mediated by interaction with tools that allow interaction with non-human technological agents. A hybrid multi-agent relationship is established, where the concept of an agent represents an entity capable of perceiving its environment (Cattabriga, 2022) and is classified according to several aspects related to autonomy and the cognitive approach (Burgin & Dodig-Crnkovic, 2009).

Interfaces, media and digital tools not only shape the way we relate and think, but also the way we interact with our bodies (Clark, 2008) and our approach to design complexity (Giaccardi & Redström, 2020). Within this context, it is fundamental to identify what limits multidisciplinary approaches and design cultures can overcome to identify new hybrid spaces where technology represents a support, not only instrumental but also collaborative, to human, cognitive and operational capacities (Monari & Baraldi, 2020), becoming a resource for actions of public interest and the innovation of operational and design processes (Hoc, 2000).

A shared and systemic vision of design practices makes it possible to identify practices that can be applied in different fields, such as the production system, which refers to consolidated processes based on the substantial consumption of energy, raw materials and human capital, or such as social and relational practices, where technologies can become a tool and an approach to the construction of collective scenarios, if designed according to an inclusive, accessible and democratic approach. Connected and collaborative actions overcoming the concept of design, cultural and natural limits allow us to imagine an integrated design between tools and actors that can foster positive change and transformation towards a future that truly considers eco-systemic and sustainable aspects (European Commission, 2019).

The objective of this contribution is to represent the experimental activities carried out in the context of a university research group to create multi-agent systems and environments where the collaboration and design-driven approach allows for the creation of methods and paradigms useful to optimize the processes in which these systems are embedded, in terms of sustainability, and at the same time can present implementation approaches to current technological development methods to make this framework more democratic and accessible.

2. Research Methodology Framework

2.1 Research framework

The presented paper finds its inspiration within the extended research of the working group of which the authors are

part. The research unit is characterized by an interdisciplinary approach resulting in the development and in-depth study of different design themes intersecting with each other. In order to better understand the design-oriented methods considered in the development of the discussions and projects described in the following paragraph, it is useful to briefly introduce the different areas of research, which mainly concern the design of services and systems for the city and the people who live in it, reactivating places and communities through inclusive and accessible processes, the transformation of models and processes within creative cultures as a system of human and social value generation, responsible innovation practices within design systems (Formia et al, 2023) and design-oriented disciplines that deal with how human beings transform themselves in dynamic and complex ways depending on the context.

These different fields of research are characterized by more defined project areas resulting from the project contamination; an example of this is the theoretical and applied field of research in Human Body Interaction and Design Driven Open Innovation in which the experimentation subsequently presented find their contextualization.

The project space is characterized by a transversal methodology and a systemic approach linked to the concept of anticipation (Celi, 2015; Formia, 2017; Iñiguez Flores et al., 2019) and future studies based on collaborative practices and collective intelligence (Celaschi, Celi & Formia, 2014) that drive transformation. Through a mapping and verticalization of data and information collected in the research phase, futures and possible scenarios are generated (Celaschi et al., 2019) conditioned by environmental and social factors that can respond to the complexity of the present and the changing context.

Anticipation represents the point of view through which the different research field are interpreted, and which are translated into project actions for the creation of multi-agent systems in different contexts and environments.

2.2 Experimental framework

As previously mentioned, the current condition in which our society finds itself differs from its predecessors due to the continuous changes, the acceleration in technological production and consumption, and the increase in social distinctions that induce the need for rapid and planned actions that can respond reactively to the criticalities that emerge. In this sense, design action and above all anticipatory action acquire importance, suggesting how in the technological sphere, issues related to sustainability (Bettiol, 2024), accessibility and the democratization of digital practices are necessary, are interconnected and fundamental for designing future scenarios of interaction with a more inclusive, conscious technology and as a tool for activating collective knowledge.

Within this academic environment, two research paths are in progress that focus on identifying new ways of interaction between people and technological tools, considering external factors and how they influence each other. Respectively, the two researches focus on the definition of new paradigms of collaboration with artificial intelligence and virtual environments; they are distinguished by their different technical backgrounds, by the use of different tools and approaches, while they are linked by a transversal method involving multiple disciplinary fields and an approach linked to experimental activities, user research and testing, iteration and validation, which are useful to form knowledge and skills that are not only theoretical and transversal, but also specific and linked to know-how (Jarmon, 2009).

The applicative nature of the two research makes them suitable for implementing the progressive results obtained within projects carried out by the research unit into national and international programs. In fact, the group's involvement in a national project running for a total of three years with the aim of developing digital tools to support design sustainability has created the context for experimenting with practices of relating people, artificial intelligence and the virtual environment.

2.3 Artificial intelligence-related fields of action

The research stream analyzing the relationship between people, artificial intelligence and the design environment has resulted in the opportunity to identify new models and paradigms of interaction which could create a more transparent (Wang et al., 2022) and accessible relationship between human and non-human agents (Wang et al., 2022).

The field of research related to artificial intelligence encompasses technical fields of study on the analysis of intelligent computational agents (Poole & Makworth, 2018) and finds a relationship with design cultures in the interdisciplinary design of modes of communication, relationship and interaction (Yang et al, 2020; Zdanowska & Taylor, 2022) that can manage and interpret the complexity of AI systems (Cattabriga, 2022).

Design-driven disciplines represent a useful tool for the definition of more democratic ways of using technologies (Qahha & Ahmed, 2021) through approaches that involve human agents, understood as end-users, and non-human agents in the design of new ways of using AI-based systems, creating processes of knowledge diffusion between people and their environment, including technologies, for the definition of a conscious user experience.

Through an analysis of the current state of the art on design actions to develop technological systems and related interaction tools that can respond to more accessible, intersectional and sustainable design methodologies, it is possible to identify new practices of relating to artificial intelligence that do not replicate the social structures mediated by the vision of the dominant design culture (O'Neal, 2016; Eubank, 2018) and that allow for an informed and aware user experience as opposed to the elusive logic of some algorithmic flows (Card, 2021).

By designing new technological tools and their implications in processes according to a collaborative approach, it is possible to imagine new scenarios in which it is possible to introduce technological support to optimize the working method and consequently bring about improvements in terms of the capital investment used. If this approach is applied in the production environment, it is possible to experiment with operating settings where collaboration and communication between people and technological agents can represent an outline that enhances the sustainability conditions of the entire system.

2.4 Extended reality-related fields of action

The research area regarding extended reality stems from the consideration of how affordance and perception change in fully virtual or real scenes with virtual augmentation (Shin, 2017). The first aim of this work is to structure and optimize digitized learning and training procedures in industrial contexts. With this intention, in the light of investigations and mapping of state of the art in the various fundamental areas, e.g. that of instrumentation, modelling software and usable applications and experiences, shortcomings in the literature were identified, which were attempted to be addressed by means of several experiments. The first specifically concerns the ability and comprehensibility of conveying written information, through its transposition into experiences of dematerialized immersive procedures (Van Campenhout, 2020).

The other raises the challenge of exploiting virtual scenes not only to foster learning on the part of the end users, but also to facilitate the creation of content, specifically textual notes and interactive videos, that simplify and make the instruction work carried out by trainers more efficient. The analysis of the data collected during the execution of these first experiential tests shows that, despite the rapid and important developments in the field of virtual and mixed reality, the element of presence is still critical and particularly complex to fully pursue.

Therefore, the analysis and in-depth study of a further field, that of haptics, was added, with the aim of investigating the impact generated by the addition of a component to the experience capable of determining greater cognitive involvement, through the creation of experiences that exploit multimodal stimuli (Gallace, 2012). In this framing, the multi-agent component is

understood, on the one hand, as a design approach that sees the introduction of digital techniques not only as an executive tool, but as a collaborator in support of design, while on the other, it is precisely the multi-sensory character that entails a change of perspective in the design of virtual experiences that are no longer driven by the sense of sight as the unique source of input and contribute to the construction of more usable and comprehensible experiences.

There is much room for improvement in this field as well, but from the combination of programmes and software already known, it was possible to realise a pilot project stressing this sector to understand its potential and limitations. A new experiment was born that focuses on textiles and aims at the convergence of perception between the touch of real materials and the touch of virtual materials reproduced through visual and tactile rendering by vibration.

3. Multi-agent design-driven experiments

3.1 General process flow

The application of the two research within the framework of the pathway financed by the National Recovery and Resilience Plan through the creation of extended partnerships between universities, research centers and enterprises made it possible to develop a series of experiments aimed at defining the characteristics and approach useful for the creation of multi-agent contexts and spaces.

Two parallel projects were started up involving multidisciplinary teams composed of human agents and non-human agents represented by artificial intelligence and extended reality.

They specifically concern the development of advanced tools for digital acquisition and visual/aptic XR interaction for the textile industry and the definition of new paradigms of proactive relationships between people and machines for continuous transformative production and robotic systems. A retrospective reconstruction of the design process allowed us to identify an approach with several features in common and some design patterns of difference. The following is a description of the general flow of the applied design-driven method, without focusing on the different declinations of the two experimental activities. In this way, it will be possible to identify the shared aspects, patterns and recurring design actions of the process of defining a multi-agent environment, underlining the transformation of the design space (Giaccardi & Redström, 2020) and the overcoming of traditional human-centred practices.

The analysis and systemic representation of these two paths is useful to define what are the results obtained from the experiments carried out up to the current state of progress of the project, which represent what are the characteristics which a multi-agent design process should take into consideration in order to favour the development of transparent and aware contexts and interactions, fostering the development of

sustainable solutions in the technological sphere. The design approach acquired in the two technological experiments (Figure 1) can be summarised in three macro-phases that define the activities already carried out and future actions for the characteristics definition of multi-agent space in which design processes are optimized. As may be noted, the actvities are divided into actions that are performed by human agents alone, non-human agents alone, or multi-agent collaboration.

The start consists of the macro-activity "Context framework phase" of defining the context and research framework; this phase, which can be analyzed as a pre-project step, represents the action through which the human multidisciplinary groups are created based on the skills and tools available. These teams define at this stage what are the common objectives to be considered in the development and structure of the project line to be followed, also examining the different nature of the skills and disciplines introduced according to which an interdisciplinary process can be developed.

The second action is the "Research phase" where the individual themes involved are defined and the mapping of the state of the art, of the various relevant topics in the project, is initiated. This analysis makes it possible to identify and collect good practices concerning both the state of the art of bibliographic research and the identification of case studies and the collection of computational tools useful for the development of the project, such as hardware and software.

This first state of research results in the definition of certain insights that will represent the starting point for user research activities and the development of design concepts. At the same time, the analysis of the human and artificial users involved, and the collection of the actors' needs make it possible to reformulate and implement the results collected, also identifying useful strategies for the development of project proposals that can respond to the research question and the needs that have emerged.

Consequently, in the 'Design phase', the process of defining the design output through the integration between the parties is designed, paying particular attention to the development aspects, and the collection of feedback that is fundamental for the correct interpretation of the dialogue between human and non-human agents with the aim of optimizing the designed experience. In this step, design- and technology-driven experimentation took place, which enabled, through an iterative process, the acquisition of a mode of knowledge mediation, information selection and interactive representation of the processes activated in the interaction with complex information systems. Two-way communication between agents (Chen et al., 2018) takes the form of a design tool where design mediates between shared feedback. The analysis, construction and testing of born design prototypes allows the process to be concluded.

The final output of the workflow takes

the form of a so-called post-design phase that represents the systematization of the main characteristics and aspects related to the construction of a multi-agent space, collected through the development of the process. This concluding activity allows the work to flow into a practical application that enhances and finalizes the collaborative process between human agent and computational agent in the execution and facilitation of new design behaviors.

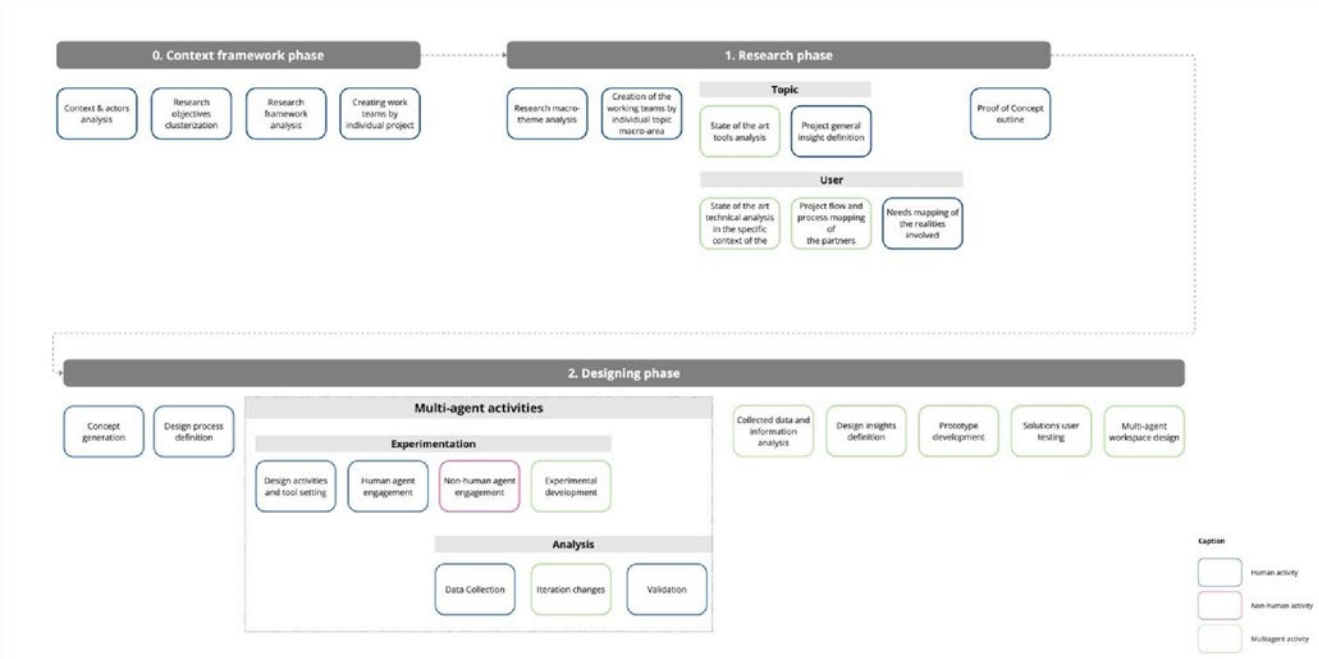

Figure 1: General workflow process

3.2 Artificial intelligence-based experimentation

The identification of new practices of multi-agent relationships makes it possible to imagine new scenarios in which this interaction can take place. In fact, by designing and testing hybrid design spaces, it is possible to scale them to different scenarios involving different domains, such as the educational domain or the industrial production domain.

The creation of a collaborative multi-agent environment between people and machine allows overcoming the concept of unidirectional interaction, identifying the potential of human and artificial capabilities, promoting diversity, empowerment (Ionescu, 2022) and testing more sustainable industrial processes.

The objective of the experimentation on the development of new paradigms of proactive relationship between people and machines for continuous transformative production and robotic systems described below, introduces the issue of cooperation between industrial operators and artificial intelligence to be able to create communication and feedback exchange systems that can make the process more iterative and sustainable. In this sense, it is crucial to analyze ways of proactive communication that enables shared decision making (Allen, Guinn and Horvtz 1999; Chen and Barnes 2014), through the definition of a flow and related interaction tools that can interact with existing established HMI systems.

The process (Figure 2) is begun through an initial definition of the issues and figures involved: the different cores of the project are represented by some fields of engineering involving the analysis of a vertical reconfigurable cable-driven system, collaborative robots powered by AI, AI-based HMI, virtual prototype and Industrial co-orchestration of network and application software.

From these aspects, the group is configured through the collaboration of different figures such as researchers in the engineering field, for the development of technical aspects, operators who directly relate to the workspace taken under analysis, and designers, who enable the design of the most optimal mode of communication for the context. At this stage, the non-human agents involved are represented by tools and figures based on artificial intelligence systems that participate in the production actions and enter the process as real operators and designers.

Following the definition of the design framework and mapping of the state of the art, the analysis of the communication needs of the human and non-human actors involved define the design insights for optimizing the interaction and identify the key aspects of the current interface used to manage the machines.

The design phase, as described earlier, is characterized by the experimental activities; in this process, this activity is characterized by three main aspects: the definition of the quantity and quality of information, in order to put the agents in a position to understand it quickly (Billsus et al., 2005), the choice of a graphical language, and the prototyping of an interface, understood as a conceptual space of action and colloquial interaction (Sheridan & Verplank, 1978; Anceschi, 1993).

By first identifying the graphic components related to the digital experience through a series of collaborative activities, it is possible to develop a series of prototype proposals tested with operators and AI systems.

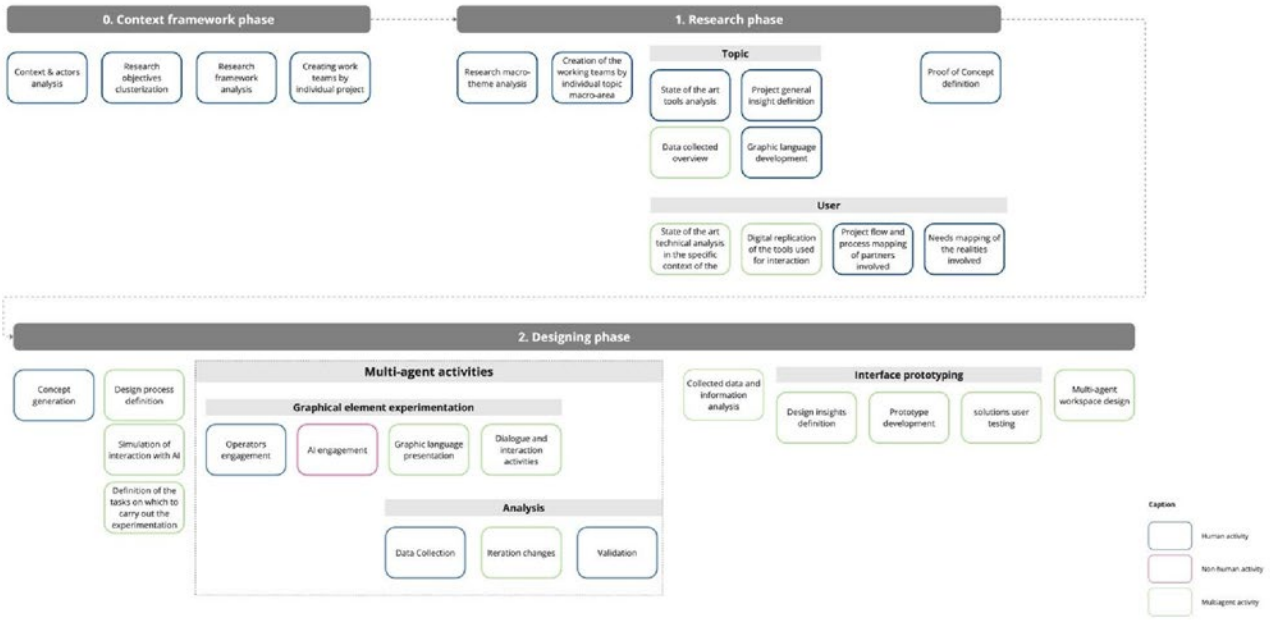

Figure 2: Artificial intelligence-based experimentation

3.3 Extended reality-based experimentation

In the context of extended reality, the thesis on which the experiments are based can be summarized in the application of the multi-agent model as an approach that, in the face of increased complexity inherent in the pre-design and design phases, positively affects the impacts of the resulting virtual experiences by enhancing the interactions between human and non-human components, multiplying the feedback produced by both parties. The common goal of the constructed digital scenes, is to shape virtual environments in which collaboration between two or more individuals is fostered by non-human factors, aligning their perceptions and stimulating their creativity in response. The result is experiences that differ in output, which it sees changing as the scope and goals for which it is being developed change but retain a structure that can be traced back to the working method in use by the research team.

The most relevant project is a pilot born out of the need to delve into the branch of haptics to understand its potential and limitations. The experience relates to remote shared design in textiles with ambivalent spillover to the fashion and furniture sectors, through the creation of a virtual environment that allows immersive interaction of designers with tissues and prototypes that do not require physical counterparts during the early operational phases; this approach can bring benefits in the optimization of concept generation and material use. The development process is articulated, and for this reason only the stages related to the proposed multi-agent approach are reported in this section.

With a view to maintaining a multidisciplinary approach, the preliminary phase (Figure 3) requires the careful structuring of a group composed of figures from different fields who share common interests and goals. Following the identification of a working outline follows the involvement of professionals and researchers whose expertise covers a broad area of knowledge. Since this is an experience related to the generation of an archive of digitized textile samples, profiles from the field of representation were needed, in charge of managing the workflow of acquisition and visual restitution; mathematicians, in charge of identifying algorithms useful for the transformation of acquired images into three-dimensional virtual geometry and figures competent in programming; and designers, dedicated to the study and creation of virtual scenes and the design of interactions, with particular attention toward haptic restitution.

Following the research phase, during the design development phase, study of the experience architecture takes place, the outcome of which is the creation of the multi-agent collaborative session being experimented on. At this juncture, activities are directed toward designing the dynamics of agent involvement and interaction, both human components (users of the experience who enter input into the system) and of the non-human components (in this case the virtual simulation environment, which inherits input and responds through feedback). What has been described needs to be evaluated through a testing process to gather data and insights useful in defining the collaborative environment. At the end of the design phase, the multi-agent collaborative sessions carried out with the aim of systematizing the dialogue between the human and non-human components, to identify the convergence between what is returned as feedback and what is perceived by the user and vice versa. This last phase is particularly significant because the totality of the non-human component's ability to express meaningful and interoperable feedback that actively stimulates the creativity and connectedness of the designers involved depends on it.

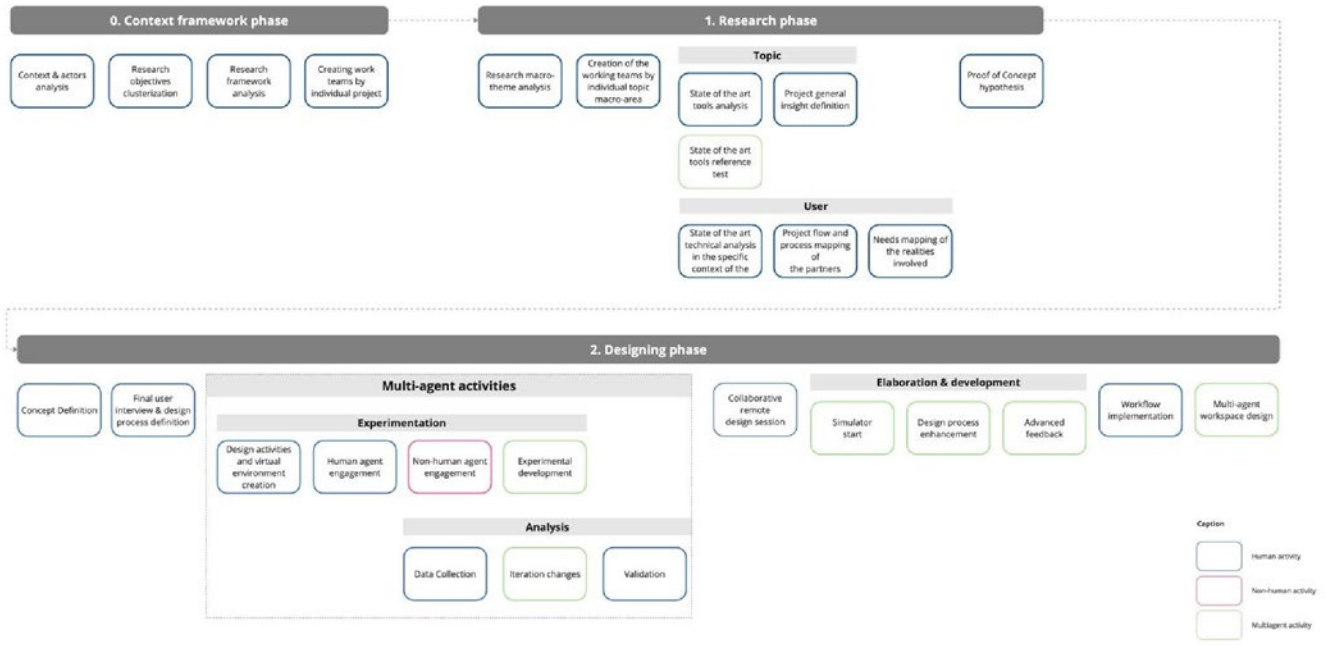

Figure 3: Extended reality-based experimentation process

4. Conceptual and methodological synthesis

The results of the research activities carried out up to now are shaped in the preliminary definition of what are the main characteristics the achieved multi-agent space should have to be a tool for overcoming design practices offering methodologies beyond human-centric cooperation to identify more democratic and inclusive scenarios.

The main features outlined can be summarized as follows:

· Interdisciplinary collaborative approach: first, it emerges the need to create a working team and design process that includes the final agents of the project in the design. In this way, the results obtained can be modified and implemented based on feedback and key aspects for putting into practice and utilization of the obtained output. Systemic analysis of the entire process allows consideration of the context within which the process is developed, gaining attention and care for environmental, human, and social issues.

· Systemic Complexity Analysis: The whole-process view allows consideration of the context within which the process is developed, acquiring attention and care for environmental, human and social issues. In this context, multi-agent systems can

range from simple interactions between a few agents to highly complex ecosystems involving numerous components with different roles and interactions.

· Agent heterogeneity: this aspect refers to the characterization of the agents involved according to different capabilities, goals and decision-making processes, from autonomy and responsiveness to the environment (Russell & Norvig, 2009; Wooldridge & Jennings 1995). Human agents may provide cognitive capabilities, social intelligence and systems approaches while non-human agents may contribute specialized knowledge, efficiency in certain tasks or automation capabilities.

· Adaptation and learning: Agents in a multi-agent design space often exhibit adaptive behavior, learning from their interactions and experiences over time. This can lead to improved performance, refinement of strategy, or better alignment with human goals.

· Ethical and social implications: The presence of human and non-human agents raises ethical considerations related to accountability, reliability, fairness, and impact on society. Collaborative design allows development processes to be defined where human and nonhuman agents can work together to modify aspects of the process and functionality to make such systems more inclusive.

5. Conclusions

From the synthesis of the analyzed processes, the need to identify new paradigms of relationship with technology emerges; in particular, the interaction with computational tools is no longer characterized only by an instrumental function but also by a hybrid dialectical exchange where nonhuman agents are collaborators of designers and researchers to develop virtuous and conscious experiences.

This approach underlines the potential of design-driven collaborative processes applied in multiagent environments (Margarido et al., 2022) fostering the possibility of interpretation of complex systems and environments by non-technical and specialized users and creating processes of increased technological awareness, accessibility, and technological democratization (Stumpf et al., 2021). In addition, the skills to simulate environments, procedures, and behaviors, makes it possible to optimize the necessary resources, including those turned into computation, producing a positive impact in making processes more sustainable.

The research activities carried out so far have made it possible to define preliminary results that can be encapsulated in 3 thematic macro-categories.

The first aspect concerns the role of non-human agents within the process: in fact, the need emerges to consider non-human - or

ultrahuman - components as technological tools no longer as at the service of designers, but on a par with any other co-participating and collaborative figure with the goal of improving the ideational and creative process behind development processes.

Second, the aspect related to the application of research in multi-agent experiments takes the form of the formulation and subsequent preparation of collaborative design activities through the definition of a shared language that allows all agents involved to be able to interact and create a hybrid dialectical relationship of information exchange. The definition and codification of a shared language makes it possible for the shared interpretation, according to their own specificities, of input data and to be able to process consistent and interoperable outputs.

Finally, the role that the designer takes on within this approach emerges: this figure assumes the function of a dragging vehicle (Irwin, 2015) to evolve traditional systems into multi-agent enabling spaces, where he or she is involved in the interpretation, transmission and facilitation of interaction and dialogue between human and non-human agents. The discipline of design again acquires the function of mediation and transmission of knowledge (Celaschi, 2015) in a context where the type of knowledge shared is human and artificial.

Moreover, the figure of the designer is required to learn and practice vertical skills that can enable design that can foster the creation of virtuous systems that can lead to open and accountable innovations (Blok & Lemmens, 2015), in addition to the traditional cross-cutting and interdisciplinary skills. The work described within the paper represents a still evolving process that will be deepened and reformulated through the planning of new project activities and actions. The goal is, in fact, to expand the field of experimentation by involving other computational agents and human agents not yet included in the study, such as generative modeling systems, to expand, but at the same time to obtain validation or useful information to the updating of the model hypothesis presented in this contribution. Through this approach, it will also be possible to identify new contexts and realities within which to scale and test the formulated approach.

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DESIGNING FOR DURABILITY: HOW FASHION BRANDS ARE ENCOURAGING LONGER GARMENT LIFE THROUGH CONSUMER BEHAVIOUR CHANGE

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ABSTRACT

The fashion system is confronted with a complex range of challenges, one of the most pressing of which is the unsustainable impact of the industry, that is responsible for a significant portion of world's pollution and textile waste. The fashion industry's linear model is environmentally destructive, as it relies on the extraction of excessive resources. In response to the linear models that have been prevalent in the fashion industry, alternative forms of collaborative retailing have emerged in the context of the Circular Economy, seeking novel solutions to promote more conscious and sustainable consumption. In this context, a growing number of fashion brands are taking proactive measures to educate consumers about the importance of garment care and durability, thus focusing on the final phases ('use' and 'post-use') as an integral asset of the transformation into a more sustainable fashion paradigm. The strategies adopted include maintenance and repair services; take-back schemes; awareness and marketing campaigns and collaborative business models. In this context, which is predominantly discussed from a managerial and marketing perspective, it is crucial to contribute to the discourse from a Design standpoint and identify its potential as an agent of change. This paper employs a qualitative approach, supported by a literature review and case study analysis, to examine the strategies employed by brands and platforms to raise consumer awareness about extending the life of clothing, thereby facilitating a shift in consumer behavior towards fashion circularity services and actions. In particular, the analysis considers the macro strategies of Care, Recommerce and Reverse Logistics services and practices, exploring how these are implemented to sensitize the consumer to a more sustainable consumption habit.

KEYWORDS | CIRCULAR ECONOMY, SUSTAINABLE FASHION, DESIGN FOR SUSTAINABILITY, RESPONSIBLE CONSUMPTION

1. Introduction

The fashion industry is a significant contributor to global pollution, responsible for considerable greenhouse gas emissions, excessive consumption of water and harmful chemicals, as well as generating a large amount of textile waste. The textile industry, in particular in developing countries, is characterised by precarious working conditions, including low wages, long working hours and exposure to dangerous chemicals (Battisti & Spennato, 2024). Furthermore, a considerable quantity of clothing is discarded annually, frequently before it has even been worn, due to the rapid obsolescence of fashion, the low quality of products and the lack of incentives for reuse and repair. The issue in question is linked to the linear business models that are typically employed by many fashion market participants. The linear economy correspond to a system in which resources are extracted to create products that ultimately become waste and are discarded. This approach, based on the principles of mass production, a focus on efficiency, a one-way business model and end-of-line disposal, has the potential to generate several negative impacts such as damage to ecosystems, a reduction in the useful life of the product and a mismatch with the demand for responsible products (Bick et al., 2018; Brewer, 2019; Fletcher & Grose, 2012).

In contrast to the linear system, Circular Fashion (CF) has emerged as a promising alternative for the fashion industry. The objective of this approach is to reimagine the system as a continuous cycle, where resources are used efficiently and products are designed to last, being recyclable or reused (Dan et al., 2023; D'Itria & Aus, 2023). The collaboration of brands, manufacturers, retailers and policymakers is highly important to create a more sustainable fashion system based on circular business models (Poldner et al., 2022). However, another crucial factor in effecting a paradigm shift is the consumption habits (Koszewska, 2019). At this point in time, brands and companies are attempting to raise consumer awareness through a variety of strategies within the concept of CF, thus concentrating part of their efforts on the last stages of the fashion chain (retailing and consumption). These strategies include: maintenance and repair services (clear and accessible instructions on how

to wash, dry, iron and store each garment; online and offline customisation workshops, professional repair services, DIY repair kits); take-back programmes (collecting the products either directly from consumers or by setting up take-back points); awareness and marketing campaigns (content highlighting the importance of conscious consumption and durable fashion, clear information on the origin of materials, production processes and environmental impact of garments); collaborative business models (recommence, rental and subscription platforms).

Within this context, this paper adopts a qualitative approach, supported by a literature review and case study analysis, to examine the macro-strategies and parallel processes employed by brands and platforms to raise consumer awareness about extending the life of clothing. The objective is to facilitate a shift in consumer behaviour towards fashion circularity services and actions. In particular, the analysis considers the macro strategies of Care, Recommerce and Reverse Logistics, exploring how these are implemented in order to sensitise the consumer to a more sustainable consumption habit.

2. Conceptual Background

2.1 Circular Fashion: How the fashion industry is moving towards a more sustainable model

The fashion market is gradually responding to the growing demand for sustainability, and the concept of CF, which promotes a more responsible approach to the production and consumption of clothing, is gaining ground. However, the dichotomy between the traditional fashion system and sustainability principles remains a complex challenge. The concept of the Circular Economy (CE) within the fashion system (Hina et al., 2023; Koszewska, 2019; Vecchi, 2020) challenges the conventional linear production system for clothing, footwear and accessories. Instead of being discarded, these products are reintroduced into the production process after use, thereby inverting the traditional logic of linear production applied into the fast fashion market. The initiative replaces the dynamics of consuming finite resources, increases the useful life of materials, reduces industrial waste and promotes the sustainable development of the sector. In practice, companies that adhere to the principles of CF utilize fewer materials to create individual items, work to eliminate non-recyclable and polluting items from the supply chain, attracting new suppliers and sustainable inputs. Furthermore, they recapture all materials that leave their factories, from garments to packaging, for reuse. They also seek to reuse inputs as much as possible, promoting the collection and renewal of materials.

The dominance of fast fashion in the market over recent decades has been a significant factor in the transition to CF, which is a complex and gradual process. Fast fashion brands have an important role to play in this

transition, but they must overcome a number of challenges to adapt to a new business model. These challenges affect not only fast fashion but the entire fashion system - from high-end to luxury - which appears to be better equipped and ready for change at the moment and, therefore, able to drive the transition. Although the responsibility for change is not limited to brands, consumers, governments, and civil society also have a crucial role to play.

In the light of this, the Ecodesign for Sustainable Products Regulation (ESPR) represents a significant transformation in the landscape of European product regulation. The regulation, which came into force in July 2024, imposes rigorous environmental criteria on all products placed on the EU market, from the design phase to the end of their useful life. By prioritizing the possibility of repair, reuse and recycling, the ESPR facilitates the transition towards a circular economy and reduces waste. This regulation serves to protect the environment while simultaneously stimulating innovation and competitiveness within the EU, thereby establishing sustainable products as the new norm. Furthermore, the ESPR is set to transform the fashion industry, challenging the dominant fast fashion model. The regulation places an emphasis on durability, repairability and recycling, compelling fashion brands to prioritize quality over quantity, transition to sustainable materials and investigate circular business models such as rental, repair and resale. While it necessitates substantial adaptation, the ESPR offers prospects for innovation and leadership, proposing a more environmentally responsible fashion landscape.

2.2 Design for Longevity: Making long-lasting clothing

Design for Longevity represents a comprehensive methodology for product development, with a particular emphasis on extending the lifespan of the product in question. The objective is to create items that are not only durable and functional, but also resilient to changing conditions and user needs. By evaluating factors such as material selection, construction methods, and user experience, designers can develop products that retain their value and utility over time, thereby reducing waste and environmental impact (Carlsson et al., 2021). Such an approach frequently incorporates strategies such as modular design, repairability and adaptability, with the objective of ensuring that the product remains relevant and desirable throughout its lifecycle.

Particularly within the fashion system, this can be achieved through the implementation of strategies such as the creation of long-lasting clothing utilizing high-quality materials, the incorporation of durable construction, the provision of proper fit, and the incorporation of clear care instructions. Furthermore, fostering an emotional connection between the wearer and the garment, as well as exploring business models that prolong the active life of clothing, contribute to the creation of value and the extension of the product's lifecycle.

Within this context, the initial phases of the fashion supply chain (conceptualization, sourcing and assembling) is of particular importance with regard to the role of Design. At this stage, the choice of materials is of great consequence, as is the development of the patterns, it should ensure that the garments are not disposed of prematurely due to rapid wear and tear or an imperfect fit. Moreover, during the modelling and sewing phase, it is essential to adopt an approach that contrasts with that of low-level production. This entails considering the social implications of the production process and re-evaluating the working conditions of those responsible for assembling the items. By doing so, it is possible to promote transparency in production processes, thereby fostering an emotional connection with consumers who choose to adopt a more sustainable lifestyle. Nevertheless, the role of Design is not limited to the initial stages of the fashion supply chain. The final phases (retailing and consumption) are being examined from a sustainable perspective due to the growing recognition of the importance of 'use' and 'post-use' as integral and crucial aspects for transformation of the fashion system into a more sustainable paradigm (Spagnoli & Iannilli, 2023).

Some fashion companies, for instance, are undertaking a process of business model redesign based on the concept of Collaborative Fashion Consumption (CFC). These business models are based on the provision of resale, rental, leasing, sharing, gifting and swapping services (Arrigo, 2021; Becker-Leifhold & Iran, 2018). The services most frequently offered by fashion brands and companies have been resale and rental (Fabro Cardoso, 2024). In theory, by being reused and shared, clothes last longer, reducing the need for constant production. However, the rationale behind consumers' decision to utilize this type of service remains inconclusive, with motivations oscillating between a sustainable positioning and an economic choice (Khalek & Chakraborty, 2023). This is because, when resold or rented, the products price is reduced. In Europe, there is a significant presence of resale services (including Vestiaire Colletive, Vinted, DePop), while the United States is also open to exploring sustainable solutions through rental and subscription services (including Rent the Runaway, Nuuly, Cocoon).

Other post-usage service that is being explored by fashion brands and retailers are the Takeback schemes, these programmes are implemented with the objective of collecting used clothing (Kant Hvass & Pedersen, 2019). The objective is to minimize the disposal of garments in landfill sites and to encourage the concept of circular fashion. By recovering the garments, companies have the option of recycling them, transforming them into new products, or even selling them on resale platforms. Such practices can offer a number of advantages, including a reduction in environmental impact, the creation of a more sustainable image for brands, and the promotion of more conscious consumption on the part of consumers. Nevertheless, the implementation of these programmes

necessitates meticulous planning and the overcoming of challenges, including those pertaining to collection logistics and the quality of returned items. Among the brands that have adopted these programmes are H&M, Levi's, Eileen Fisher Patagonia and The North Face.

Furthermore, some brands are creating dedicated areas in their stores where customers can take their parts to be repaired by qualified professionals. Another alternative is to provide repair kits so that customers can carry out small repairs at home. This option allows consumers to be more independent and to carry out small repairs quickly. Other brands and platforms are partnering with local seamstresses to provide repair services to their customers. This strategy not only facilitates access to the service, but also contributes to local economic development by strengthening local trade. Repair and reuse are fundamental pillars of the 'Care' concept in the fashion industry. By offering repair services and promoting the reuse of clothing, brands are contributing to a more sustainable and circular future. Veja, Nudie Jeans and RE;CODE are companies involved in this concept.

In this context, Product-Service Systems (PSS) Design is an emerging as that provide valuable tools in the redesign of fashion services (Afief et al., 2021; Johnson & Plepys, 2021; Lang & Armstrong, 2018; Pal, 2016). PSSs in the fashion industry represent a paradigm shift in the way clothing is sold and used, moving beyond the traditional model of a one-time purchase. By offering services such as rental, subscription, repair, customization and take-back schemes, PSSs provide consumers with access to a wider variety of items, thereby extending the life cycle of clothing and reducing waste (Vezzoli et al., 2022). This business model has the potential to promote sustainability, personalization and customer satisfaction, transforming the fashion industry into a more circular and conscious model. In contrast to the linear model of production, consumption and disposal, PSSs can possibly promote reuse, recycling and the creation of value from existing products (Tukker, 2015).

Fashion brands, companies and retailers are not limiting themselves to a single strategy or process when responding to sustainable demands. Instead, they seek to integrate a variety of practices and processes to engage consumers, as will be discussed in further detail in this paper.

3. Methodology

The aim of this paper is to identify and discuss the strategies that the fashion system is currently pursuing to transition towards a more sustainable system, with a particular focus on how it is encouraging longer garment life through consumer behavior change. Moreover, the regulatory proposals put forth by the EU, which aim to enhance the circularity, energy performance, and environmental sustainability of products sold within the EU market (known as the Ecodesign for Sustainable Products Regulation, or ESPR), serve as a further catalyst for this study.

Methodologically, this article is structured in two parts. Initially, a conceptual background is presented, based on a literature review, followed by an analysis of case studies. The selection of the cases was made through secondary research methods, resulting in the identification of six case studies. The following criteria were employed in the selection of the cases: (1) Commitment to sustainability: all the selected cases adhere to principles based on circular and sustainable fashion as their guiding philosophy; (2) Diversity/Relevance in consumer awareness initiatives: variety and/or relevance of initiatives to raise consumer awareness of the durability of clothing's life cycle; (3) The cases are approached from two distinct perspectives: In one approach, half of the cases are developed by established fashion brands, while the other half concern businesses that act as support and consultancy for fashion companies.

The cases were primarily framed into three macro strategies: (1) Care, exemplified by the cases RE;CODE and The Seam; (2) Recommerce, exemplified by the cases of Pangaia Rewear and Vestiaire Collective; and (3) Reverse Logistics, exemplified by the Ellen Fischer and SuperCycle cases.

Within those macro strategies, the processes explored are: (1) Maintenance and repair services: clear and accessible instructions on how to wash, dry, iron and store each garment; online and offline customisation workshops, professional repair services, DIY repair kits; (2) Take back programmes: collecting the products either directly from consumers or by setting up take-back points; (3) Awareness and marketing campaigns: content highlighting the importance of conscious consumption and durable fashion, clear information on the origin of materials, production processes and environmental impact of garments; (4) Collaborative business models: resale, rental and subscription platforms.

Taking these factors into account, the analysis aims to investigate the strategies adopted by the fashion industry to prolong the lifespan of clothing items by fostering consumer awareness. Furthermore, the objective is also to identify which processes are addressed in parallel with the macro strategy.

4. Case Studies Analysis

4.1 CARE

This section will analyse two case studies in relation to the 'Care' macro-strategy. The first case study considers RE;CODE, and the second case study considers The Seam.

RE;CODE is a South Korean sustainable fashion brand that has as primary focus the upcycling, specialized in transforming surplus materials and discarded textiles into garments, reducing waste and promoting an eco-friendlier fashion cycle. The incorporation of recycled and organic materials into their collections serves to minimize the environmental footprint, allowing the brand to create unique pieces or limited collections. In this context, the service called MOL 1 RE;CODE offered by the brand is dedicated

to the upcycling and transformation of pre-owned clothing. The service provides a means of transforming existing garments into new and stylish items through the application of alterations, enabling the wearer to refresh their wardrobe and give new life to items that are no longer worn. The customer selects a garment that they wish to have reworked, RE;CODE tailors and upcycles the piece based on the customer's preferences and their design expertise. The customer then receives their renewed garment.

Furthermore, the brand offers a movement called RE;TABLE, an activity where individuals can gather with friends and family at the table and practice fun upcycling together. Until today, 20,824 people participated of the initiative, which also aims to empower single mothers financially and to sustain their economic activity. The promotion of upcycling and sewing education is offered to single mothers who experience difficulties in balancing childcare and economic activity. They are trained to become professional instructors through this initiative, and those who successfully complete the educational programme are subsequently employed as skilled upcycling workshop instructors, guaranteeing a stable standard of living through continued economic activity. In addition, RE;CODE keeps its sustainable impact numbers up to date on its website (number of revived stock garments; number of repair/ remodeling requests; number of designers who have partnered with them, number of socially responsible people together; number of participants in the workshop RE;TABLE).

Moreover, RE;CODE's BOX ATELIER represents an expansion of the company's commitment to sustainable fashion practices through the incorporation of a resale service, facilitating the circularity of garments by enabling customers to extend the life cycle of their pre-owned RE;CODE clothing. To do so, individuals may present unwanted items to the BOX ATELIER, where a potential consultation may assess the condition of the garment and establish a fair resale value. Subsequently, RE;CODE oversees the listing and sales process, thereby enabling the clothing to be repurposed and reducing textile waste. Conversely, the resale section enables customers to become active participants in sustainable fashion by offering a curated selection of pre-owned garments at potentially reduced prices.

Still concerning Care strategies, the platform The Seam has established itself as a crucial service provider within the fashion industry, with a particular focus on the UK market. The organization's fundamental objective is to encourage the adoption of sustainable practices through the provision of clothing repair and alteration services. This approach directly addresses the environmental consequences of fast fashion by extending the lifespan of existing garments, thereby reducing textile waste and the necessity for continual new clothing purchases. The Seam offers a comprehensive range of services, encompassing repairs that address minor imperfections such as ripped seams, as well as more intricate alterations such as zipper replacements. Furthermore, they offer

garment tailoring services with the objective of achieving an optimal fit, including operations such as suit tailoring, hem adjustments, and dress alterations. Additionally, select locations offer cleaning services for garments, thereby providing a comprehensive approach to clothing care. This dedication to sustainability is not limited to the longevity of garments, The Seam actively fosters the revival of skilled craftsmanship within local communities. By forming partnerships with local tailors and seamstresses, they are able to guarantee the provision of high-quality alterations and repairs, while simultaneously supporting the growth of small businesses.

The Seam also places a premium on customer convenience. Their website offers a user-friendly interface for online appointment booking and service selection. This includes the option of studio visits, whereby customers can bring their garments to a designated Seam location. For an additional fee, they offer the convenience of at-home visits by skilled tailors.

4.2 RECOMMERCE

This section will present an analysis of two cases pertaining to the 'Recommerce' macro strategy. The first case study is that of Pangaia Rewear, and the second is that of Vestiaire Collective.

The PANGAIA Rewear initiative, projected by the sustainable clothing brand PANGAIA, is a peerto-peer resale platform dedicated to the sale of pre-owned PANGAIA clothing items, aiming to extend the life of their garments by encouraging consumers to resell them when they are no longer fit for purpose. From an environmental perspective, this process has the benefit of reducing the amount of clothing waste and the necessity for new PANGAIA clothing production.

The use of Quick Response (QR) codes on care labels facilitates the listing of items. PANGAIA Rewear is conceived as a nexus for their circular fashion mission, with the potential for the integration of rental, repair, and take-back schemes in the future. In addition, PANGAIA has a page dedicated solely to the care of its articles. Entitled 'PANGAIA Aftercare', the use of natural fibers and dyes in their products, requires an extra care to keep them in good condition.

Other incentive of the brand regards the Pangaia's Inner Circle, a complimentary loyalty programme. The registration process can be completed by creating an account on their website, and for each purchase made, customers are awarded points, which can subsequently be redeemed for discounts and vouchers on future purchases. In addition, members of the Inner Circle have exclusive benefits, including the opportunity to gain early access to new product launches and sales. As one ascends through the tiers, which are unlocked by accumulating more points, one may gain access to special events or experiences that align with PANGAIA's sustainability mission. One may also select a welcome gift at the time of joining, such as a discount or a donation to environmental causes.

The brand goes beyond, offering a B2B service named 'Powered by PANGAIA', a platform that makes its apparel and accessories available to corporate clients who are inspired by and aligned with the platform's mission. From the provision of merchandise to major corporations for the benefit of their employees and for corporate gifting, to the formation of bespoke artist partnerships with cultural institutions, to the enhancement of company uniforms for employees, as well as to larger innovation-driven projects such as the recycling of old garments into new materials, 'Powered by PANGAIA' ensures that other business solutions achieve the same high quality and responsible standards as their own brand.

The second case studied in this section regards the global online marketplace Vestiaire Collective, where users can purchase and sell pre-owned designer clothing and accessories. The company's focus is on luxury, with a particular emphasis on top brands and vintage items, as opposed to fast fashion. The platform employs a multi-faceted approach to act against the phenomenon of fast fashion. The promotion of CF is a key aspect of the company's business model, predicated on the repurposing of garments and accessories, thereby curbing the demand for mass-produced fast fashion items. In 2022, the company initiated a policy of banning fast fashion brands from its platform, making it increasingly challenging for users to locate these items on the site. Vestiaire Collective also educates consumers about the negative impacts of fast fashion, such as textile waste and pollution, and demonstrates the lower cost per use of second-hand clothes, which is typically less than that of fast fashion items. The company has also formed sustainable partnerships with organizations such as The OR Foundation to address the issue of clothing waste in developing countries.

With Sojo, a UK-based enterprise specializing in the repair and alteration of garments, Vestiaire Collective has established a strategic alliance. The objective of this collaboration is to address two significant challenges within the pre-owned fashion market: achieving an optimal fit and ensuring the longevity of garments. By incorporating Sojo's services into their platform, customers can now purchase pre-owned luxury items with greater assurance of size and fit. The capacity to tailor these garments ensure a precise fit, thereby reducing the risk of disappointment due to sizing issues and fostering a more favorable perception of pre-owned fashion.

Finally, in response to the growing demand from our eco-conscious consumption, Gucci has collaborated with Vestiaire Collective to launch a new take-back programme. The proprietor of a handbag from one of their signature lines can exchange it for store credit. This may be done either through an elevated in-person experience in selected Gucci boutiques or online, the extension of the lifespan of a Gucci product is in alignment with the House's vision of a circular future for fashion.

4.3 REVERSE LOGISTICS

The section will analyze two cases in relation to the 'Reverse Logistic' macro-strategy. The initial case study is that of Ellen Fisher Renew and Supercicle Platform.

The Eileen Fisher Renew platform was developed with the objective of promoting sustainability in the fashion industry, where pre-owned Eileen Fisher clothing to be given a second life. The programme is a recycling initiative whereby used Eileen Fisher clothing is collected and returned to the company, it encourages the practice of responsible consumption and the reduction of textile waste. Clothing produced by Eileen Fisher may be returned regardless of its condition, whether it is gently used, damaged, or in any other way unsuitable for sale. For the consumer there is a reward in the form of a Renew Rewards Card for each returned item. From an environmental perspective, this process extends the lifespan of garments and reduces the necessity for new clothing production.

Launched in 2018, Eileen Fisher's Waste No More initiative extends the life of clothing and resources by transforming pre-consumer and post-consumer textile waste, specifically unwanted Eileen Fisher garments, into unique and artisanal textiles. Through the Eileen Fisher Renew programme, customers can return used clothing in any condition. Waste No More then meticulously sorts, cleans and repairs these garments whenever possible. Using a felting technique (process of matting and condensing wool fibers together using heat, moisture, and agitation), they give new life into the used materials, creating one-of-a-kind sustainable textiles. These transformed textiles are then used to make products such as cushions, wall hangings and decorative objects. Waste No More not only combats textile waste destined for landfill, but also offers customers the opportunity to participate in a more environmentally conscious fashion cycle. Furthermore, although the brand doesn't focus on marketing campaigns, it does have a section called 'the journal' on its website, dedicated to providing information on repair and resale techniques, on the certificates the brand has earned, such as the B Corp, and on materials and how to extend their useful life.

Supercircle is a comprehensive technology platform designed to assist retail brands in the implementation of circular practices, with a particular focus on the textile industry. The platform's primary objective is to facilitate the transition towards a more circular economy. Aiming to reduce textile waste by establishing a closed-loop system for the collection, processing, and reuse of clothing, footwear, and other textiles. This is accomplished through the provision of a range of services for brands. Through the Turnkey Trade-In Programmes, Supercircle assists brands in implementing consumer-facing programs that facilitate

the return of unwanted items and provide customers with credit towards future purchases. This encourages the practice of responsible consumption and facilitates the reintroduction of used items into the supply chain. The platform also offers solutions for excess inventory overseeing the management of a brand's surplus inventory, which may include damaged goods, samples, or excess stock. Supercircle assumes responsibility for the collection, transportation, and potential resale or recycling of these items.

In terms of data and reporting, Supercircle furnishes brands with exhaustive data and reports on the performance of their programmes. This enables brands to monitor the environmental impact and customer response to their circular initiatives. Brand partners of Supercircle include Reformation, ALC and Uniqlo US.

5. Discussion and Conclusion

The aim of this paper was to contribute to the field of Design by illustrating 6 of the best practices in the fashion system in relation to consumer awareness through strategies and processes related mainly to the use and post-use of clothing (Figure 1).

The first finding of this study concerns the encouragement that a fashion brands and platforms are providing for its consumers towards a more sustainable fashion system. The construction of a macro-strategy (Care/Recommerce /Reverse Logistics) supported by parallel processes, can lead to positive socio-environmental effects. The cases presented illustrate two distinct paths. The first is exemplified by fashion brands (RE;CODE, PANGAIA and Eilen Fisher) that demonstrate diversity in their processes and services, irrespective of their macro-level strategies. The second is represented by platforms that have the fashion system as their target customer base (The Seam, Vestiaire Collective, Supercicle). In this case, processes and services tend to be more specialized. The analysis demonstrates the interrelationship between services and processes, given that in the majority of cases, brands and platforms offer a combination of them.

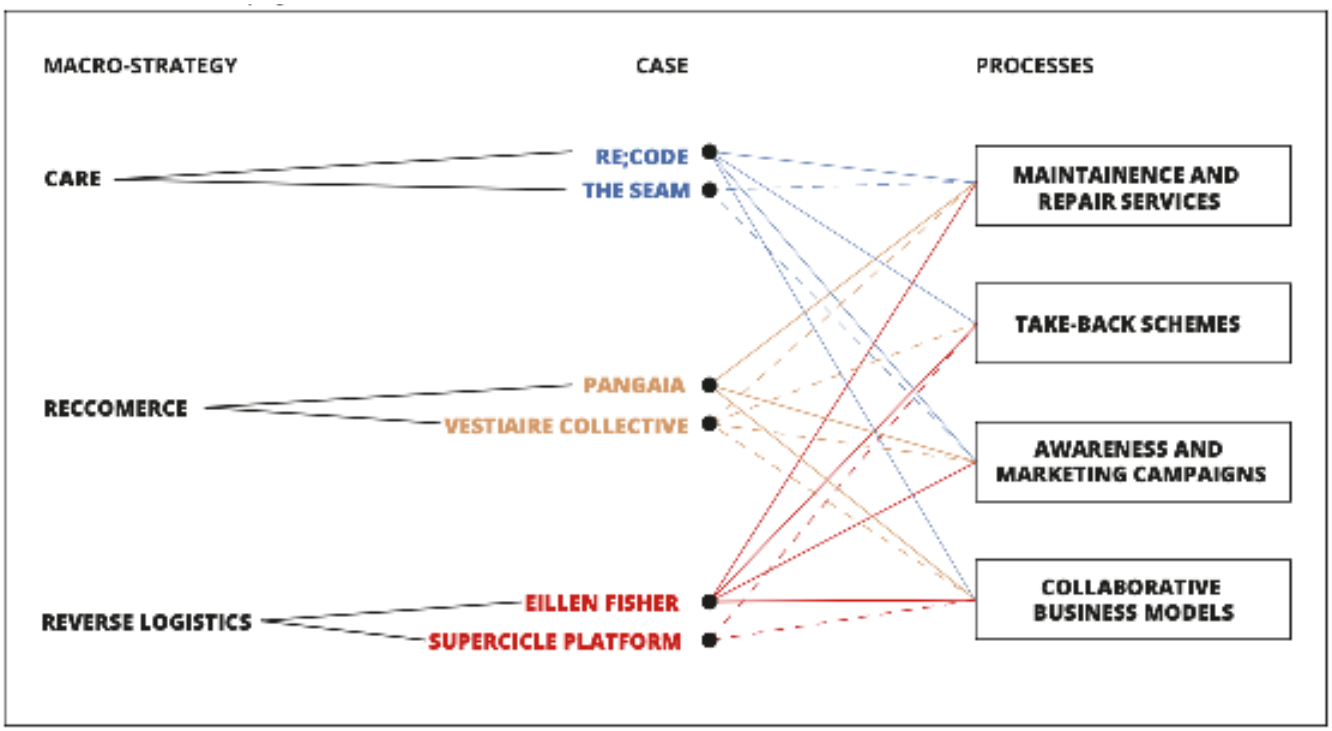

Figure 1. Connection among macro-strategies and processes gained from fashion best practices in relation to consumer awareness related mainly to the use and post-use of clothing.

Having as a macro-strategy the concept of 'Care', RE;CODE transforms surplus materials and discarded textiles into unique garments, offering services like custom upcycling and resale. Beyond environmental sustainability, the brand empowers single mothers through upcycling education and employment opportunities. By tracking its sustainable impact and offering a platform for community engagement through RE;TABLE, RE;CODE is leading the way in creating a circular and socially responsible fashion industry. The Seam instead, by offering a wide range of clothing repair and alteration services, extend the life of garments, reduce waste and promote ethical fashion. Their commitment to local craftsmanship ensures high quality repairs while supporting the community. The Seam also prioritizes customer convenience with online booking, in-store services, home visits and mail-in options.

From the 'Recommerce' macro-strategy point of view, the PANGAIA Rewear platform facilitates the resale of pre-owned PANGAIA items, extending the life of garments and reducing waste. But the brand also supports the consumer through other processes, for example the Inner Circle loyalty programme, where customers are rewarded for their sustainable choices and receive exclusive benefits. To extend its impact, Powered by PANGAIA offers B2B solutions for businesses in line with the brand's sustainable mission. With a focus on aftercare and material transparency, PANGAIA aims to create a long-term relationship with its customers and the environment. Always

under the same macro strategy, Vestiaire Collective, through the promotion of circular fashion and the banning of fast fashion brands, addresses the adverse effects of the industry. Collaborations with organizations such as The OR Foundation and Sojo further enhance the sustainability efforts of the platform. Additionally, the partnership between Vestiaire Collective and Gucci highlights the growing significance of resale and circularity in the luxury fashion sector.

Furthermore, Eileen Fisher Renew programme, based on 'Reverse Logistics' macro-strategy, encourages customers to return used clothing in exchange for rewards. Meanwhile, Waste No More transforms unwanted garments into new products. Through education and transparency, Eileen Fisher empowers consumers to make informed choices. The Supercircle platform instead offers a technology platform to support brands in implementing similar circular initiatives. This provides tools for trade-in programmes, inventory management, and data analysis. Collectively, these initiatives promote a circular fashion economy and reduce textile waste.

The second key finding of this study highlights that the transformation of the fashion system does not depend solely on the actions of individual consumers despite the relevance of their role. Indeed, the role of consumers is crucial in shaping market trends, production decisions and the overall value chain of the fashion industry. Consumer demand, which moves towards greater sustainability and circularity, is increasingly recognized as a driving force in encouraging more responsible corporate behaviour (Musova et al., 2021). Consumer and industry responsibilities are distinct but interdependent aspects of promoting responsible consumption (Cavender, Lee & Wesley, 2021). While research has traditionally focused on the lack of circularity in the textile supply chain or on consumer habits regarding the use and disposal of garments, the involvement of the fashion industry in the post-retail phase is a more recent development. The connection between consumer and industry responsibility is particularly evident in the increasing recognition of the fashion industry's role in the circular economy and the growing consumer awareness of sustainability. However, this awareness, widespread especially among the younger generations, does not always translate into behavioural changes. Therefore, fostering consumer attitudes towards sustainability, together with a sense of responsibility, is essential to promote meaningful change (Luchs, Phipps & Hill, 2015).

In response, companies, brands, retailers, and platforms can contribute through a range of strategies, engaging the consumer in the process. Design, in its diverse forms, represents a potential avenue for impact. In addition to influencing the initial stages of the fashion supply chain (conceptualization, sourcing and assembling), the efficacy of Design on the final stages of the fashion supply chain such as distribution, retail,

and consumption is important to guide the consumer into a more conscious use and post-use of the garments. In this sense and within the concept of Design for Longevity, the relationship between Use and Post-Use Services (such as Fashion Resale/Repair Platforms and Take Back schemes) and Product Service Systems (PSSs) Design is becoming increasingly close and strategic, with the objective of developing a circular and sustainable business model in the fashion industry. These approaches ultimately converge towards the extension of product lifespan and reduction of waste.

PSSs are embedded in a fashion system with the objective of minimizing resource use, waste, emissions and energy losses through the implementation of strategies that seek to slow down, close and narrow material and energy cycles. This can be achieved by extending the lifespan of products, improving efficiency in product use and operation, and recovering materials that could be exploited at the end of their lifespan. Therefore, PSSs must be intentionally developed for the purpose of the circular economy, although it is still challenging to see full results, since a fashion company can adopt circular economy principles of closing the loop and still be unsustainable, for example, if its employees work in poor working conditions.

In conclusion, the study shows that design processes, which will soon be further encouraged in light of the recently introduced EU ESPR regulations, have become a challenging undertaking. This is due to the necessity of developing a system comprising products and services in an integrated manner, in accordance with the new guidelines that have yet to be considered in the conventional linear development approaches employed by numerous companies within the fashion industry.

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PROTOTYPING A MIGRATING VIRTUAL RE- CEPTIONIST USING PHYSICAL AND VIRTUAL REALITY TOOLS: IMPLICATIONS FOR DESIGN COMPETENCY AND TOOL DEVELOPMENT.

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ABSTRACT | This paper presents an examination of the design process and tools for adaptable Intelligent Virtual Agents (IVAs) in both physical and virtual proto- types, using a Research through Design (RtD) approach and prototyping. The study focuses on the design of a migrating virtual receptionist for a computer science department, transitioning from a screen at the entrance, to a phone for mobile interaction, and ultimately to a robot in the coffee area. The research ex- plores the educational implications of designing such virtual agents, raising significant questions about the competencies required and the tools necessary for future designers. The study also investigates design tools equipped with pre- configured agents, identifying and discussing the adjustable parameters within these tools. The prototypes were evaluated with 23 participants who interacted with the virtual receptionist in both a virtual reality (VR) and a physical environ- ment, with the evaluation results indicating a high level of usability in both envi- ronments. The research contributes to the field of design research, particularly in the context of designing IVAs, by furthering understanding and application of the design process and tools, exemplifying the integration of physical and virtual realities in prototyping, and suggesting improvements for design tools and meth- ods to facilitate this process.

KEYWORDS | MIGRATING AGENT, VIRTUAL RECEPTIONIST, INTELLIGENT VIRTUAL AGENTS, DESIGN, SKILLS, COMPETENCIES, PROTOTYPING, RESEARCH THROUGH DESIGN, USER- CENTRED DESIGN COMPETENCY MODEL

1. Introduction

An agent is commonly defined as a software or computer system that is situated in an environment and capable of autonomous action in this environment to meet its design objectives (Wooldridge & Jennings, 1995). Intelligence is, in this context, demonstrated through flexible autonomous actions, that is, how the agent per- ceives its environment, how it reacts to the environment, and its social interac- tion capabilities (Wooldridge & Jennings, 1995).

Intelligent virtual agents (IVAs) are defined as interactive digital characters that are characterised by human-like modalities and flexible autonomous actions by means of real-time perception, cognition, emotion and action. (Lugrin, 2021). Related, Embodied Conversational Agents (ECAs) demonstrate interaction abili- ties similar to face-to-face human conversations. This includes the ability to pro- duce and respond to verbal and nonverbal communication (Cassell, 2000; Lugrin, 2021). The physical presence and visual representations of ECAs aim to enhance engagement and user experience (UX). The nonverbal cues and facial expressions of the embodied conversational agents can be used to convey meaning and emotions (Cassell, 2000).

A virtual receptionist is an IVA or ECA that uses verbal and nonverbal input such as “the user’s voice [...] and contextual information to provide assistance by an- swering questions in natural language, making recommendations and perform- ing actions” (Cowan et al., 2017). Such agents should be able to engage in face- to-face conversations with visitors to a place, demonstrating many of the same communicative behaviours as humans do in service situations.

Different agent embodiments provide varying opportunities for interaction while imposing different limitations. Robots compared to screen-based ECAs have a greater physical presence (Li, 2015), but can suffer from mobility problems and power limitations (Kriegel et al., 2011). Digital characters convey emotions more effectively but do not move in physical space as they are confined to a screeen. Characters on handheld devices can accompany their users but their size is a limitation, and they also have limited interaction modalities (Aylett et al., 2013).

The design of these interactive technologies necessitates specialised expertise and knowledge from various fields or domains, making it crucial for these diverse disciplines to have effective methodologies (Kautonen & Nieminen, 2016). Com- petency models offer a structured approach to organising and evaluating the knowledge, skills, abilities, personal characteristics, or a combination of these attributes necessary for effective performance (Kautonen & Nieminen, 2016). Nieminen (Nieminen, 2015) developed a User-Centred Design (UCD) competency model comprising 12 fundamental competencies (see Table 1). These competen- cies are categorised into four groups: User Strengths or Designer Strengths depending on the participant's role, Soft Skills and Hard Skills, based on whether the com- petency is innate or acquired (Nieminen, 2015). We have created prototypes of an IVA that migrates between three embodiments. This can be thought of as a'soul-shell'approach in which the IVA is characterised as the soul and the embodiments it inhabits as the shell and only one instance of the IVA is able to migrate between various shells (Koay et al., 2011). The main research centres on the design of a migrating virtual receptionist for a computer science department with questions on what competencies are required to design these IVAs, and how might we equip future designers with these skills?

Table 1: UCD Competency Model according to Nieminen (Kautonen & Nieminen, 2016)

User Strengths	Soft Skills	Designer Strengths	Hard Skills
Subject Domain Experience (SDE): (Tacit) knowledge, crafts and skills gained by (long) experience.	**Communication (C)**: Wellfunctioning and democratic communications are the most time consuming and critical part of design work.	**User Involvement (UI)**: Capabilities in selecting the right users and working with them effectively.	**Process and Methods (PM)**: Process, management and methodological excellence and the skills to adapt them.
Context Availability (CA): Access to real context of use, may be restricted or difficult to arrange.	**Multidisciplinarity and Collaboration (MC)**: Multiple points of view increase the eventual impact of design.	**Problem solving and Designerly ways (PSD)**: Attitude and determination towards designing a change for the better and having the means to realize it in a responsible manner.	**Technology and Market Potential (TMP)**: Awareness of advances in available technologies and relevant trends at target markets.
User Cultures, Social Networks and Practices (USP): Each user groups have their own language and culture that can be difficult to grasp and utilize in a design project.	**Motivation and Ambitions (MA)**: Intrinsic motivation, self-improvement, professional ambitions, competitive salary and manageable workload create solid design conditions.	**Conceptualization, Visualization and Validation (CVV)**: Skills in creating product concepts, prototyping and testing.	**Subject Domain Knowledge (SDK)**: Knowledge and skills gained by education and certification.

In this paper, we describe the proposed design and its embodiments in two pro- totypes, which have been tested with 23 users. Data on perceived usability, prod- uct reactions, and strengths and weaknesses in the user experience were col- lected. As different prototypes filter a design space and manifest design ideas differently (Lim et al., 2008), the two prototypes effectively work as data source triangulation (Thurmond, 2001) to increase confidence in the research findings.

The structure of the paper is as follows: Section 2 provides a background on the migrating virtual receptionist and the study's tools and methods. Section 3 out- lines the methods

employed in the study, while Section 4 details the results of the evaluation of the two prototypes. In Section 5, a discussion of the study and its findings is presented, and Section 6 contains the conclusions.

2 Migrating Receptionist Prototypes

The prototypes of the migrating receptionist are based on the findings of a previous study on the conceptual designing of a virtual receptionist (Author, 2021). Three concepts were generated and the concept of a migrating virtual reception- ist was selected after a PMI (plus, minus, interesting) chart evaluation process.

The prototypes were designed for three places of interaction: the entrance, the corridor and the coffee area of the department. The receptionist migrated to a different embodiment at each place. The users were to interact with the receptionists on a large screen by the entrance, on a mobile phone used while walking in the corridor and embodied in a robot in the coffee area. The interaction with the receptionist on the screens was based on a form of text-to speech (TTS). The user selected among text alternatives whilst the receptionist responded using speech. Two prototype versions were developed: one in VR and one in physical space.

2.1 Virtual Reality Prototype

The migrating receptionist in VR was developed and run in Unreal Engine [1]. Unreal Engine is a 3D game engine made by Epic Games used to create video games, VR experiences, and other interactive content for various platforms. Unreal Engine was selected due to its graphics qualities in VR and good support for VR, which facilitated making the VR environment realistic in relation to the physical prototype. The environment (3D layout of one floor of the department) was developed using Blender [2] which is a software used for creating 3D models, animations, visual effects, etc.

The 3D model of the VR environment is a representation of the three places of interaction (the entrance, the corridor, and the coffee area). The VR controllers represented the user's hands, and a 3D model of a mobile phone appeared in one hand. Communication between the user and the receptionist was that the user selected among text alternatives, and the receptionists responded using speech. Communication with the robot in the coffee area was in text-based dialogue format. The user selected text alternatives and the robot responded with both audio and text. Orange text represented the user's text and green text was the robot's response.

2.2 Physical Prototype

The physical prototype was developed using a static website for the agent on the entrance and the mobile device screens. The robot

1Unreal Engine
2 Blender

used in the coffee area was a Furhat robot [3]. Furhat is a social robot that communicates with users in human–like face–to–face human conversations by speaking, listening, showing emotions, and maintaining eye contact (Al Moubayed et al., 2012). A touch pro- jector screen [4] by the entrance was used for the initial interaction with the receptionist. Each participant was then accompanied by the agent after it migrated to their personal mobile phone. The migration to the phone happened after the user scanned a QR code provided by the receptionist on the entrance screen. In- teraction on the phone was performed using the the touch screen. Communica- tion with the Furhat robot was a face–to–face human-like conversation.

3 Method

The data collection of the migrating virtual receptionist study was carried out with a number of tools and methods. Video recording of the touch interaction with the screens in the physical prototype, as well as the interactions in VR was performed. Audio was recorded during the product reaction card words session (described below). The study procedures and the data analysis methods are pre- sented in this section as well.

3.1 Instruments

Product reaction cards were used to collect product desirability, and the system usability scale (SUS) was used to collect the usability data of the prototypes. An age and gender questionnaire was used to collect demographic data.

Product Reaction Cards

Benedeck and Miner (Benedek & Miner, 2002) developed product reaction cards at Microsoft as part of the desirability toolkit (also known as the Microsoft Reac- tion Card Method). The toolkit was created to understand the intangible emo- tional responses like desirability and fun resulting from a user's experience with a product (Barnum, 2021). The method introduces a controlled vocabulary for participants (Moran, 2016). The toolkit consists of 118 words, the intention is to cover a wide variety of possible reactions. The word list can be modified in terms of the kind and number of words. The selection process of which words to use depends on design objectives, that is desirable UX qualities, and the type of study (Arvola, 2010; Arvola & Holmlid, 2015).

The words selected for the migrating receptionist study were based on the following design objectives:

- Immersion and engagement.
- User-friendly interfaces.
- Seamless (continuous/fluent) transition between interfaces and embodiments.
- Awareness: the user should feel accompanied by the same agent between embodiments.
- Similarities in interactions between the two

3 Furhat Robotics

4 Sony Xperia Touch

prototypes, i.e., both prototypes should represent the same interaction design.

The words used in the reaction cards included 15 positive words and 11 antonyms of the positive words. The use of antonyms was done to allow for expansive vocabulary – to give participants more options to express themselves. The reaction card method recommends including at least 40% of negative words, and some neutral words (Moran, 2016). The words used were selected from the 118 words of the Microsoft desirability toolkit. Although not in the toolkit's 118 words, the words indifferent and Ok were included for the expansive vocabulary.

System Usability Scale (SUS)

The SUS, developed by Brooke (Brooke, 1996), is a standardised questionnaire used for the assessment of perceived usability (Bangor et al., 2008; Lewis, 2018). The SUS is a relatively quick and easy-to-use tool to be used when doing usability evaluations. It is adaptable to various interface technologies due to its technology-neutral approach, allowing it to provide a comprehensive assessment (Bangor et al., 2008). The SUS is stated to be robust even with a relatively small number of participants (8–12 users) (Tullis & Albert, 2013)

We used the original SUS questionnaire questions, with the word system repre- senting the migrating receptionist prototype as that does not affect the results (Bangor et al., 2008; Brooke, 2013). One questionnaire was used for each environment (VR and physical prototype) of the study.

Positive	**Negative**	**Neutral**
Easy to use	Negative	Familiar
Engaging	Complex	Indifferent
Seamless	Disconnected	Ok
Relevant	Irrelevant	Exceptional[5]
Immersive	Disengaged	
Inspiring	Impersonal	
Stimulating	inconsistent	
Effective	Difficult	
Personal	Overwhelming	
Exciting	Confusing	
Novel	Intimidating	
Approachable	Annoying	
Consistent		
Motivating		
Appealing		

3.2 Participants

5 Exceptional: Depending on the context of use, the word can have either positive or negative connotations.

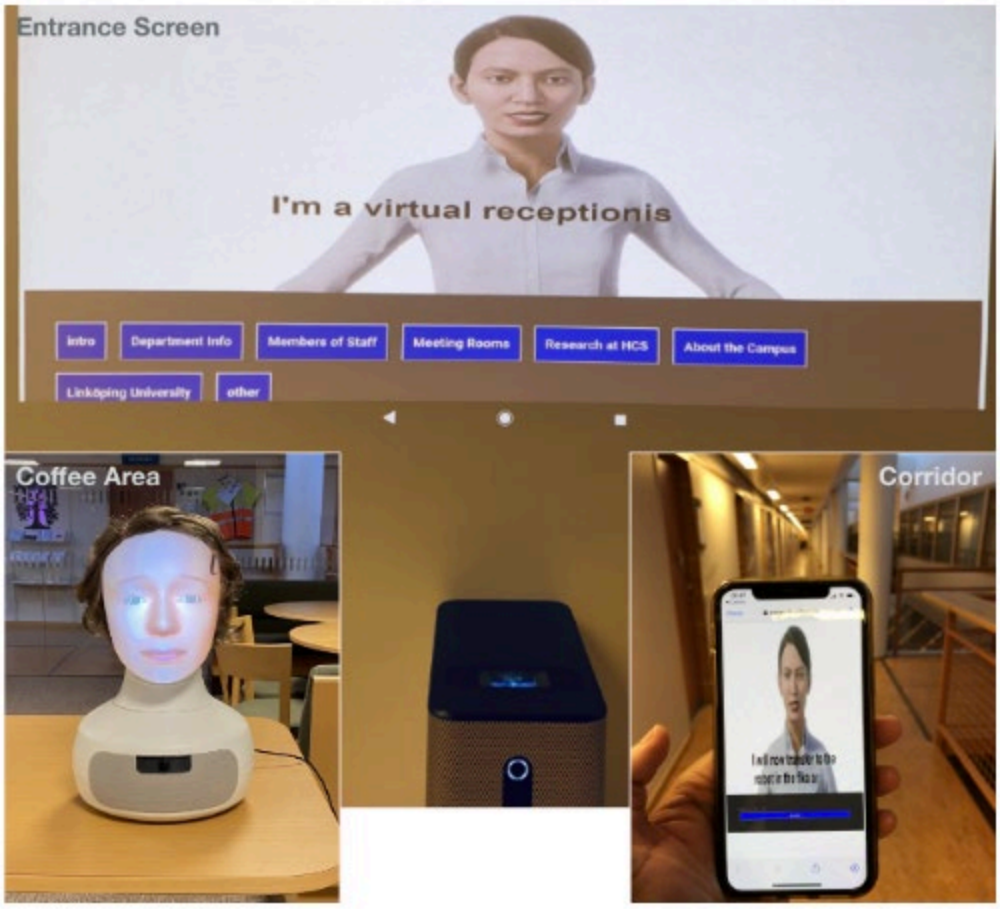
The study consisted of 23 participants, 12 members of staff, 6 female and 6 male (age range: 21–59). 11 student participants, 6 female and 5 male (age range: 18– 49). The mode (10) of participants was within the age range of 21–29. 80% of these participants belonged to the student group. The member–of–staff group was evenly distributed across three age ranges. Four participants were between the ages of 30–39, four between 40–49, and another four between 50–59. Six of the member–of–staff participants were researchers and the other six were not.

Following The European Code of Conduct for Research Integrity (All European Academies, 2017), prior to participating in the study, all participants were required to provide their consent. They were briefed on the data collection methods and tools, as well as the intended use of the data. The consent form covered specific areas, such as conferences, teaching, presentations, and workshops. Information regarding data storage and management was also included in the form. Additionally, in accordance with the research code of conduct, no personal data of the participants was to be presented in any of the defined areas (conferences, teaching, presentations and workshops).

3.3 Procedure

Participants were first presented with the age and gender questionnaire. Then a scenario was given describing that they were unfamiliar with the department building and were to find the office of a named member of staff. Participants first interacted with the receptionist at the entrance screen. Once they found the E.Chilufya, M.Arvola, T.Ziemke part of the building to go to, the agent then migrated to the mobile phone, giving real–time directions to the office as they walked in the corridor. Participants were then informed that the member of staff was in a meeting ending in 10 minutes and were asked to wait in the coffee area. The participant was then given direc- tions to the coffee area and informed that the receptionist would migrate to the robot in the coffee area. These interactions are illustrated in Figure 1 and 2. The physical screen and VR interactions were video-recorded during each session.

Figure 1: Migrating receptionist in physical prototypes.



This was followed by the product reaction card session. The user was asked to select which words they associated their interactions with the receptionist in the 3 embodiments. The participants were to explain why they selected each word. The explanations were audio recorded. The last part of each session was for the participant to fill out a SUS questionnaire.

Changes were made to the VR experience as the design had to be adapted to the prototyping technology used. The HTC Vive Pro [5] was used. As the HTC Vive Pro requires a cable (from the PC) to be attached to the Head–Mounted Display (HMD), the cable limits the navigation space. We used the VR teleport function to overcome the limitation. The participants first had a trial session to get familiar with teleportation, having the HMD on, and using the VR controllers for interac- tion. The participants practised interacting with the robot in the coffee area during the trial sessions as well. This had the participants familiarise themselves with the robot, which responded through speech and text. The participant used the trigger function on the VR controller for all interactions in the VR environment.

The order in which a participant experienced a prototype was balanced. If a participant's first interaction with the virtual receptionist was in the physical prototype, the next participant would

5 HTC Vive Pro

start with the VR prototype. This was done with the purpose of reducing learning and order effects.

Figure 2: Migr

3.4 Data analysis

Analysis of the SUS data was done using the SUS grading ranking, whilst the reac- tion cards data was analysed using Burke's pentad with the WWWWWH (5WH).

SUS Grade Ranking

Bangor et al. (Bangor et al., 2009) incorporated a grade ranking system into the SUS, inspired by the letter grades used by many universities as a recognisable and easy–to–understand point of reference. This entails that a score of 80.3 or higher corresponds to an A, a score between 74 and 80.3 equates to a B, a score between 64 and 71 corresponds to a C, a score between 51 and 62 is equivalent to a D, and any score below 51 results in an F.

Burke's Pentad and

Mediated Action is an approach to studying cognition by analysing people's ac- tions with physical and psychological mediating means (tools) (Rowe & Bachman, 2012). Wertsch (Wertsch, 1997) uses Burke's Pentad of human actions and mo- tives in his own framework of thinking as mediated action. He states that the pentad involves focusing on agents and their cultural tools or mediational means.

Burke Pentad is Burke's approach to human action. It uses five terms as gen- erating principles of investigation: Act, Scene, Agent, Agency, Purpose (Burke, 1969). As the pentad can also be used for the analysis of the design problem as described in the WWWWWH (5WH) method (Van Boeijen et al., 2020), we com- bine the two (agent/who, act/what, scene/when–where, agency/ how, and pur- pose/why) to present the emotional valence of the words selected during the product reaction cards session.

4 Results

The data collection methods combine both quantitative and qualitative approaches. This section presents the SUS score with Bangor et al.'s (Bangor et al., 2009) grade ranking, as well as the product reaction cards results and their relation to Burke's Pentad and the 5WH method.

4.1 SUS Results

The SUS results of both prototypes showed more positive results with a mean of 83.9 for the physical and 78.3 for the VR as shown in table 2. A SUS score ranges from 0 to 100, with higher scores indicating better usability. A score above 70 is considered good, while a score above 85 is excellent.

Table 2: The mean, standard deviation and mini of the SUS score for the VR and physical prototype

	Physical prototype	VR
Mean:	83.9	78.3
Std Dev:	10.7	13.2
Min:	60	47.5

Using Bangor et al.'s (Bangor), the major- ity of the SUS scores for both the physical and VR prototypes fall under the ad- jective best imaginable (scores between 84 and 100), with the highest count of A grades by the participants. This is followed by a B grade (adjective excellent) of 6 for the physical and 8 for the VR prototype. The next range is under the adjective Ok, D grade, with 2 for the physical and 4 for the VR prototype. The lowest SUS score of 47.5 is under the adjective poor. This was a single result from the VR prototype.

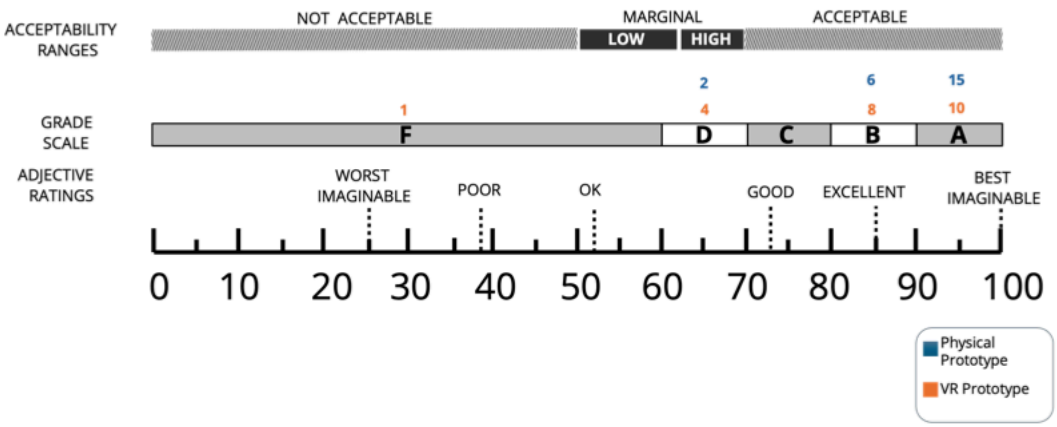


Figure 3: SI

4.2 Product Reaction Cards Results

The results of the product reaction cards session are shown in Figure 4. The word easy–to–use has the highest count in both the VR (15) and the physical prototype (20). The words not selected by any of the participants (with zero count) are: dis- connected and disengaged. The top 5 positive words in both prototypes are easy to use, effective (23), engaging, seamless and novel (all selected 20 times). The neg- ative words are confusing (9), impersonal (6), complex (5), intimidating (5) and overwhelming (4). The most selected neutral words are familiar (10) and ok (8).

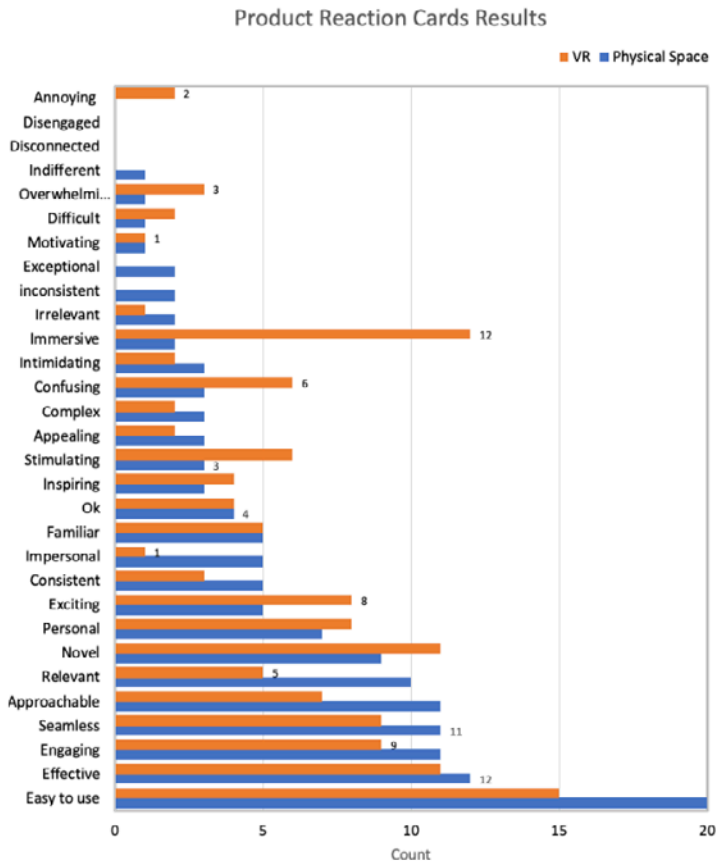


Figure 4: PRC selected w

The top positive, nega the following Burke's Pentad and the SWH as follows:

- Easy to use relates to how/agency. Participants selected the word to refer to the experience of interacting with the migrating receptionist.
- Effective relates to why/purpose, Participants found the idea of having a migrating virtual receptionist effective.
- Engaging relates to who/agent and how/agency. Some participants selected the word engaging to refer to having the same agent accompanying them. Other participants referred to interactions with the different interfaces (agency) as engaging.
- Seamless relates to when/scene and how/agency. Participants used the word seamless to refer to the VR environment and the interaction with a migrat- ing receptionist (agency).
- Novel relates to why/purpose and how/agency. The idea of interacting with a migrating virtual receptionist was novel to most participants. The form of using VR for the purpose of interaction with the agent was novel to a num- ber of participants as well.
- Confusing relates to how/agency. This referred to the interactions in VR.
- Impersonal relates to who/agent: Participants used the word impersonal to refer to the interaction with the Furhat robot, it felt disconnected from the screen embodiments.
- Complex relates to what/act and how/agency. Participants used the word complex to refer to actions in VR such as teleportation. Others used the complex to refer to the technology/programming used to build the prototype.
- Intimidating relates to how/agency and who/agent. Participants not familiar with VR found it intimidating. Other Participants used the word intimidating to refer to the Furhat robot.
- Overwhelming relates to the how/agency and who/agent. Though categorised as negative, one participant used the word overwhelming for a positive ref- erence during the VR experience. Others used the word to refer to a nega- tive inference to the VR experience and interaction with the receptionist.
- Familiar relates to where/scene and how/agency. Participants used the word to refer to the familiarity of the VR environment as it felt like the physical environment. Familiar was also used to refer to the technology used before; such as QR coding, interactive touch screens and the Furhat robot.
- Ok relates to why/purpose. Participants selected the word to refer to the experience with the migrating receptionist.

Relations of the rest of the words to Burke pentad and the 5WH method:

- Why/purpose: Relevant, Inspiring, Stimulating, Motivating, Irrelevant. • What/Act: Exciting and difficult.
- How/Agency: Consistent, disconnected and inconsistent.
- Who/Agent: Approachable, personal,

appealing, disengaged and annoying.

- When–where/Scene: Immersive.

Two participants added 2 words that were not included in the collection of words provided. Unapproachable was used to refer to the initial interaction with the Furhat robot by one participant. The other word is natural, which was used to refer to a meaning connecting the words seamless and effective. The participant used natural to refer to the manner in which the migrating agent took the initia- tive to make itself known to the user once it migrated to another embodiment.

Table 3: Burke's Pentad with the 5WH association to the words selected by the users.

Why?/ Purpose	Novel, Relevant, Inspiring, Stimulating, Motivating, Effective, Ok, Irrelevant.	+ + + + + + +/- 0 - (mdn= +, mode= +)
What?/ Act	Exciting, Complex, Difficult	+ - - (mdn= -, mode= -)
How?/ Agency	Easy to use, Engaging, Seamless, Consistent, Novel, natural, Overwhelming, Familiar, Confusing, Complex, Intimidating, disconnected, Inconsistent	+ + + + + + (+/-) 0 - - - - - (mdn= +/-, mode= +)
Who?/ Agent	Engaging, Approachable, Personal, Appealing, Intimidating, Impersonal, Disengaged, Annoying, Unapproachable	+ + + + - - - - - - (mdn= -, mode= -)
When? Where?/ Scene	Seamless, Immersive, Familiar	+ + 0 (mdn= +, mode= +)
Valence: + Positive, - Negative, 0 Neutral		

Table 3 shows the valence of the words selected by the participants and the association to Burke's Pentad and the 5WH. The words associated with the why/purpose relate to the users' interpretation of the purpose of the migrating receptionist.

The purpose has a median and mode of positive valence. The what/act words relate to how the users perceive the actions taken in interacting with the agent in the different embodiments. the Act has a mode of negative valence and the median is negative.
The how/agency words relate to how the users perceived the interaction with the receptionist in

the 3 embodiments (interfaces). Agency has a median of +/- (the word 'effect' was used to refer to negative and positive valence). The mode of the agency is positive. Who/agent, in this case, is the virtual receptionist. Agent has a median and mode of negative valence. The words associated with When/where/scene refer to the space in which users interact with the receptionist.

5 Discussion

The purpose of this study is to explore how to design a migrating virtual receptionist for a computer science department, to contribute to a discussion about the competencies required to design IVAs for public spaces, and how future designers can be equipped with such competencies.

The paper describes two prototypes of the same agent that filter the design space and manifest design ideas differently (Lim et al., 2008). This and the use of quan- titative and qualitative data collection effectively work as data source triangula- tion (Thurmond, 2001) to increase confidence in the research findings.

Although differently filtered design spaces, the results of both prototypes were similar. Initially, it was that the VR prototype would be less accepted by users due to limitations in mobility and the use of VR equipment. However, this was not supported by the results, which showed similar levels of acceptance between the VR and physical prototypes. The physical prototype exhibits slightly better results in terms of the SUS results. The VR equipment affected some responses on immersion, seamlessness, novelty, complexity, overwhelming and familiarity. The SUS score grading places both prototypes primarily within the categories of best– imaginable, excellent, and good (figure 3).

The results from the product reaction cards indicate a higher count of positive words compared to the negative and neutral words. However, there are slight differences between the two, with the physical prototype having a higher count in areas such as ease of use, approachable, and relevance. The overall trend, how- ever, remains similar for both prototypes. The VR prototype scores higher in words such as immersive (exceedingly), exciting and stimulating. Some of the negative words that stand out for the physical prototype are impersonal, complex and in- timidating (with reference to the Furhat robot). The VR prototype has confusing, overwhelming (though used as a positive word by some users), and annoying. The neutral words familiar and Ok score the same for both prototypes.

Burke's pentad and the 5WH analysis of the top positive, negative, and neutral valence focus on the interaction of the user with the migrating receptionists. With the most prominent being the ease of use and seamlessness of the embodiments. This includes the complexity and intimidation of some of the mediums of interac- tion. Some of the words apply to more than one term

of the pentad and 5WH. Complexity relates to the act as well as the agency. The neutral word familiar looks at the familiarity of the environment and some of the technologies used for the prototypes. The word Ok refers to how the ideas of the prototypes being passive (Bangor et al., 2008).

5.1 Competencies and Skills

Nieminen (Nieminen, 2015, p. 22) refers to "competency (pl. competencies) to describe the characteristics, abilities, and necessary resources to complete a de- sired task in an excellent manner". We use Nieminen's UCD competency model (Table 1) to outline the design competencies and skills required by designers of IVAs. This identifies and clarifies the necessary skills, knowledge, and characteristics (Nieminen, 2015, p. 22) to design the IVAs. We selected the competencies essential/ relevant to the study findings.

User Strengths

The user Strengths competencies are characterised by items, actors, and concepts belonging to the users' immediate surroundings (Nieminen, 2015). These include experiential knowledge acquired through work tasks or prolonged use, the context of use as a design resource, and ingrained user cultures, networks, and practices (Nieminen, 2015). The study is conducted with students and members of staff who frequent and work at the department. This includes the use of the three areas of interaction (entrance, corridor and coffee area) with the receptionist. The **user domain experience** can range from low:i.e. visitors to the department, medium:i.e. students and members of staff who have been in the department for less than 3 years and high:i.e. graduate students and members of staff who have been in the department for more than 5 years (Nieminen, 2015, p. 67).

Context of use (**context availability**) is often associated with situatedness, encompassing time, location, and other factors surrounding the actual use (Niem- inen, 2015, p. 68). The design of the IVA physical prototype must consider the location of the interaction, as well as when and how the agent can be accessed. In the case study, the agent is accessed via the large screen by the entrance, the mobile screen as the user walks through the corridor, and the physical robot in the coffee areas. The design of an IVA in VR must account for the scale of the available physical space users use to manoeuvre, and alternatives such as teleportation if the space is limited, with teleportation methods varying based on the user's past experiences. Other contextual factors include the presence of other users in the areas of interaction and the levels of access to those areas - e.g. high for members of staff as they can access most parts of the building, medium for students and low for visitors.

User cultures, social networks, and practices refer to the common practices

(Subject domain terminology) and cultural interpretations of future users of the product or service (Nieminen, 2015, p. 70). The virtual receptionist study primar- ily involved Swedish speakers, with a few participants from other countries, including one native English speaker. Although participants were proficient in En- glish, a few words required further explanation or translation during sessions with a few of the participants. An important factor in this context is the use/ display of written text during digital (screen or VR) interactions.

Soft Skills

Soft Skills competencies encompass design and teamwork traits that are influenced by personal aptitudes, such as communication and collaboration skills, a multidisciplinary attitude, and motivation (Nieminen, 2015, p. 72). While these skills can certainly be refined through training, they are primarily rooted in intrin- sic abilities (Nieminen, 2015, p. 70).

Prototypes facilitate and encourage a shared understanding between users and designers. They provide means to identify relationships between users' tasks and system functionality that can guide how to order functions and contents tempo- rally as well as spatially (Hakim & Spitzer, 2000). The study involved participants from the same department, which allowed for a high level of communication. All parties had the same vocabulary, which enabled easy dialogue with the de- signer. Communication in the design of IVAs should be high for effective team-work and design outcomes (Nieminen, 2015).

The conceptual phase of the study involved participants with expertise in multiple fields, including design, computer science, and cognitive science. A multidisciplinary approach facilitates a more comprehensive understanding of the human aspects of complex design tasks that necessitate expertise from several disciplines (Nieminen, 2015, p. 73). This design approach is required for IVAs oper- ating within social interactive spaces, which are expected to interact with diverse users with varying levels of experience.

Designer Strengths

These competencies focus on the core values of UCD: user involvement, designerly ways of solving design problems, and professional skills in defining, visualising, and testing new solutions' (Nieminen, 2015, p. 77). Designers of IVAs need to integrate these codes to generate relevant and useful designs.
User involvement pertains to identifying and engaging suitable users at the correct time, and incorporating suitable interaction methods to stimulate their participation and creativity (Nieminen, 2015).

The design phase dictates selecting suitable users (Nieminen, 2015). In the case of the virtual receptionist, user involvement began from the concept generation phase, which included students and researchers from design, computer science and cognitive science. The prototype evaluation phase involved students from various programmes

within the department, administrative staff members, and researchers.

The interaction methods were chosen based on a mixed-method approach (triangulation), adhering to UCD principles as UCD aim to understand users and pro- pose new solutions to improve their lives (Nieminen, 2015, p. 79). “Design as a practice is characterised by an attitude and a determination to introduce change for the better, and have the necessary means to realise it, in a responsible manner” (Nieminen, 2015).

New designs must be defined, have a concrete form and be evaluated to determine a suitable solution (Nieminen, 2015, p. 81). Ideas and features must be refined into **concepts** that describe the scope of the design. The forms and contents of these concepts are explored using various **visualisation** techniques (low to high fidelity) (Nieminen, 2015). Artefacts are then used to test the design (**validation**) using a plurality of usability or user experience (UX) evaluation methods (Nieminen, 2015).

The generation of ideas and features for the virtual receptionist was achieved using a combination of methods. These included a remote bodystorming (Porfirio et al., 2019) with the staff researcher and a *desktop walkthrough* (Blomkvist et al., 2016; Stickdorn et al., 2018) with the student participants. During these sessions, participants discussed each of the three areas of interaction and proposed potential ideas and features. This was followed by a *brainstorming* session with the participants after each method, which served to refine the identified ideas and features. The findings from both sessions were then analysed using a combination of *morphological* chart (Smith et al., 2012) with *Burke’s pentad*, resulting in three concepts. The *Plus, Minus, and Interesting* (PMI) (Sharma & Priyamvada, 2020) method was used to select the final concept: the migrating virtual receptionist. The final concept was then developed into VR and physical prototypes, which were evaluated using usability and UX methods.

Hard Skills

Training and education serve as the foundation for acquiring these competencies. These competencies contain the capability to choose and apply appropriate procedures and methods, comprehension of the potential of available technologies and the market, and a segment of knowledge that forms part of the subject domain expertise (Nieminen, 2015, p. 84).

The training and education required for prototyping IVAs can vary significantly, depending on the intended context, the prospective user, and the current knowledge and skills of the designer or developer. For instance, the physical prototype of the virtual receptionist study required programming skills in HTML, CSS, and Javascript for the agent displayed on the screens. The Furhat robot, on the other hand, requires

programming skills in Kotlin or graphics. The VR prototype de- mands proficiency in 3D modelling, animation, and C++ and/or node-based pro- gramming. This highlights the diverse skill set required in the field of IVA design and development.

The type of equipment required to develop an IVA for a social interactive space is context-dependent as well. For example, in the case where the agent migrates between three embodiments, interactions by the entrance happened via a touch projector screen [6]. Participants used personal mobile phones for interactions in the corridor. The Furhat robot was used to conduct interactions in the coffee area.

The *Effectiveness* and *efficiency* of developing an IVA are influenced by the context and the designer or developer's knowledge and learning skills. Using the development process for the virtual receptionist serves as an example. With a large learning curve, the VR prototype took approximately six months to develop. This included a four-month period of gaining a comprehensive understanding of the tools and equipment, followed by two months of development of the VR environment. In contrast, the physical prototype took approximately two weeks to develop, with the majority of the time spent on learning and developing the dia- logue in Kotlin for the Furhat robot. The other platforms (screen-based agents) did not require much time due to the developer's prior proficiency in the development tools.

5.2 Limitations

The longer development time of the VR prototype can be attributed to the extensive feature set and complex toolset of the platform. Building the features for the three embodiments required the integration of multiple external plugins, which added to the learning time and complexity. The development time could have been reduced by building the environment from scratch, eliminating the need to learn and customise the dialogue plugin. Similarly, utilising tools like MetaHuman Animator [7] could streamline the animation generation process and further optimise development time.

The notion of developing the physical space prototype using two different platforms (web development stack and Furhat SDK) goes against the significance of utilising a single platform for developing the agent across all embodiments. This approach ensures seamless integration and connection between the different embodiments, enhancing the overall cohesiveness and functionality of the prototype.

It is important to acknowledge that the findings may not be generalisable. Instead, it is more appropriate to consider the transferability of the results on a case-by-case basis, allowing readers to assess the applicability to their specific design contexts or challenges. This approach recognises the

6 Sony Xperia Touch

7 MetaHuman Animator

unique characteristics of each design situation and the influence these can have on the outcomes of the research

While case studies in industry contexts are common in design research, we opted to create our own project within the department. This decision was made to ensure better control over the experiment and to explore innovative methods without the constraints of business risks. However, it is important to note that this approach may result in reduced ecological validity, as the findings may not directly represent real-world industry scenarios. Nonetheless, it provided us with the opportunity to experiment and test new ideas in a controlled environment.

6 Conclusions

This paper has presented a study of the prototyping and evaluation of a migrating virtual receptionist in virtual reality (VR) and in physical prototypes. The two prototypes were used to filter a design space and manifest design ideas differently. The prototypes effectively function as data source triangulation to increase confidence in the research findings. While the generalisability of the findings to the comprehensive design of migrating embodied agents for public spaces may be limited, specific aspects of the findings can still be effectively employed in the field of design research. These aspects further understanding and application of the design process and tools, exemplify the integration of physical and virtual realities in modern design practices and suggest improvements for design tools and methods to facilitate this process.

The idea of applying design ideas from this study to the design of agents in other public spaces is interesting for further research.

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DESIGNING HYBRID WELFARE SPACES AND SERVICES: EXPLORING THE INTERSECTION OF PHYSICAL AND DIGITAL DIMENSIONS FOR SOCIAL INCLUSION IN URBAN CONTEXTS AND PERIPHERIES

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ABSTRACT | This paper presents the preliminary findings of a multidisciplinary study exploring how physical and digital spaces contribute to social inclusion within welfare systems. Conducted by a team of sociologists, urban planners, and designers, the study focuses on the exploratory mapping phase, which encompasses two main areas of investigation: 1) the impact of digital dimensions on socio-spatial inequalities in welfare access in contemporary cities and 2) the role of physical spaces in promoting social inclusion in the peripheral areas of Milan, with a specific focus on youth, the elderly, and migrants. To address these questions, the study utilizes a specialized triple mapping tool: 1) the Context Tool, which places spaces within their broader neighbourhood context; 2) the Detailed Space/Service Tool, which evaluates the internal layout and technological infrastructure of these spaces; and 3) the Activities and Digital Service Tool, which identifies and assesses digital welfare services. The findings from this phase are compiled into a dossier that aggregates data and provides a foundational framework for analyzing and designing future welfare spaces. This preliminary research underscores the potential of hybrid spaces—integrating multiple functions and stakeholders—to enhance digital competencies and improve access to welfare services for vulnerable populations. Ultimately, this paper aims to set the stage for further research and policy development in welfare design, highlighting the designer's role in creating analytical tools and innovative solutions.

EYWORDS | E-WELFARE, DIGITAL WELFARE, SPATIAL AND SERVICE DESIGN, SOCIAL INCLUSION

1. Introduction

This paper presents the initial phase of a multidisciplinary research project conducted by sociologists, urban planners, and designers from Department of Architecture and Urban Studies (DAStU) and the Design Department at Politecnico di Milano.

The paper illustrates the preliminary results of the ongoing research "E-Welfare in the city. Physical and digital spaces for social inclusion in the metropolitan area of Milan" conducted by this interdisciplinary group, which operates within the "MUSA - Multilayer Urban Sustainability Action" ecosystem, funded under the National Recovery and Resilience Plan (NRRP) by the European Union - NextGenerationEU.

MUSA - Multilayer Urban Sustainability Action aims to transform the Milan Metropolitan Area into an innovation ecosystem for urban regeneration, encompassing all levels of intervention, from social to technological. The goal is to scale this model at regional and national levels and eventually to serve as a European benchmark. This objective will be achieved through a set of actions addressing various dimensions of an innovation ecosystem, defined as "an evolving set of actors, activities, and artefacts, and the institutions and relations, including complementary and substitute relations, that are important for the innovative performance of an actor or a population of actors" (Granstrand & Holgersson, 2020). The ecosystem is designed to thrive on the synergy between academia, industry, local government entities, and civil society. It is a collaborative effort involving Università di MilanoBicocca (the lead entity), Politecnico di Milano, Università Bocconi, Università Statale di Milano, the Municipality of Milan, and the Lombardy Region.

The project's intervention areas, referred to as "spokes," include various domains. The Department of Design and the Department of Architecture and Urban Studies (DAStU), to which the research group belongs, are engaged in multiple aspects of the project, from social to technological scales. The research focuses on:

- Immersive digital platforms for communication, visualization, and interaction with territorial data related to urban contexts to guide sustainable urban regeneration processes.
- Sustainable fashion, luxury, and design to steer key economic sectors towards an eco-digital transition, contributing to low-impact production and distribution processes.
- Innovation for sustainable and inclusive societies, aiming to strengthen social inclusiveness by tackling inequalities, promoting public engagement, enhancing social sustainability, and advancing technological tools for individual and social wellbeing [Spoke 6].

Within Work Package (WP) 3 "Innovative Models against Social Inequalities", the project addresses existing obstacles to social inclusion, focusing on the most vulnerable individuals and groups. It develops innovative welfare services, supports stakeholders and policymakers in measuring social inclusion impact, and identifies inclusion indices to suggest and develop technological strategies to reinforce the presence of marginalized groups. Specifically, Task 3.3 focuses on Territorial Welfare, promoting interventions towards social inclusiveness, recognizing and including marginalized and precarious populations within local welfare services and policies, shaping local policies to improve work-life balance, and promoting integrated access to social and healthcare services, particularly for vulnerable individuals.

The research "E-Welfare in the City" and this paper contribute to the ongoing debate regarding the relationship between digital tools and welfare provision, exploring the implications when digitalization intersects with territorial welfare systems. It specifically highlights the significance of **physical spaces in shaping the modes of digitalization**. Contrary to the assumption that digitalization eliminates the need for physical spaces, it redefines their role in facilitating access to welfare. These spaces serve as crucial intermediaries, bridging specific subsets of the population with welfare services. This renewed function underscores the importance of physical locations in ensuring that digital welfare services are accessible and effectively meet community needs. **By examining these dynamics, the research aims to provide a deeper understanding of how digitalization and physical spaces can coexist and complement each other in providing welfare services**.

2. The Digital Divide as a trigger element in Design for Welfare

Recent technological advancements, driven by platforms supported by terrestrial and space-based infrastructures, induce systemic changes in urban environments with implications that are largely unknown. Traditional concepts such as the "smart city" have proven inadequate in addressing these complex challenges and may even exacerbate socio-spatial inequalities. The smart city narrative often emphasizes

technocratic governance through data and surveillance while neglecting the role of citizens and the existing vulnerabilities within urban populations (Angelidou, 2015; Kitchin, 2014; Aurigi & Odendaal, 2020). Without addressing underlying systemic and structural inequalities, the uncritical adoption of digital technologies risks marginalizing those unable to meet the imposed digital standards (Datta & Odendaal, 2019). This research critiques the simplistic application of smart city concepts. It underscores the necessity of understanding the nuanced impacts of digital transformation in local contexts, particularly regarding the digital divides affecting access to rights and welfare services.

Digital divides refer to the boundaries that separate inclusion and exclusion in societies that depend on digital platforms, and they can serve as avenues for expressing ongoing social tensions. The emergence of digital platforms has resulted in substantial social and cultural transformations. Consequently, the discussion around digital innovation has become widespread and is largely regarded favorably (Selva, 2020).

In the realm of digital technology, there are many noticeable and distinguishable uses. Participatory uses of digital media enhance recreational activities by allowing individuals to utilise digital tools for economic and social participation. This includes using digital media for work, education, political engagement, and interacting with public administrations and governments through e-government and open government platforms (De Blasio, 2018).

Digital capital is derived from the expansion of possible applications of digital media. Digital capital enhances and supplements other types of economic, social, and cultural capital. It refers to the effects and societal implications that arise from the diverse ways in which different groups of people utilise digital media (Ragnedda & Ruiu, 2017). The digital divide is the conceptual disparity between persons who possess access to and are fully integrated into the digital society and those who lack such access and integration. This division signifies the discrepancy in terms of inclusivity and exclusivity, the inequitable allocation of resources, and the segregation among various groups (Selva, 2020). Over the years, scientists and policymakers have adopted many understandings of the digital divide. The concept is typically seen as a compilation of multiple divisions, known as digital divides, rather than a singular separation. The digital gap refers to the unequal access and use of digital media among individuals, with some having access and utilising it while others do not (van Dijk, 2020, p. 1).

As digitalization progresses, **three primary levels of the digital divide become evident**:

1. **Access Divide**: This level concerns access to digital infrastructure, including connectivity, devices, and software. It highlights disparities in the availability of and access to essential technological resources.
2. **Skills Divide**: This level focuses on digital literacy and skills, including using

devices and software effectively and understanding the implications of digital interactions, such as data privacy.

3. **Structural Divide**: This level addresses how digital divides intersect with existing socio-economic inequalities, such as those based on gender, age, economic status, and citizenship. It reflects how these divides exacerbate pre-existing disparities in access to resources and opportunities.

Even with social protection measures in place, welfare systems may not guarantee equitable access due to the ongoing digital transition affecting organizations and administrations. Barriers to access can arise from disparities in information and relational resources, limiting awareness of rights and the ability to formalize requests and institutional design limitations. In this evolving digital landscape, digitalization plays a crucial role in welfare distribution by transforming access methods through online tools and platforms, altering resource distribution, and changing intervention approaches, such as remote learning (DAD) and telemedicine. Moreover, digitalization redefines social needs, including social isolation and educational poverty, and influences support programs, such as IT training courses and youth engagement initiatives.

By examining these dynamics, the research aims to identify insights into whether and how digital and physical spaces can collaboratively contribute to the delivery of effective welfare services and highlight the need for integrated approaches to address the evolving challenges of digitization.

3. E-Welfare in the City Research Project Objectives and Roadmap

The study focuses on two main areas of investigation. First, it aims to analyze the digital dimension's role in reproducing or mitigating socio-spatial inequalities in accessing welfare in contemporary cities. Second, it explores the role of physical spaces in fostering social inclusion in peripheral areas of the metropolitan city of Milan, focusing on youth, older people, and people with migrant backgrounds. The research spans three years, and this paper focuses on the initial phase, specifically the field research. The activities and spaces examined for field exploration of the impact of digitalization on welfare at the metropolitan scale include the WeMi Spaces of the Municipality of Milan and Polimi Off Campus Nolo and Polimi Off Campus San Siro. The interest in WeMi started with the "Welfare di tutti" project. This initiative, active in the Milan metropolitan area since 2015, was developed by the Municipality of Milan in collaboration with 16 partners, including Politecnico di Milano, and funded by Fondazione Cariplo. This project provides a valuable case study for assessing an ongoing initiative, analyzing its strengths and weaknesses years after implementation, and offers insights into a model of welfare access that integrates digital tools while remaining embedded in local communities.

The "Welfare per Tutti" project consists of two main components:

1. **Digital Platform**: A public platform that serves as a showcase for aggregating welfare services. This digital platform allows users to identify the services offered and the providers, supporting associations, and the nearest locations to access these services.
2. **Territorial Physical Spaces**: These are physical locations, known as WeMi Spaces, where citizens can receive assistance and guidance towards welfare services. These spaces, managed by local authorities and supported by foundations, associations, and cooperatives, aim to address the potential limitations of accessing services solely through digital means (Bricocoli & Sabatinelli, 2017).

In addition to WeMi Spaces, the Off Campus initiatives of the Politecnico di Milano were also selected for field research in the Milan area.

The Off Campus program is an initiative promoted by Politecnico di Milno to strengthen Politecnico's presence in Milan and foster a more responsible university that is attentive to social challenges and open and connected to local territories and communities.

Launched in 2018, the Polimi Off Campus initiative saw the opening of the first Off Campus space in the San Siro neighbourhood in April 2019, followed by three other spaces: in the Nolo neighbourhood (September 2020), at the F. Di Cataldo Prison/San Vittore Prison (October 2022), and Cascina Nosedo, at the entrance of the Parco Agricolo Sud (December 2022).

Within the Polimi Off Campus spaces, faculty, researchers, and students engage in the following activities: innovative teaching, focused on working in real-world contexts as a means to develop new skills; responsible research, attentive to the inclusivity of knowledge production processes; co-design with local entities, to implement interventions that have a positive impact on the community. Additionally, services are provided to the territory and neighbourhoods, and a cultural and educational offer is promoted for local actors and communities.

The research focused on nine of twenty WeMi Spaces and two of four Polimi Off Campus Spaces across Milan. These cases were selected to ensure variability in location (central and peripheral areas), management type (foundations, associations, and cooperatives), services provided (range and nature of shared services), and spatial attributes (size, visibility, and accessibility).

3.1 The Exploratory Dimensions

These methods were analyzed along three interpretative axes, referred to in the research as Exploratory Dimensions.

1. **Service**: The service encompasses the activities and functions related to the case's welfare. It dictates the requirements to which the space adapts. Beyond activities in terms of actions and policies, the service also includes digital aspects such as the platform and access.

2. **Space**: The Space can be defined as "long-term physical assets in the social sectors that enable goods and services to be provided" (Fransen et al., 2018, p. 14), this dimension explore the spatial configuration and characteristics of the case's spaces. Space overlaps with the service and is shaped, modified, and adapted according to it. At the same time, the space includes both technological (computers, printers, illuminated banners, screens) and analogue (furniture) equipment.
3. **Digital**: The digital infrastructure and its relationship with access, skills, and awareness among users and operators. This can refer to both the platform, which showcases the services and highlights the capabilities of the service space, and the technological-digital equipment, such as computers and printers.

The integration of these axes aimed to understand the organization's mission, the services provided in the WeMi and Polimi Off Campus contexts, digital services and challenges, and the specific characteristics of the space and neighbourhood.

3.2 The Exploratory Mapping Tool

The exploratory mapping tool comprises three main elements:

1. **Context Tool**: Identifies the reference context in which the space/service is situated, including the neighbourhood and nearby services.

The selected WeMi and Polimi Off Campus spaces are always located in urban contexts characterized by a strong social fabric, often on the city's outskirts, and they work closely with neighbourhood dynamics.

It is important to note that some cases are set in unconventional contexts. For example, Polimi Off Campus Nolo is situated in a location that might not traditionally be associated with welfare services. The Polimi Off Campus Nolo is located within the municipal market on Viale Monza in Milan, a covered space with various commercial stalls. Similarly, WeMi San Gottardo is located inside RAB, a bar where people can have breakfast, study, meet friends, and more. This placement ensures exposure to a broader audience, who may learn about the service while engaging in daily activities, thereby better integrating with the neighbourhood. The Context Tool helps map the space's surroundings to understand the proximity relationships with different local entities, providing quantitative and qualitative data on the primary users likely to engage with the service.

2. **Detailed Space/Service Tool**: Details the internal division of the space its location (within other activities or associations) and identifies all physical and digital touchpoints and technological infrastructure.

Through the space/service tool, the internal and external layout can be diagrammatically mapped to track the number of rooms and spaces and the types of activities conducted there. For instance, WeMi spaces typically include an area called "Chiocciola," designed for digital literacy, though it often serves multiple functions as needed. This tool also identifies technological devices, workflows, entrances, square footage, touchpoints (between users and service providers), furnishings, and more intangible elements like accessibility, recognizability, and the type of access (direct, indirect, or semidirect).

3. **Activities and Digital Service Tool**: Identifies the digital service functions and activities related to welfare, including organizers and users, as well as access and competencies.

This tool is essential for briefly describing each activity, detailing the timing, actors involved, and levels of digitalization or digital technologies used. Concerning the first level of the digital divide, it notes the percentage of digital access and the specific services accessed. Regarding the second level of the digital divide, it assesses the competencies acquired and their specifics. However, this tool presented challenges, particularly in organizing information gathered during interviews and site visits. Therefore, it was reconsidered and more effectively utilized during the debriefing phase, with extended time for reworking and interview transcriptions.

3.3 Results of the Exploratory Mapping Activity

The main results from this exploration indicate that the services' characteristics and recognition are strongly influenced by the history and activities of the managing entity (association, cooperative, or academic institution). In some contexts, the space is better known and serves as a reference point for other local entities/organizations engaged in services rather than individual citizens.

From a digital perspective, those who approach the help desk primarily struggle with the bureaucracy of accessing welfare, which is exacerbated by digital barriers. This makes it increasingly more challenging to access services with digital skills and with the mediation of these entities. The connection between "analogue and digital" is essential and manifests in various forms, relying on the mediation of the operator (an "analogue" element), who must increasingly possess digital skills in addition to their relational and social worker competencies. This enables them to navigate and manage the network to support measures and meet the emerging needs of the target populations of these spaces.

Regarding the physical space, its configuration and location matter. Direct street presence facilitates access, visibility, and circulation, while intermediary spaces within the facility help accommodate diverse activities.

Among the cross-cutting results, it is notable that the local network of participation, services, and associations plays a key role in the operation of the examined spaces.

Identified potentials include a social mix in spaces and services and welfare spaces as a physical/digital continuum. The "physical space defined as "the material world that surrounds and is perceived by bodies, measurable and with clear boundaries" (Mütterlein, Fuchs 2019), where welfare services, projects, and programs circulate and the "digital space" (defined as "the digitally open world where technologies and devices blur the boundaries between physical places, such as markets or squares, and virtual places, such as Facebook, where users interact virtually, for example through user profiles," ibid. 2019) are increasingly interacting and continuous.

Despite variable configurations and intermediary transitions that act as "doors," sometimes closed, sometimes open, these transitions are mediated by devices and, always essentially, by the social worker (or their proxy).

3.4 Future Developments on the Tools

The mapped spaces were used to construct a dossier, which is not merely a document binding all mapped spaces but an extrapolation of descriptive elements that enable the creation of a framework for analyzing future spaces and, more importantly, understanding how to design future welfare spaces, creating meta-design guidelines to generate new valuable solutions.

The dossier facilitated the development of a "reading grid," which provides guidelines for future design, a toolkit comprising various instruments with a focus on spaces and services to continue mapping other locations. This extends the analysis beyond the Milan Urban Area, reaching into the broader metropolitan area of Milan.

These design tools will be helpful in the upcoming development and co-design of new spaces/services, as well as in the development and co-creation of new spaces/services for mediating access to welfare.

4. Conclusion

This research on "Designing Hybrid Welfare Spaces and Services" underscores the significance of integrating physical and digital dimensions to foster social inclusion in urban and peripheral contexts. By exploring the intricate dynamics between these dimensions, the study highlights how they can mitigate socio-spatial inequalities and enhance access to welfare services.

The exploratory mapping phase revealed that the effectiveness of welfare spaces is heavily influenced by the history and activities of their managing entities. Additionally, the study found that digital barriers often complicate access to welfare services, emphasizing the

need for digital literacy and the mediation of skilled operators. Integrating physical and digital elements in welfare spaces is crucial, as physical configurations and locations significantly impact accessibility and usability.

The findings are compiled into a comprehensive dossier that documents the current landscape and provides a framework for future analysis and design of welfare spaces. This framework and a toolkit of design instruments will guide the creation of new spaces and services, extending the research beyond the Milan Urban Area to the broader metropolitan region.

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“ALLES RICHTIG IST NICHT RICHTIGES FÜR ALLE”.

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ABSTRACT | Design (intended in the broader way, as the Italian tradition and definition) has always been a decisive player in the realm of the disciplines connected to the project, shaping and defining spaces and voids, roles and opportunities. At the same time, the natural making of choices, willy-nilly, generates stereotypes and oppression. The constant, pervasive and horizontal presence of the multiple aspects of the discipline and its applications in people’s lives brings with it an inevitable social mandate. The responsibilities and social awareness of future designers must be built and stimulated during the training phase: in this direction, a critical evaluation, a posteriori, must encompass the changes in society and the futuristic changes in design approaches. We wish to introduce in this paper a crucial disciplinary debate, as imperative as an eleventh principle, added to the ten of Dieter Rams. Could there ever exist a genderless design? Trying to answer, coping with the issue of gender and sustainability we are offering our reflections about an unanswered question. According to our theoretical observation and discourse, through references and reflections - from two generations and two professional points of view – we state that going from a genderless design to a gender-sensitive one is socially more sustainable and reasonable for the future. Among designers’ responsibilities, the ability to comprehend and handle the multiplicity of aspects linked to the mutability of society is a clue point: an aspect that – yesterday, today and tomorrow – never stops influencing people’s lives with close interconnection.

KEYWORDS | DESIGN HISTORY, CONTEMPORARY DESIGN CULTURE, GENDER STUDIES, SUSTAINABILITY, RESPONSIBILITY

1. Introduction: what our time brings to us

It seems there is not an exact date on which to address the birth of Dieter Rams's ten principles; what is sure is they come after the indisputable experience of Rams in Braun and influenced, inspiring, generations of designers, not only in product design realm but in all the design's world, because of their sensitivity and forward-looking wiseness. Stating the importance of innovation, usefulness, aesthetics, functionality, honesty, duration, environmental consciousness, Rams bridges from the product design field to the entire design discipline a mean of opportunity and appropriateness. But when it comes to unobtrusiveness and essentiality, we might feel the distance between the German cultural context in which the principle were born and the over-exposed position that design nowadays, willy-nilly, takes in the global contemporaneity. As Sudjic states:

...«Many people believe that objects are the indisputable facts of everyday life. Dieter Rams, who for two decades was head of design at Braun, the German consumer electronics company, certainly believed this. He described Braun razors and kitchen mixers as if they were English butlers, discreetly invisible when not needed, but always ready to serve effortlessly when called upon. In reality, this description no longer suffices.» (Sudjic, 2015, VI-VII)

It is only related to the German consistency or it is instead somehow connected to the inextricable bond that design, objects and society have? Georg Simmel expresses that: «Individualism, adopting what suits the individual, has very different roots than in Germany» (Simmel, 2015, 27). Written in the early XX century, this concept was addressed to fashion (and trends) but in some ways it is impossible not to encompass fashion and trends within the realm of design. They are eventually part of it, due to dealing with two key aspects: society's evolution and self-expression.

In the contemporary panorama, in fact, design is positioned as a widely recognized discipline, an object of constant research and evolution, increasingly enriched by the experiences that contribute to defining it as a fundamental subject for the growth of society.

(Walker, 1989, 31-2) For decades scholars have debated which the definition of design must be the right one and even if is possible to come up with (only) one. Walker in the past, but also Lorusso in closer days, quoting Victor Papanek kind of contradict and confirm his statement about everyone being designer and mostly all human actions being design(ed) ones. (Walker, 1989, 31; Lorusso, 2023, 15-6)

Among the many definition presented, offered and debated within the years of existence of the subject, from the ICSID one of 1961 to nowadays, we will assume design is a discipline, «used to give form to perceptions, with which we comprehend objects.» Having many facets of resonance, design is also a pleasure by itself. Actually, it is not so important to state what, but why, because design «is a language that evolves and changes its meanings as quickly as any other language. [...] It is the key that allows us to understand the world made by man.» (Sudjic, 2015, 37)

Therefore, having a constant memory of the complexities that characterize this discipline in relation to society, is mandatory: between society - intended not only as but also as economic comportments in consumption, but even choices, behaviours and trends – and design exists a strong bond and this inevitably confronts, contaminates, shapes and is shaped. (Margolin and Margolin, 2002, 24-30).

«The overuse of the word designer has erased its previous meanings. [...] However, the design of objects can offer a formidable means of seeing the world. [...] Our relationship with what we own is never linear. It is a complicated mixture of awareness and innocence.» (Sudjic, 2015, VIII)

Design, for sure not only meant as objects but encompassing communication, events and fashion within, forms and defines roles and opportunities: at the same time - in the natural operation of choices, willingly or not - it generates stereotypes and oppressions.

The constant, pervasive and horizontal presence of the multiple aspects of the discipline and its applications in people's lives, brings with it an ineluctable social mandate. Maldonado expresses how impossible is not to contemplate this aspect (Maldonado, pp. 133-5), which in the European panorama is debated and questioned over and over again but never denied (Walker, 1989, p. 52-3).

Therefore, identifying, clearly what the responsibilities and consequences of disciplinary applications are is crucial, so much so that in the theoretical literature of design we speak of ontological design: it is asserted that design itself projects and influences our lives (Willis, 2006, p. 70).

From the chaos of a messed "starter pack" (Lorusso, 2023, 21-2) to the symmetric wise disposition of Rams's principle, design suits in the middle «looking at how designers have to negotiate between management and execution, technics and humanities, autonomy and dependence, power and subjugation, bureaucracy and innovation, things and self.»

2. Design changing through society's lens changing

2.1 Of design, trends, culture and other amenities

«When Gertrud Arndt quit her job in an architect's office in 1923 to take up a scholarship at an art and design school whose prospectus promised to welcome " any person of good repute, without regard to age or sex," she had high hopes of studying architecture. Instead, she was urged to join the weaving workshop, as were most of the other women who enrolled as students at the Bauhaus. Those who refused were encouraged to choose book binding on the grounds that it too was suitably "feminine."» (Rawsthorn, 2022, 79)

Leaving apart pretenses and hypocrisy and going straightforward to the point, being a woman and a designer nowadays will assure going through a tough time, probably a bit less in respect of Arndt's time but still tough enough. If you are not grasping and feeling it, probably you are a man. More than one hundred years passed and yet, women have to demonstrate more, work more, harder and better, being rarely acknowledged for their contribution. (Rawsthorn, 2022, 83-4)

On the other side, the consumers' one, rarely women are taken primarily into account, or are addressed as first users, unless it is a "feminine" product: in this latter case, what will be evoked immediately is either a stereotyped senses of motherhood/caring or a sensual consciousness. In the fashion realm, always the differences between men and women attitude has existed and been exhibited because, due to the differences imposed by societies on one hand and of bodies on the other, it was however an opportunity to express oneself choices. (Simmel, 2015, 11).

This, nevertheless, finds an answer in Sudjic saying : «the question is not so much whether fashion is truly design but what fashion has done to design.» Continuing farther on: «Fashion has the ability to control all the control buttons of contemporary life. (However, editor's note) [...] With a few exceptions, including Adolf Loos, fashion has never been taken seriously.» (Sudjic, 2015, 111)

Since the First Industrial Revolution, in fact, due to some behaviours that from the fashion world spread to the design one, more and more increasingly temporariness and selfexpression have brought design to be the chaos Papanek, Lorusso, and Rawsthorn critically refer to, undoubtedly deeply far from Rams's conception of it.

How to change the attitude if the society is not ready? And why has design to deal with fashion when debating about gender and gender sensitivity. The second answer lies in the fact that, at this very moment, dealing with gender and gender issues is a trend: this might occur as a detriment instead of a benefit. Fashion design has been the first dealing with the topic, but as said rarely it is taken seriously, so the first fashion designers "playing" with gender issue has been considered as performing an exercise.

This was, indeed, the anticipation of what would become in short time a cogent issue, to be considered in the design world. About the first question instead, the responsibilities and social awareness of future designers must be built and stimulated, during their training, and in this direction a critical evaluation a posteriori can be of great help, identifying the biases and shortcomings. Such responsibilities include, among other things, the ability to include different aspects linked to the changeability of society and its needs: aspects that influence each other with close interconnection, evolve in a symbiotic way, to allow the discipline of design to move easily in a succession of increasingly rapid transformations. In this sense, excellent results are demonstrated by the intersectional approach to the discipline.

Lorusso quotes Maldonado, dealing with institutions, education and schools highlight the double nature of design, «[...] Maldonado offered a compelling definition: the designer is a technical intellectual. This way, he attempted to abolish the false dichotomy that opposes humanistic culture to scientific culture.» (Lorusso, 2023, 274)

This concept, applicable in a professional context, is equally identifiable in academic classrooms and in education: what is shared in university courses of study responds to a matrix built on archaic models - now obsolete (Walker, 1989, p.200) - dictated by a social reality far removed from what defines contemporaneity today. It requires a revision, appropriately preceded by a careful and precise preliminary discussion. Design, as an open discipline in constant change and self-definition, must lay its foundations on the composite nature of its own cultural space. What should leave us speechless and ashamedly asking for a change is the consideration of what could be being a non-cisgender or a transgender designer today. But the future might be better. «Given [...] the growing acceptance of the design process as a possible solution to an increasingly expansive range of socioeconomic and environmental challenge more new discipline should surface in the future.» (Rawsthorn, 2022, 86)

Women have the natural power to adapt, comprehend, consider and evolve, but « queer and trans designer should gain too. They stand to become prime beneficiaries of the new opportunities offered by attitudinal design.» (Rawsthorn, 2022, 86)

Sanctimoniousness is still part of the design world because it's part of our society. And it is very harsh not to convey with Rawsthorn asking:

«Why has design remained a "man's world" for so long? And how much longer will the gender politics of a discipline that should in theory be open and eclectic, remain so archaic given the surge of interest in feminism, transgenderism and gender fluidity?» (Rawsthorn, 2022, 81)

2.2 The role of gender identity in social constructs

As is well known, society undergoes continuous evolution and renewal, constantly changing its nature and essence (Bauman, 2000). It adapts to the needs of its actors, absorbing the everdifferentiating characteristics that mark the evolution of the cultural landscape it inhabits. Indeed, each society has its own nature, development, and construction, perfectly fitting into the environmental and cultural context in which it is generated (Scott, 2017). This opens up very different scenarios, which are comparable and sometimes overlapping, but certainly defined by specific peculiarities that determine their uniqueness. This aspect forms the basis of the theme investigated in this contribution, offering a preliminary viewpoint on what is to be researched in the field of design and its interaction with social sciences.

As mentioned, there are various aspects that define a society and, in particular, its actors, shaped in response to certain socially recognized, accepted, and proposed dictates over the years and historical epochs. However, it is also well known that the parameters validated by society are in constant flux. Each individual is defined by various aspects that contribute to shaping their identity, such as ethnicity, religious belief, gender, spoken language, physical abilities or disabilities, and much more. This approach, aimed at understanding and intertwining the different aspects that define each person as an individual, creating particular forms of discrimination, is known as intersectionality (Angelucci, 2015, 268-274).

This term, first introduced in the scientific panorama by Kimberlé Crenshaw in 1989, leads to the intersectionality theory, theorizing the phenomenon of multi-layered discrimination, highlighting how human experiences undergo and reflect the complexities of the society which they refer. Here is how Crenshaw – reported by Angelucci - describes the origin of her thoughts on Intersectionality Theory:

«It originated from the attempt to conceptualize the way in which the law responded to problems involving both racial and gender discrimination. What was happening was like an accident, a collision. Intersectionality comes from the idea that if you are on the trajectory of two forms of discrimination, it is likely that you will be hit by both. These women are injured, but when the ‘ambulance’ of race and the ‘ambulance’ of gender arrive at the scene of the accident, they find them at the intersection and say: Well, we cannot determine whether this is gender or racial discrimination and until they tell us which one it is, we cannot help them. » (Angelucci, 2015, 269).

The described theory, very complex and rich in reflections, provides a broad and articulated vision. Specifically, in the ongoing research, we focus on investigating one of these aspects, namely gender identity. Gender identity is one of the aspects that most significantly contributes to the identification

of every human being, regulating various social and cultural aspects. The significance of this aspect in social construction defines roles and opportunities for each individual, leading to confining stereotypes. It is in this specific aspect that the designer is involved, capable of shaping and directing society and its users, creating artifacts that can break the rigid dictates imposed by models from past realities that are now outdated. Therefore, following the evolution of society and activating a critique of design and the designer's role, it is natural to ask whether and how the dimension of gender enters into the project, evaluating its impact on users. This contribution aims to address this aspect, which is undoubtedly central to multiple areas of contemporary research, necessarily entering the debate of design disciplines. Hence, the aspects that define identity – in the various sectors that are the domain of design – are investigated through a fundamental question: can there be a genderless design? There are various viewpoints on this reflection, derived unequivocally from the perspective through which the intersection between the two disciplines in question, design and gender studies, is observed, often finding differing positions.

3. Design, gender, sustainability: an open issue

As mentioned, gender stereotypes can be defined as a rather rigid set of culturally shared beliefs. These beliefs dictate many aspects of users' lives, such as physical and psychological characteristics and activities typically attributed to male or female figures (Eagly & Wood, 2012). Each stereotype, contributing to the definition of opportunities and limitations, is shaped through both individual and collective processes of categorization or simplification of the social reality in which social dynamics are embedded (Wagner, Holtz, Kashima, 2009). By actively participating in the structuring of social realities, design plays a fundamental role in perpetuating these stereotypes.

In the research presented here, we aim to investigate all aspects that contribute to the gender definition of design artifacts, addressing the central question of this reflection regarding the necessity of having a gender-neutral design. To answer this question, it will be necessary to proceed on several levels: delving into the topic through literature review and analysing exemplary case studies. Concerning the literature aspect, this research is clearly structured on multidisciplinary foundations, drawing on what parallel disciplines—such as sociology, anthropology, psychology, and pedagogy—can offer. Although the debate on the intersection between design and gender studies is becoming increasingly frequent, within the project discipline it remains an aspect still under exploration, primarily deepened in the field of communication design and less so in other project areas (Almeida, Balaam, Comber, 2020). However, being a hybrid discipline between technique and theory, leveraging humanistic content can certainly foster the ongoing debate.

In this regard, as quoted by Lotti in his publication, Flaviano Celaschi states:

«The design we study today appears to us as a knowledge of relation among other knowledges. A discipline that seems to consolidate around the sensitivity of not producing an autonomous type of knowledge (or at least not having succeeded yet) in competition with the analytical capacity and knowledge of the other diverse and historical disciplinary lines of modern science; rather, by respecting the statutes and analytical knowledge synthesized by other disciplines, it appropriates them as project inputs, as a basis for developing organized transformation actions of the world of goods that surround us.» (Lotti, 2016, 32).

3.1 Case studies and insights from fashion to digital devices

It is true that some fields of design have already understood how to develop and reflect on concepts that keep the gender dimension at the core of their design activities; among these, fashion design stands out (Fallan, 2010). This branch of design has always absorbed social influences, incorporating the unique, often temporary characteristics that define the contemporary landscape into its production. Throughout fashion history, various evolutions, rich in suggestions, have often become manifestos of what the socio-cultural context was experiencing at a given time.

One of the most disruptive examples of the last decade is undoubtedly the work of Alessandro Michele, former art director of the fashion house Gucci. Through his contributions, several social themes—including gender equality, social justice, disability, environmental sustainability, and circular economy—were brought to light and showcased through collections, events, and installations (Paulicelli, 2021). This not only repositioned the brand in the market under a new guise but, more importantly, opened a debate on globally significant issues, offering more contemporary perspectives capable of raising user awareness. Frequently, this was achieved in a provocative manner, presenting images that had a broad impact, thereby initiating widespread debate.

The Florentine Maison, under Michele's direction since 2015, had already demonstrated a commitment to addressing fundamental social issues for the future by founding Chime for Change, a campaign launched in 2013 by Gucci along with co-founders Salma Hayek Pinault and Beyoncé Knowles-Carter. The association has carried out many initiatives, including a short film exploring the concept of gender fluidity titled "The Future is Fluid," directed by Jade Jackman, produced by Irregular Labs, and presented at the Sundance Film Festival in 2019.

This production gathers the testimonies, voices, and experiences of 13 individuals from around the world, aged 15 to 25, hailing from Brazil, Canada, India, Italy, the United

Arab Emirates, the United Kingdom, the United States, Singapore, and South Africa. These narratives reflect the stories of the next generation that is redefining our world through a prism of fluidity.

Another branch of design that has long been sensitive to the gender dimension is graphic design. Through choices in colour, form, text, and more, it has the power to divide as well as unite aspects that contribute to gender categorization. Communication design, understood as a tool for inclusion, has the potential to counter disparities, stereotypes, and gender binarism, working to dismantle the rigidity of roles and dominant hierarchies (Lupton, Tobias, 2021). The process of ensuring communication that is attentive and respectful of all users' needs is indeed complex, involving various aspects that characterize each individual's identity. This requires particular attention to multiple factors that contribute to creating socially ethical and sustainable communication (Ting-Toomey, Dorjee, 2018). For instance, ensuring that image selection fairly depicts both women and men to better guarantee the quantitative representation of both female and male subjects, and avoiding the use of the masculine generic form. This latter aspect pertains to languages that distinguish gender in speech.

Other focal points include non-discriminatory representation of roles, promoting representations that do not imply gender-based hierarchies, avoiding depictions that reinforce the status quo, and promoting the use of diverse and non-stereotypical colour palettes. As is well-known, the distinctive elements mentioned here are only a few of the visual tools that contribute to gender categorization and stereotyping, thereby reinforcing social constructs that do not reflect contemporary cultural evolutions. (Milestone, Meyer, 2020)

A case that sparked significant discussion was the Immuni application, released in 2020 by the Milan-based company Bendign Spoons to track Covid-19 infections. The public outcry upon the app's release centred on the highly stereotyped representations of users. Upon opening the digital platform, users were required to register through a simple procedure, but what disturbed many was the mandatory selection of a gender, limited to male and female, and the chosen representations of these genders: the woman dressed in various shades of pink, cradling a baby, while the man was depicted in a blue work suit, behind a laptop.

Unsurprisingly, users quickly voiced their dissatisfaction with these formal and chromatic choices, as they perpetuated a narrative that no longer aligns with the diverse familial and personal structures of contemporary society. The company promptly revised the images to better represent the population, using neutral colours such as green and orange and reversing the occupations previously assigned to the subjects. The path toward stereotype-free visual representation is certainly long and complex, but some cases demonstrate the fundamental importance of staying connected with the social context and its needs.

Even in the fields of product and interior design, considerations regarding the gender dimension and how it can be a distinctive element in defining roles and opportunities for users have been addressed. When considering spaces and their organization, an interesting example is the London toy store Hamleys, which in 2011 decided to break gender stereotypes. Among its seven floors of toys, one was dedicated to those labelled as feminine and another to those labelled as masculine. The entire department was painted in pink and blue hues, from the signage to the shelving, creating a monochromatic world inaccessible to the opposite gender. The store redefined these divisions, preferring a categorization based on themes and/or age groups, thus opening each department and its contents to all young customers. Following this trend, a few years later, Selfridges in London challenged gender stereotypes with a pop-up store. Through a collaboration with English designer Faye Toogood, a space was created that broke gender binarism and transcended predefined social norms: titled Agender, the concept store went beyond androgyny and unisex, questioning the common practices that still support gendered, sectorized, and categorized clothing. The space aligned with the social theme through its neutrality of forms and colours, as well as the arrangement of the items for sale. The area, freely traversable in its entirety, did not impose distinctions or divisions indicating which space was designated for whom, thus ensuring a neutral experience open to all possibilities.

In the realm of inclusion and awareness, facilitating user accessibility, projects of various natures also become relevant to the research presented here. If the liveability of spaces is central to our daily lives, the digital device sector plays a fundamental role regardless of users' gender, age, ethnicity, abilities, and other identifiers. Today, most actions we perform are mediated by our relationship with digital tools, often highly advanced in their employed technologies. One such tool is the voice assistant, an artificial intelligence instrument that has become part of many people's personal and professional lives, facilitating various daily tasks.

Well-known examples, familiar to a broad audience, include Alexa, Siri, and Google Assistant. Despite the significant technological advancements achieved, some aspects remain limiting. Through the lens of gender studies, it is evident that these tools are still rooted in outdated, binary gender stereotypes. Specifically, the chosen vocal attributes and names assigned to these tools often define their gender and role: stereotypically, the female voice assumes a nurturing, compliant, and always-present role.

Thus, it is clear that the design of voice assistants needs to be more conscious and equitable. Although the latest versions allow users to personalize their voice assistants with their preferred vocal attributes, the default setting remains a female voice.

Not surprisingly, voices assigned to machinery or industrial equipment in professional contexts are always male. This stark contrast results from socially accepted norms constructed on a model of society quite different from the contemporary one.

Sound designer Nis Norgaard addressed this design issue by creating "Q", a gender-neutral synthetic voice, positioning it as a political act in the contemporary debate (Prochner, 2023). In this project, the designer involved individuals identifying across different genders, collecting vocal recordings which were then overlapped and manipulated to achieve various sound alterations.

These outputs were evaluated by a sample of 4600 people on a scale from 1 to 5, where 1 corresponded to masculine and 5 to feminine. This process identified a range in which the voice is perceived as neutral, specifically at 153Hz. "Q"'s vocal timbre falls between 145 and 175 hertz, creating a sound range perceived as neutral by users, thus varying in perception by different individuals.

3.2 Toward inclusive design practice

The relationship between design and gender studies is an evolving field that reflects the social and cultural dynamics of each era. Historically, design has often contributed to the perpetuation of gender stereotypes (Eagly & Wood, 2012). Through rigid categorizations, design has defined and limited the opportunities and roles available to individuals based on gender. However, the design discipline, owing to its hybrid nature of both technical and theoretical aspects, holds the potential to challenge and transform these narratives.

Looking ahead, the prospects for design in relation to gender studies are both promising and complex. One of the primary challenges will be to continue developing design practices that not only recognize but also valorise gender fluidity and the diversity of identities. As evident from the extensive body of research preceding us, it is crucial to foster a dialogue between design and the humanities and social sciences to enrich the discourse and develop a design practice that is ethical and sustainable. Parallel disciplines such as sociology, anthropology, psychology, and pedagogy offer tools capable of deconstructing what has been learned and disseminated thus far, thereby enriching the design process from a social sustainability perspective. To achieve these goals, a rethinking of the academic training of future designers is necessary. Design programs should include courses that explore issues of gender, diversity, and inclusivity, as well as the social impact of design. Students should be encouraged to develop a critical understanding of the social and cultural implications of their design choices and consider how these can affect various user groups. Collaboration with experts from other disciplines, with a view to interdisciplinarity, can further enrich designers' education. Through a critical reflection of its models

and principles, design can truly contribute to achieving a more equitable and just society. This requires an academic education that promotes a broad and integrated view of design, preparing future designers to become agents of social and cultural change.

Figure 1. Q, the first neutral voice assistant, by sound designer Nis Nørgaard.

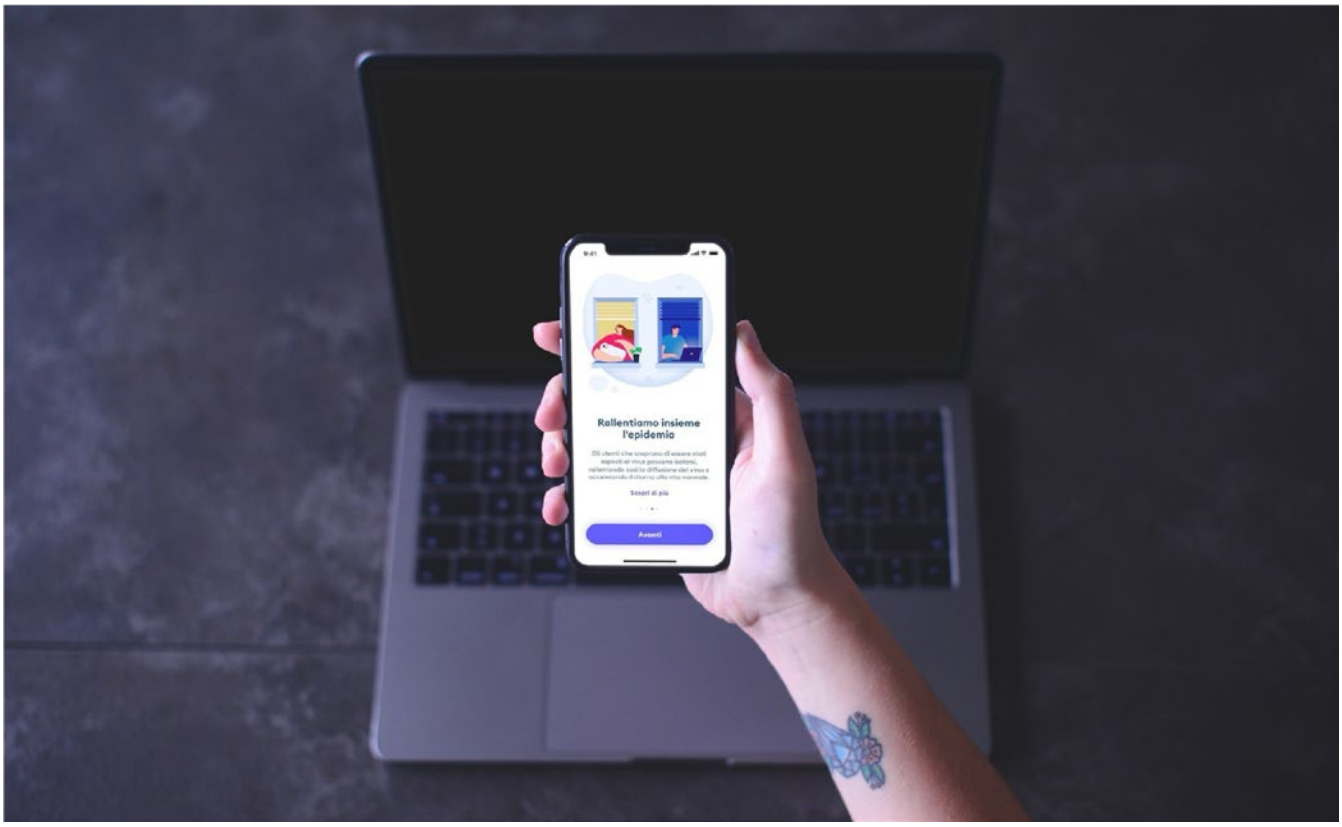

Figure 2. Immuni app interface before redesign.

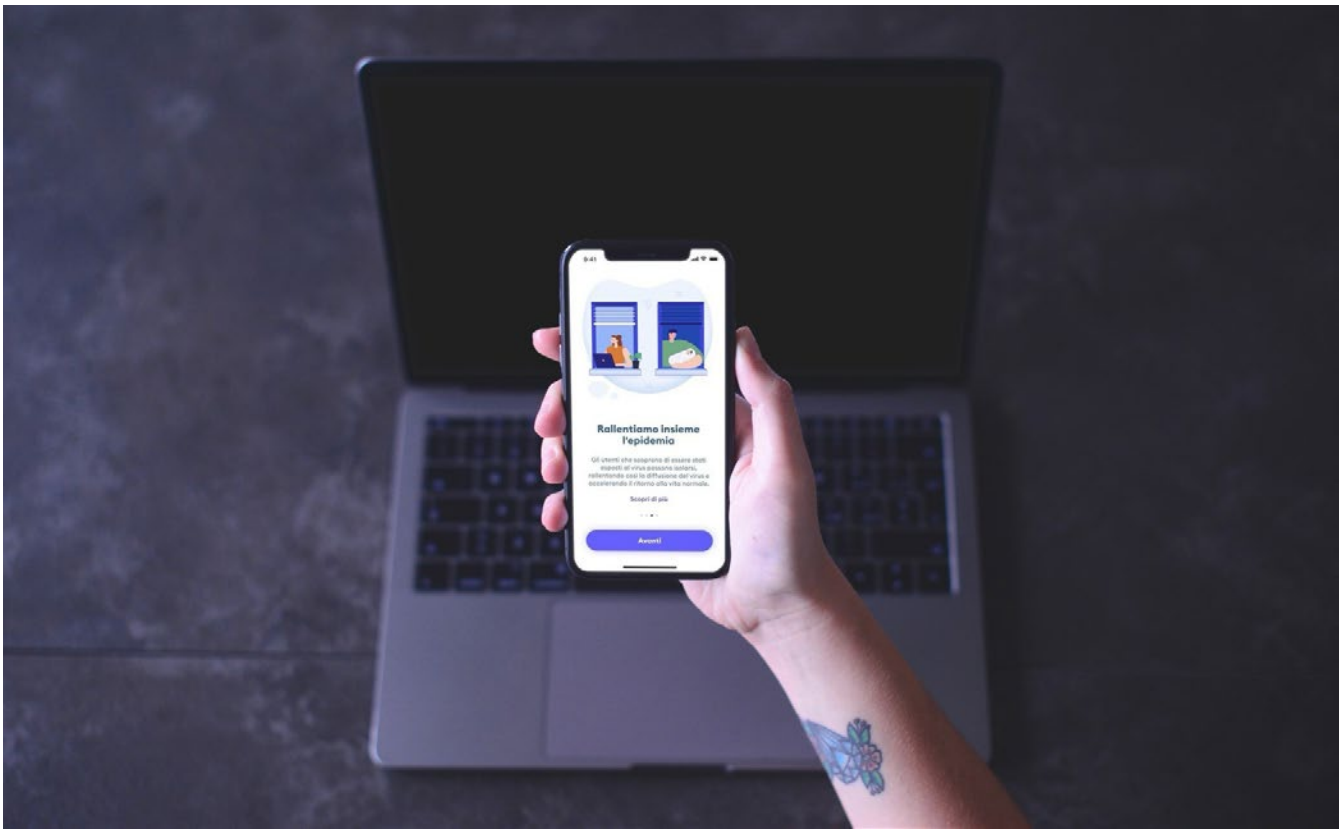

Figure 3. Immuni app interface after redesign.

4. Conclusion: only the future knows

In 1885, the Englishman John Kemp Starley created the first real bicycle, which he called the Rover Safety Bicycle (Morteo, 2019, 36): it was equipped with all those features that made it, unlike the previous bicycles, safer and more comfortable: wheels of the same diameter, thanks to a chain to transmit movement to the rear wheel, a freewheel pedalling system (a mechanism that allows the wheel to continue turning even when the pedals are stationary), a sprocket fixed to the hub of the rear wheel and a sprocket keyed to the pedal axle, a frame in Mannesmann tubes and tires along with a braking system. In some additional years, it will become a hobby and a way to keep in shape.

What now we consider something part of our everyday life, something to which everyone of us is trained for since being a child, was for a long time a simple (and not so safe) vehicle, alternative to horses and carriages. Innovation brought a huge change in its time: it changed society's habits, although having appeared exactly for answering to another society need.

In 1986 a law introduced in Italy the mandatory use of helmets when riding or being passenger on a motorcycle and a scooter, for all younger than eighteen. In 2000 it became mandatory for all ages and all two-wheels vehicles. The use of helmets increased from 15% to 97%: from the design

point of view, this was the chance to develop incredible products, fashionable yet based on safeness, elegant icons connected to any generation (necessarily).

Reaching the interest of bespoke historical brands, a law changed how society appears: in this direction the collaboration for the 2024 collection of Nolan and Borsalino, two bespoke brands, self-defying ambassadors of Italian heritage.

Understanding and evaluating properly in advance which will be the spark leading to innovation, the one that will draw new futures, answering to expressed and unexpressed need is almost impossible.

What design can do is try to give a reasonable answer to the changes, looking at them with the right criticism, thanks and due to the right instruments: the best of this instrument is knowledge, and it perfectly pairs sensitivity.

At this moment the 'issue' of gender impacts design realm in our everyday life with a spread of "her/his/they" indications at the bottoms of our emails: despite of being maybe interested, possibly aware of what is the current debate about this, not many of us have thought about the reasons and the consequences these pivotal changes would have.

We think of design as a discipline capable of universally dialoguing in the same way, a shared and universal language: this is unreal and utopian. It would mean aspiring to a flattened reality, devoid of cultural diversity and nuances.

The clue is that an oriented (man-cis-white-young-healthy) approach for too long has affected the design discipline, which shapes and diriges our lives. This affects everyone's life and this is a problem. Rawsthorn, quoting Criado Perez, highlights how the "one-size-fits-all" is a lie, as well as is a untruth. (Rawsthorn, 2022, 81)

We might add that, even if this would likely to solve some problems and issues related to consumption and production, sustainability and environmentalism, a genderless design, wouldn't be a solution. It would not leave space for expression, behavioural statements, nuances to which nowadays we are all used.

«As a binary definitions of cis male and cis female appear increasingly outdated, it is even more important for us to all able to decide how to express the nuances of our personal identities in our design choices, rather than leaving it to the cis male establishment that has sustained the "man's world" of design for so long.» (Rawsthorn, 2022, 87)

What, so far, could be the answer? The educational context is the place where - using the words of the feminist educator and writer Bell Hooks - freedom can be trained.

In the recognition and consideration of the multiplicity, the incredible varieties within cultural expression, behavioural dispositions,

personal conditions in this world there is not a single answer, and there could never be. We struggle so much for preserving and enhancing natural biodiversity: considering of an answer in design discipline and process that fits all would always leave someone out of the range. Designer must be trained to be aware of it, conscious they would need and will be asked for choosing which question they are addressing their efforts. Because, even if following straightly and exactly the perfect Dieter Rams' s ten principles still one seems to look great along for the contemporary era, when coming to largely intended design: everything right is not right for everyone.

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CO-DESIGNING WITH HUMANS.

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ABSTRACT | Incorporating artificial intelligent agents into the design process has been an important challenge during the past decade. From neural networks to generative adversarial networks, to modern large language models and latent diffusion models, there has been a large advancement, not only in terms of technology, models and methodologies, but conceptually in terms of how creative professionals, specifically designers engage with machine learning and artificial intelligent agents, this study presents and documents the advancements, process, methodology and results of a set of projects derived into a course designed to introduce designers to machine learning and artificial intelligence, from the perspective of Co-Design. Encouraging designers to envision artificial agents as active contributors of the design process, either as agents or as factual users in a co-design or cocreation process.

KEYWORDS | ARTIFICIAL INTELLIGENCE, CO-DESIGN, MACHINE LEARNING, DESIGN PROCESS

1. Introduction

The integration of artificial intelligence (AI) into design processes has dramatically transformed the way we approach creative problem-solving and innovation over the past decade (Chen, Z., & Ye, R. 2021). From neural networks and generative adversarial networks (GANs) to modern large language models and latent diffusion models, there has been substantial advancement in technology, models, methodologies, and conceptual frameworks for how designers engage with AI allowing them to explore unprecedented creative possibilities.
AI's capabilities in data analysis, image generation, and decision-making have introduced new dimensions to design thinking and practice, enabling designers to overcome limitations related to scale, scope, and complexity.This publication aims to review the development, implementation, and outcomes of the "Co-Design with AI" course in Japan. The course is structured to introduce design students to AI and machine learning concepts, emphasizing co-design principles where AI agents are considered active contributors to the design process. By reviewing the methodologies, projects, and educational strategies employed in the course, this paper provides insights into the educational approach and the potential of AI in design education.

The relevance of integrating AI into design education cannot be overstated. As AI technologies continue to evolve, their application in design processes becomes increasingly critical for fostering innovation and efficiency. Educating designers to work with AI agents as stakeholders of the design process not only enhances their creative capabilities but also prepares them for the future of the design industry, where AI is expected to play a significant role.
This course at Chiba University represents a pioneering effort to bridge the gap between traditional design practices and emerging AI technologies, promoting a collaborative and interdisciplinary approach to design education. Therefore, the course focuses on teaching machine learning (ML)

techniques that are essential to develop a full understanding of the design process in the context of today's data-driven world. As design increasingly integrates AI, understanding how ML works enables designers to create adaptive, and user-centered solutions. ML techniques, such as supervised learning (learning from labeled data), unsupervised learning (learning from unlabeled data), semi-supervised learning (using both labeled and unlabeled data), and reinforcement learning (learning through interaction with environments), offer powerful tools for generating insights, automating tasks, and optimizing design decisions (Mohammed, M., et al, 2016). This course focuses on learning these techniques through a hands-on approach, such as practical classes, intensive workshops, all of them based on projectbased learning. Students benefit most when they are tasked with building functional prototypes, applying ML algorithms to real-world design problems. Additionally, collaborative learning environments and interdisciplinary projects are effective educational techniques in the AI and design field, allowing students to explore the creative possibilities of ML while developing technical expertise.

This paper reviews and documents the advancements, processes, methodologies, and results of a fourth year course designed to introduce designers to AI and machine learning from a co- design perspective. The goal is to encourage designers to view AI agents as active contributors to the design process, either as agents or as factual users in a co-design or co-creation process.

2. Designing with AI: Course Development and Implementation

2.1.First Iteration / Tool Generation & Generative Adversarial Networks

In 2020, the initial iteration of the course was developed to integrate artificial intelligence into a design curriculum within the System Planning Laboratory at Chiba University in Japan, driven by the increasing prominence of AI models as design tools (Chacón, J. C, 2021) . Previous reference projects such as Deepwear (Kato N.,2018) and the ChAIr Project (Schmitt, 2018), have utilized GANs to generate images for fashion and furniture design, respectively and showed great possibilities for the use of these technologies in design. Despite this, many students lacked the technical expertise to fully utilize AI in their design processes, and at that time, there were fewer open platforms for interacting with these models compared to the accessibility available today. During this iteration, the necessity to teach fundamental machine learning concepts while enabling students to interact with generative AI models and create different outputs using this technology motivated us to develop the GANSta platform (Figure 1) (Juan Carlos Chacon Quintero, & Hisa Martinez Nimi 2020), a Python-based tool with a graphical

user interface that facilitates the design and training of Generative Adversarial Networks (GANs), and its application in various stages of the design process. This node-based interface, familiar to designers from tools like TouchDesigner and Grasshopper, allowed users to design and train GANs without prior programming knowledge. While other graphical tools for machine learning exist, GANSta was uniquely developed to meet the needs identified during design-led projects. It facilitated an understanding of GAN concepts through the distribution of Nodes (Table 1) and allowed designers to develop and train their models. However, limitations such as the cost of computer equipment, GPU requirements, and training time may hinder widespread adoption. Despite these challenges, the success of that initiative indicates that AI will likely become an integral part of the design process in the near future.

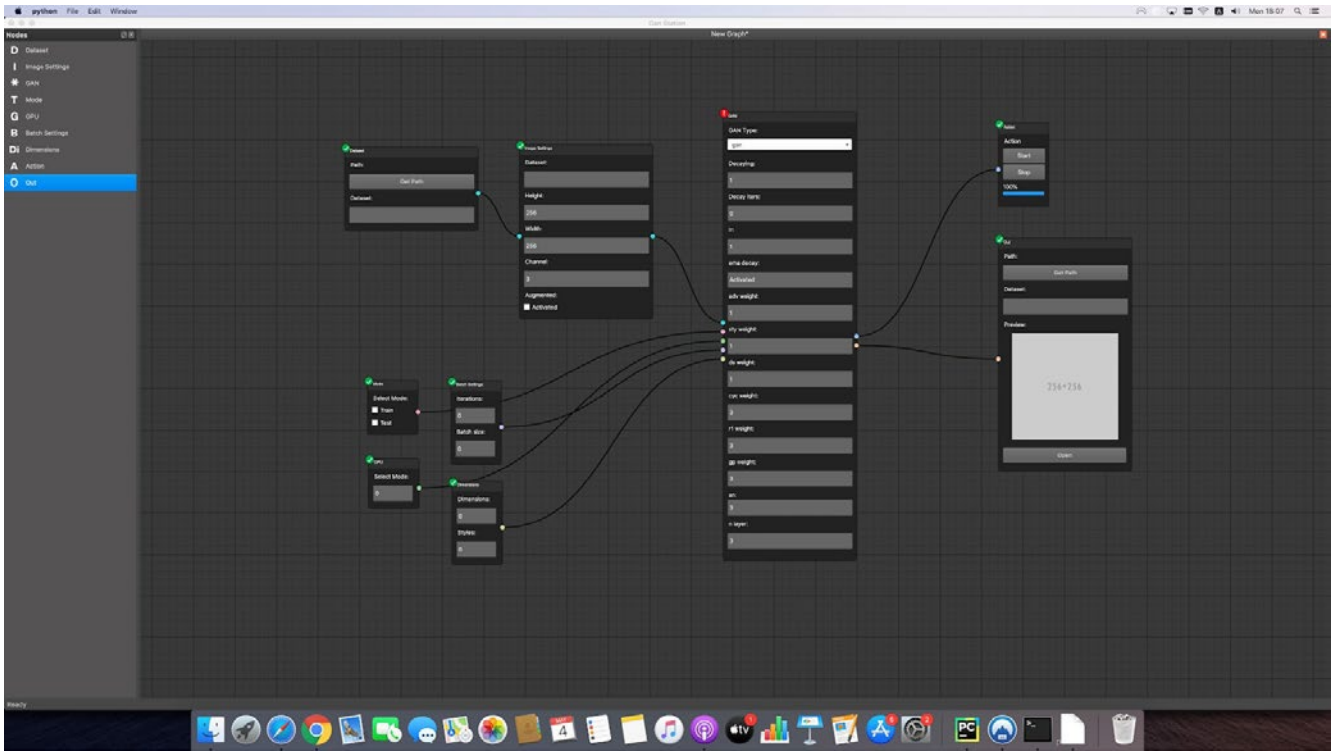

Figure 1. GANsta: A Graphical user interface that facilitates the design and training of Generative Adversarial Networks (GANs)

Table 1. GANsta platform Nodes and functions.

Dataset Node	Selects and verifies the dataset path.
Image Node	Defines image parameters and applies transformations.
Mode Node	Chooses between training and testing.
GPU Node	Optionally selects GPU usage.
Batch Node	Determines batches and epochs for training.
GAN Node	Sets parameters for the generator and discriminator.
Output Node	Defines output path and format.
Action Node	Initiates training and testing, displaying progress.

Participants from Chiba University engaged in several projects as a result of the implementation of this platform. Some of the remarkable projects include iconographic branding generation and typographic font design projects to explore the potential of GANs in design. The results demonstrated that prior knowledge in programming or machine learning is not required for designers to benefit from this technology; however, some basic fundamental knowledge will definitely impact the quality of the results.

2.2.Second Iteration / AI as a co-creation Partner

After the first iteration of incorporating AI as a tool in the design process, we explored the potential of utilizing this technology not merely as an auxiliary tool but as an active co-creation partner. This realization highlighted AI's ability to participate in creative decision-making and generate innovative design solutions collaboratively with designers. The success of this approach opened up new opportunities for the next iteration of the course and projects, encouraging a deeper exploration of AI's role in the design process and fostering a more integrated and synergistic relationship between human creativity and artificial intelligence. This stage delves into the concept of AI as a co-creation partner, focusing on the collaborative dynamics between designers and AI in the context of imagebased design projects using Generative Adversarial Networks (GANs).

To explore the collaborative potential of AI, a workshop was conducted at Chiba University's System Planning Laboratory. The workshop aimed to provide practical machine learning knowledge to design students and integrate AI as an active participant in the design process. The workshop was structured into five stages: project selection, dataset creation, dataset testing, results evaluation, and documentation. Also, in this iteration, our internal tool GAN Station (GANSta) was used to include designers without prior programming knowledge.

The workshop brought together a diverse group of design students from various creative fields, including graphic design, industrial design, product design, and interactive design. These participants were organized into five teams based on their individual skills and interests. The topics chosen for this iteration of the workshop included Japanese kanji design, font design, emotions applied in character design, character animation, and icon generation. During the workshop, students had the autonomy to select their topics and methods for developing their projects, leveraging their personal interests as a catalyst for learning. This approach, inspired by Seeley Brown and Adler's (2018) concept of passion-based learning, encouraged students to delve deeply into their subjects, applying and practicing their knowledge through productive and peer-based learning. This method allows students to learn new techniques by observing their peers, defending their work, and engaging in community discussions about emerging challenges. The use of passion-based projects proved advantageous, as students, already familiar with their chosen topics and related processes, were able to incorporate the intelligent assistant or tool effectively, despite limited prior knowledge of deep learning, generative design, or engineering processes. Throughout the workshop, a variety of methods and tools from other disciplines were integrated into each team's creative process. Design thinking, persona profiling, and other design methods complemented the process, facilitating student interaction with the tool in their own unique ways. Management, evaluation of result quality, and the number of process iterations were determined by the participants, based on their preferences and experiences.

Each team tailored their dataset to meet the specific requirements of their project. From a generative design perspective, the characteristics of the selected dataset were used as parameters to create new domains or "designs" by mixing characteristics between dataset components. After the model training, the introduction of new domains and parameters enabled the transfer of dataset characteristics to new domains, generating new design variants beyond the initial dataset parameters.Upon completing the training process and verifying its functionality, the learning evaluation continued by generating images from transversal latent walks within the same model, without using other images as input or guiding parameters. This evaluation further extended through the generation of images derived from the mixture of characteristics and parameters deemed relevant during the visual assessment of the initial results (Figure 2). At the conclusion of the evaluation, students proposed potential uses or applications for the resulting models, aiming to develop future services or tools. They also conducted a personal evaluation of the knowledge acquired and the methodology followed throughout the project. This reflective process led to observations and recommendations on how to simplify and improve the workflow for future iterations of the workshop.

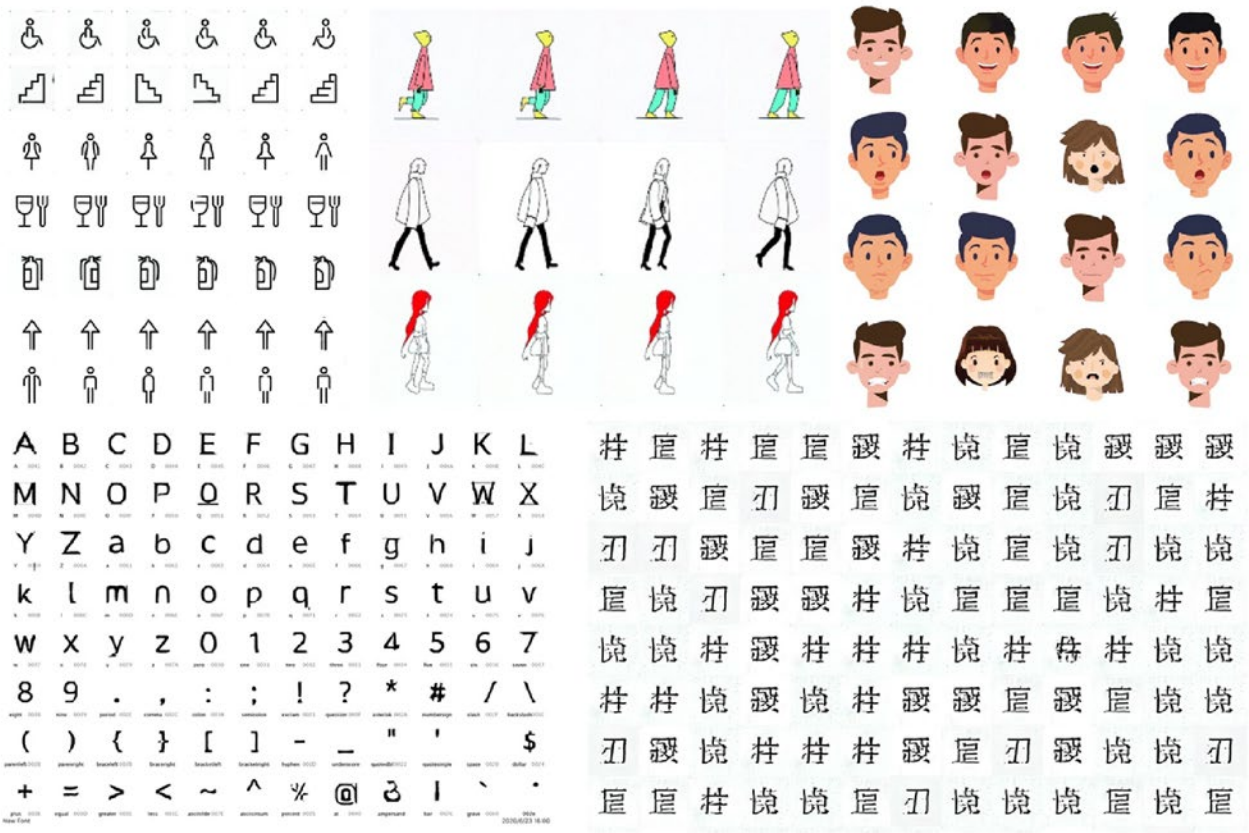

Figure 2. Student Outputs from the 'AI as a Co-Creation Partner' Workshop

2.3.Third Iteration / Co-designing with the Machine

Following the second stage of integrating AI as a co-creation partner, where AI was utilized to augment the creative process, we discovered its profound potential not only as an assistant but as an equal collaborator in design (Carlos, C.Q.J., Hisa, M.N. 2024). This realization led us to envision a more integrated approach where AI is embedded deeply within the co-design framework. This shift opened new avenues for the next iteration of the course and projects, emphasizing collaborative creation with AI at every stage of the design process. At this stage, the "Co-Designing with AI " became a class inside the Industrial Design curricula of Chiba University. This course was designed to introduce design students to Generative Design and Machine Learning tools while adopting a unique perspective by positioning AI as an active agent (Huang, Y. 2024) in a co-design process. Through a combination of regular classes and intensive workshops, the course enables students to collaborate with AI agents, fostering a deep understanding of AI and enhancing their practical skills. This chapter reviews the course structure, methodologies, and student projects, highlighting the immense creative potential of AI in diverse design contexts.

The concept of co-designing with AI agents emphases the collaboration between human designers and AI models throughout the design process. At this stage, a shift was made from co-creation to a co-design approach. For this case, we refer to co-creation as a process that involves collaborative creativity enacted by a group (Sanders, E. B. et al. 2008), while with co- design we refer to a collaborative creative process applied throughout the design cycle (Flores, R. L., et al. 2015). In the context of this course, co-designing with AI entails human designers and AI agents working together from idea generation to evaluation and refinement. This approach aligns with the distributed creativity framework, which views creativity as a collective phenomenon involving multiple actors, artifacts, and environments.

The course is structured into four key stages: introduction to machine learning concepts, project conceptualization, development, and evaluation. Students work closely with researchers to refine models, understand technical implications, and reflect on their experiences. The course is offered in two formats: a traditional seven-session classroom course and an intensive 5-7 N. Surname, N. Surname (LEAVE BLANK) [STYLE: _P/RoD RUNNING HEAD Even] session workshop, conducted in collaboration with various institutions. Students from diverse academic levels and backgrounds collaborate on projects, enhancing their proficiency in technical areas and problem-solving skills. The co-design framework underscores the importance of usercentered design and collaborative problem-solving.

The following results demonstrate the utilization of various artificial agents across different stages of the design process.

Lamp Project: Conceptualizing a Product with GANs

In this project the AI Agent was involved in the conceptualization stage. The focus of this proposal is on designing lighting fixtures inspired by sea creatures (Figure 3). Using generative adversarial networks (GANs), students designed AI agents capable of proposing conceptual sketches for lamp designs, including colors and illuminations. The collaborative process involved interpreting AIgenerated proposals and developing three-dimensional representations from the human side, demonstrating AI's role in the conceptualization phase.

Figure 3. Student Outputs from the 'AI as a Co-Creation Partner' Workshop

Envisioning Future Scenarios: AI Sneak Peek Project

In this project the AI Agent was involved in the prototyping, voice recognition, and image generation stages. Students created a diffusion-based image generation model that translated real-time conversations into images depicting potential romantic futures for participants (Figure 4). This interactive experience demonstrated AI's ability to impact users' perspectives and communication.

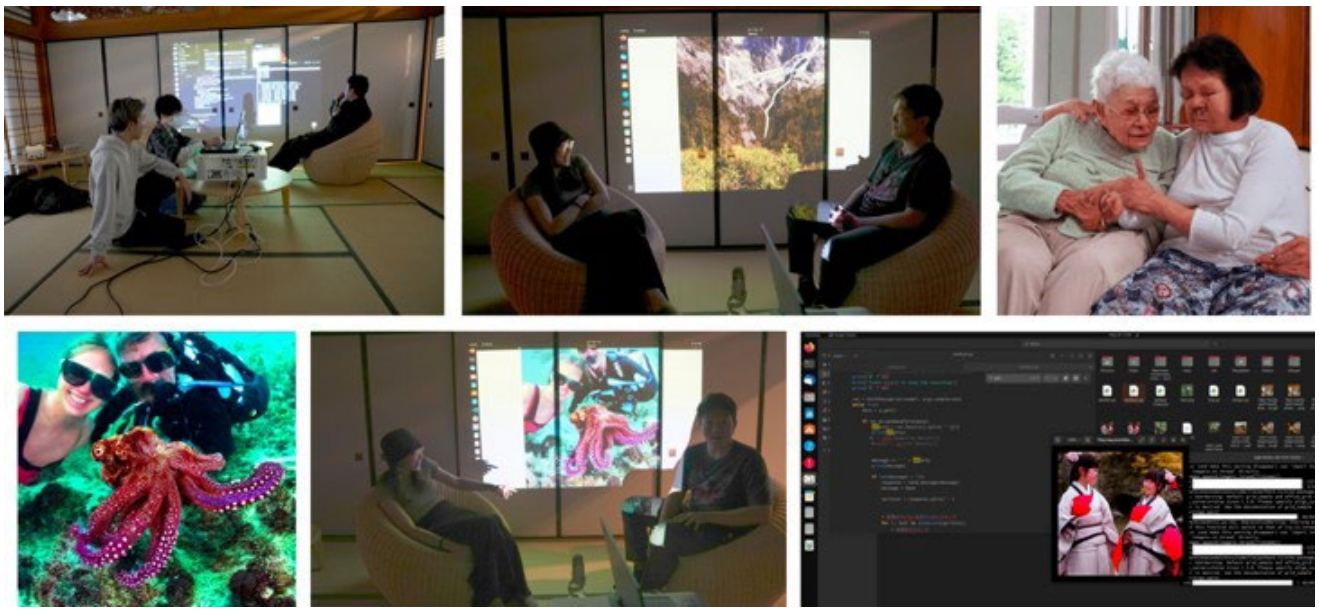

Figure 4. Prototype testing of the AI agent that translates conversations into images depicting potential future scenarios for the participants.

Real-Time Co-Design with AI: Shadow Master Project

This project explored new ways of interacting with generative AI agents through lighting and shadow identification. The project allowed users to create graphic representations of animals through body movements, even without prior knowledge of the generative process (Figure 5)..

This playful co-design approach has significant potential for visual communication in cross-cultural environments and for representing complex concepts and storytelling. The project highlighted the use of AI models in the design stage, analyzing user shadow images and generating final illustrations, fostering inclusive and innovative visual communication strategies.

Figure 5. AI agent interacting in real time with the users through the detection of shadows and lighting.

Incorporating AI agents into the design process has been a transformative educational experience. The “Co-Designing with the Machine” course highlights the potential of AI in education, demonstrating a multidisciplinary approach that provides a stimulating learning environment. By engaging with AI as team members, students harness the potential of collaborative AI to enhance their creative abilities and develop problem-solving loops for training AI models. This educational experience emphasizes the importance of collaboration and co-design, showcasing how diverse roles and skills can work together effectively. Adopting this perspective enriches designers’ abilities to navigate the evolving landscape of human-machine collaboration, paving the way for groundbreaking design innovations. These examples inspire further exploration and innovation in this rapidly evolving field.

2.4.Fourth Iteration / Co-designing with Humans

The “Co-Designing with AI” course at Chiba University has progressively evolved through four distinct stages: AI as a tool, AI as a co-worker partner, co-designing with the machine, and,

most recently, codesigning with humans. This chapter delves into the fourth stage of this course, where AI agents undertake the majority of the design process autonomously, while human participants engage as stakeholders, providing input and feedback without being fully aware of the underlying design mechanisms. In this stage, the role of the designer shifts from direct involvement in the design process to creating and managing interactive loops (Verganti, R., 2020) between AI agents and human stakeholders. The course components are structured to reflect this dynamic interaction. AI agents are tasked with conducting comprehensive design activities autonomously to generate innovative solutions. Human participants, acting as stakeholders, engage in periodic reviews, offer contextual insights, and make strategic decisions without needing to grasp the technical intricacies of the AI processes. However, designers play a crucial role in creating interactive loops that facilitate ongoing collaboration between AI agents and human stakeholders, ensuring continuous improvement and adaptation of the designs. This framework not only enhances the learning experience but also simulates real-world scenarios where AI and human collaboration is pivotal.

During this session, designers were responsible for Creating Interactive Loops: Designing systems that enable seamless collaboration between AI agents and human stakeholders, ensuring that both parties can contribute effectively to the design process. Designing their tailored AI agents: For this session, designers are not only in charge of designing the loop in which the user and the machine intervene but must also be able to design their own intelligent agents and train them combining several models and other techniques. *Facilitating Stakeholder Engagement*: Ensuring that human participants can provide valuable input and feedback at strategic points, enhancing the overall design outcome. *Monitoring and Improving Processes:* Continuously evaluating the performance of AI agents and making necessary adjustments to improve their effectiveness.

Collective emotions project

The design project tasked designers with creating a system where AI agents engage with a group of students in drawing images related to their emotions. By aggregating these individual drawings, the AI then was able to generate a collective visualization of the group's emotional perspective. Following this, the AI agent creates a 3D visualization of the collective emotions, preparing the results for physical manifestation. The students utilized resin printing to transform the AI-generated visualizations into tangible exhibits, allowing the group to physically display and reflect on their shared emotional landscape. This exercise not only demonstrated the potential of AI in synthesizing collective human experiences but also provided a tangible means for participants to engage with and exhibit their collective emotional expressions. In this project, the designers played a pivotal

role in both the technical and logistical aspects of the process. Initially, the designers focused on developing the AI agents, programming them to engage with humans by asking them to draw images related to their emotions. This involved creating algorithms capable of interpreting emotional input and translating it into visual data. Once the AI agents were operational, the designers managed the logistics of the project, coordinating the various stages to ensure smooth execution. They organized sessions where students were asked to draw their emotional responses, providing the necessary materials and guidance. After the drawings were completed, the designers facilitated the scanning process, ensuring that the physical images were accurately digitized and input into the AI system. Following the digitization, the designers feed the AI agent with the collective emotional visualization, to translate these visualizations into 3D models. They then managed the printing process, using resin printing technology to create physical representations of the collective emotional landscape. By meticulously coordinating these steps, the designers ensured that the project not only harnessed the technical capabilities of AI but also effectively engaged human participants, resulting in a meaningful and tangible exhibition of collective emotions.

The fourth stage of the course represents a significant advancement in the integration of AI in design. By positioning AI agents as the primary drivers of the design process and engaging humans as stakeholders, this stage highlights the transformative potential of AI in creative fields. The experiences and insights gained from this educational initiative provide valuable lessons for the future of design education, emphasizing the importance of collaboration, trust, and ethical considerations in the evolving landscape of AI-driven design. However, the transition to a predominantly AI-driven design process presents several challenges and insights. Firstly, technical limitations pose a significant hurdle; ensuring the accuracy and creativity of AI-generated designs necessitates robust datasets and multimodels. Any deficiencies in these areas can compromise the quality of the output. Secondly, building human trust and acceptance is crucial. Demonstrating the efficacy and creativity of AI solutions is essential for gaining stakeholder confidence and fostering a collaborative environment. Thirdly, the autonomy of AI in the design process raises ethical considerations regarding authorship, creativity, and potential biases. Addressing these concerns is vital for the responsible integration of AI in design. For future iterations, this fourth stage of the “Co-Designing with the Machine” course opens new avenues for design education and practice. Enhanced collaboration can be explored in future iterations, with AI handling complex design tasks while humans provide strategic oversight. Additionally, a continued focus on developing AI models that prioritize inclusivity, fairness, and transparency will be paramount as AI becomes more integrated into creative processes.

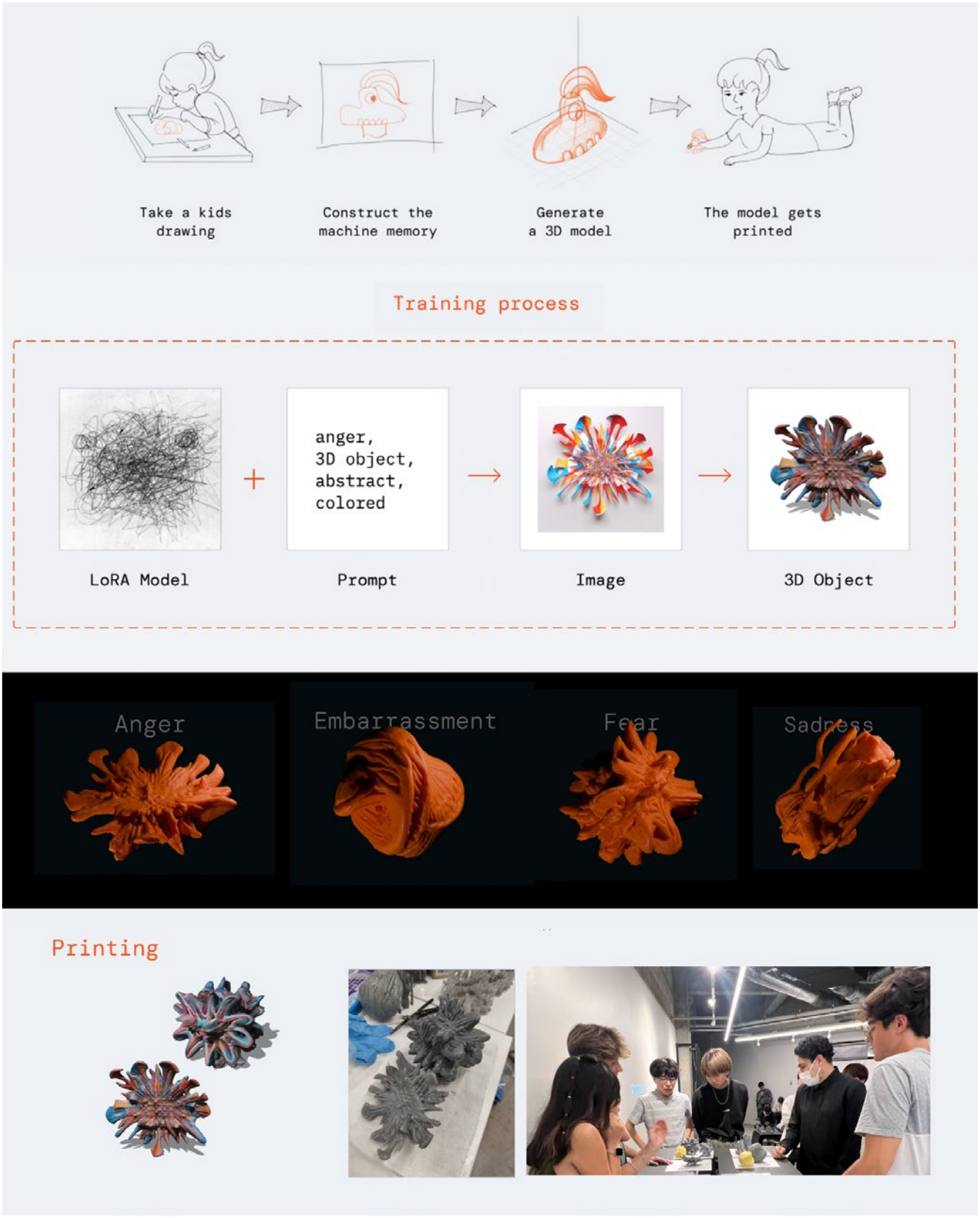

Figure 6. Process and results of the collective emotions project during the fourth iteration of the course.

3. Conclusion

The “Co-Designing with AI” course at Chiba University has provided a comprehensive exploration into the integration of AI within the design process, evolving through four distinct stages: AI as a tool, AI as a co-worker, co-designing with the machine, and co-designing with humans. This study has documented the progression of these stages and the methodologies employed to leverage AI as both a collaborative partner and a primary driver of the design process. The course has showcased the transformative potential of AI in creative fields, emphasizing the role of AI as an active contributor rather than a mere tool. In the initial stages, AI was used to automate repetitive tasks and enhance efficiency, helping designers to streamline their workflows. The second stage shifted AI’s role to that of a co-worker, actively participating in creative decision-making and generating innovative design solutions collaboratively with human designers. The third stage, co-designing with the machine, highlighted the seamless integration of AI into the co-design framework, promoting collaborative creation at every stage of the design process. The fourth stage, co-designing with humans, represents a significant advancement where AI agents undertake the majority of the design process autonomously, while human participants act as stakeholders. This stage underscores the importance of designers creating and managing interactive loops between AI agents and human stakeholders to ensure continuous improvement and adaptation of designs. The educational framework immerses students in the role of stakeholders, allowing AI agents to drive the design process while human participants provide strategic oversight. Despite the advancements, the transition to a predominantly AI-driven design process presents several challenges and insights. Technical limitations, such as ensuring the accuracy and creativity of AI-generated designs, require robust datasets and multimodels. Building human trust and acceptance remains crucial, as does addressing ethical considerations regarding sustainability and potential biases. Enhanced collaboration between AI and human stakeholders can be explored. The experiences and insights gained from this educational initiative emphasize the importance of collaboration in the evolving landscape of AI-driven design. These lessons will undoubtedly inspire further exploration and innovation in this rapidly evolving field, paving the way for groundbreaking design innovations and a more inclusive future in design education and practice.

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ECONOMIC GENERATION PROJECT FOR INDIGENOUS WOMEN IN NORTHERN CAUCA

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ABSTRACT | This project, developed in Colombia, contributes to improving the living conditions of 200 indigenous women in northern Cauca by creating sustainable economic generation options. This population is considered high-risk due to the presence of armed groups that violate the community's rights. In this context, the project represents an opportunity to promote the economic and political empowerment of women and reduce inequities.

Three main components were proposed: first, to train and obtain the official hand-weaving seal from the Colombian government, as well as to train in adapting design and production processes to meet the specific demands of the slow fashion market. Second, to implement a commercial strategy to establish agreements with previously identified actors in the tourism and slow fashion sectors. Third, to strengthen internal business management processes by adopting basic practices that govern product design, production, quality control, as well as supplies and sales.

The importance of economic development from the natural and social sustainability of the territory is highlighted. Therefore, in the different processes, priority was given to strengthening their ancestral practices, which involved the use of native raw materials and an integrative product design approach, respectful of the indigenous cultural identity and their relationship with the land. Equally important was promoting women's empowerment through autonomy in decision-making and economic independence.

KEYWORDS | HAND-WEAVING, INDIGENOUS WOMEN, SUSTAINABLE ECONOMIC, WOMEN'S EMPOWERMENT.

1. Introduction

This article explores the challenges faced by design in communication [among and for multicultural audiences] from a social and territorial perspective, focusing on the traditional practices and knowledge of Latin American Indigenous communities. These dynamics were analyzed from the results obtained in the development of the international cooperation project called "Integral Program of Commercial, Productive, and Business Management Transfer for the Promotion of Access to Slow Fashion Markets for Indigenous Women in the Department of Cauca, Colombia"[1].

The project was funded by the CHANEL Foundation and implemented by the CODESPA Foundation, Colombia delegation, between 2018 and 2021. CODESPA is a Spanish non-profit development cooperation organization that focuses on strengthening the enforceability of social and economic rights, promoting productive activities for the revitalization of local economies, and facilitating income-generating opportunities for displaced families in urban and rural areas. The main objective of the project was to improve the living conditions of 200 Indigenous women in the northern part of the Department of Cauca, specifically in the municipalities of Caldono, Corinto, Jambaló, Caloto, and Toribío. To this end, sustainable economic generation options were created that promote the economic and political empowerment of women in situations of inequality (Codespa America Foundation, 2019).

This was achieved with the mediation of some cabildos[2] of Indigenous reserves[3] and the collaboration of key allies, such as governmental institutions, including the National Learning Service (SENA). Territorial

[1] Cooperation Agreement between the CHANEL Foundation and the CODESPA America Foundation named CHANEL PE-1826.
[2] The Cabildo is defined as the local authority and coexists with the central and regional government of the country.
[3] The indigenous reservation constitutes the basic unit of territorial and socio-political organization from which the life of the indigenous peoples is developed (Donato et al., 2007).

liaisons from the Governor's Office of the Department of Cauca also participated, including the Cooperation Office, the Departmental Secretariat for Women, and the Secretariat for Education and Culture. In addition, the project team had a diverse professional composition, including political scientists, business administrators, industrial designers, and artisan technicians specializing in weaving techniques.

As indicated by Andrés Rodolfo Trujillo (2023), representative of the CODESPA Foundation, Colombia delegation, the methodological approach was developed in three key stages. First, participants were trained in adapting design and production processes to meet the specific demands of the slow fashion market. Second, a commercial strategy was implemented to establish agreements with previously identified actors to access stable and sustainable markets. Finally, internal business management processes were strengthened by adopting basic practices that govern product design, production, quality control, supply, and sales processes.

The results of the design process adaptation[4] component reveal the challenges faced by the discipline of industrial design, from the perspective of the [communicative object], that is, "the relationship between language and object" (Cid Jurado, 2002). In this case, the development of [*Indigenous objects*] of [*everyday and non-ritual use*], elaborated from artisanal production processes, was addressed. According to Ballestas Rincón (2019), these categories of utility are deeply rooted in the "meaning assigned or codified by the community" (p.17), while the geographical context determines the material and intellectual links with their territory, thus generating a construct of symbols that define their physical and cultural world (Quiñones Aguilar, 2003,p. 1).

This article proposes to follow the following route of analysis: first, to contextualize the territory around the handicraft activity; second, to describe the handicraft and gender approach from the living conditions of the beneficiaries; and third, to understand the dynamics around their knowledge and ancestral practices based on the [*Indigenous object*]. Finally, the methodological approach and the results obtained are presented, offering a comprehensive view of the challenges and achievements of the project.

1.1 Contextualization of the Territory

The Department of Cauca, known for its ethnic, cultural, and environmental plurality, is the department with the second largest indigenous population in Colombia. It is in the southwest of the country in flat areas and areas of medium and high mountains ranging from 1,600 to 2,800 meters above sea level. It is made up of 39 municipalities, 29 of which are inhabited by seven Indigenous

[4] Activities were carried out as part of the technical assistance and training component by design professionals for the "Association of Artisans and Craftsmen of Cauca Enredarte con identidad", legally established during project execution.

peoples: Nasa, Guambiano, Yanacona, Totoró, Coconuco, Eperara Siapidara and Inga. Of these, only five have preserved their native languages (Donato et al., 2007,p. 60).

Despite this cultural heritage, the socioeconomic context of artisans in Cauca is complex. According to the Statistical Information System of Artisan Activity - SIEAA (2014 -2020), out of a total of 32,187 artisans registered in 29 departments of Colombia, the 13th place is occupied by the Department of Cauca with approximately 1,404 artisans, where 35.8% inhabit rural areas, 32.6% indigenous reservations, 31.1% municipal capitals and only 0.5% peasant reserve zones (National Administrative Department of Statistics - DANE, 2022).

However, most of the artisanal production systems present in these territories respond to subsistence economies, where it is the families living in the villages or peripheral areas who develop the artisanal trade. A total of 69.5% of the artisans belong to vulnerable populations, while 30.5% do not recognize themselves as such. The context of vulnerability may be determined by several factors, such as being the only person responsible for the household, belonging to an ethnic group, being in a situation of poverty, and being a victim of armed conflict and displacement, among others. These aspects make artisans be perceived as agents in a condition of vulnerability. This situation is intensified due to the strong influence of illegal economies present in the area, which displaces labor towards activities such as coca leaf cultivation, illegal mining, and even sex trade, activities that predominate in the young population between 17 and 35 years old (Codespa America Foundation, 2019).

Given this reality, community associations and enterprises emerge as a crucial field of action for the construction of autonomy (Donato et al., 2007,p.54). From this perspective, the initiative arose to consolidate a network of artisan workshops as a social enterprise with a focus on the valuation and recovery of the cultural identity of the indigenous and peasant communities of the territory. This network of workshops was named “Association of Artisans of Cauca Enredarte con identidad” and made up of six artisan workshops. Its purpose is to promote quality work to improve the social and economic conditions of women through handicraft weaving.

The importance of these workshops lies not only in their economic contribution but also in their role as guardians of community traditions. The family weaving workshops are the base where these traditions rest, transmitting their knowledge from generation to generation, either through technical instruction in the field or orally (Campi, 2021). Therefore, promoting the creation of networks and relationships among artisans is fundamental for the subsistence of the workshops (Pérez, 2023, p.208). In the context of the project, the network of artisan associations of the “Enredarte con identidad” was formed with the traditional knowledge and know-how of the artisans of: SEK DXI from the municipality of Jambaló, WAKAT

KIWE NASA from Toribío, KUMBIAXCA from Corinto, Kwesxksxawnxi from Caloto and UMA from Tacueyó.

In summary, the dynamics generated by the artisan workshops not only allow for economic subsistence but also act as a vehicle for cultural preservation, essential for the continuity of the traditions and identity of the Cauca communities. The network of artisan associations made up of workshops from different localities, demonstrates that collaboration and the exchange of knowledge are fundamental for facing the challenges that affect these communities, ensuring the survival of their cultural legacy.

1.2 Gender and craft

The panorama of the handicraft sector in Colombia reveals that weaving is the most common craft, classified into two types: textiles and basketry. Both use different techniques to weave threads and fibers, using materials such as wool, cotton, and vegetable fibers. The regions with the greatest presence of artisan weavers are the Caribbean, Pacific, Coffee Belt, Central East, and South.

Weaving stands out as a predominantly female activity; 72% of artisans are women and 28% are men. This female predominance is also reflected in the project, which was executed with the participation of 200 women, 74% of whom belong to the Nasa people and 26% of whom are mestizos. These women artisans, who live in the northeastern part of the Department of Cauca, in the municipalities of Caldono, Corinto, Jambaló, Caloto, and Toribío, face various educational and labor constraints.

Only 36% of these women attended elementary school more than 30 years ago, and 70% do not have a paid job, dedicating themselves mainly to household chores, such as cleaning, cooking, caring for children, and weaving. Although weaving is a deep-rooted tradition, for 71.5% of them it does not represent their main source of income, benefiting economically only 28.5% of the participating population. The ages of the women who made up the six artisan workshops associated with the project can be seen in Table 1, where 68% of the artisans are between 26 and 50 years old, 16% are under 25 years old, 14% are between 56 and 70 years old and only 2% are over 70 years old.

Table 1. Beneficiary group by age.

Age group	Percentage participation
18 -25 years	16%
26 – 40 years	48%
41 -51 years	20%
56 -70 years	14%
Over 71 years old	2%

Nota. Table data reproduced from "Fostering Access to Slow Fashion Textile Markets for Indigenous Women in Cauca, Colombia" (p.9), All rights reserved 2019 by NGO CODESPA Foundation. Reproduced by permission of the author

The transmission of traditional knowledge is a key aspect of the practice of weaving. According to Donato (2007), traditional knowledge could be defined as "the collective memory, past, present and future of the different indigenous peoples and local communities" (p.232). In many communities, traditional Indigenous knowledge is transmitted by women who are mothers or grandmothers over 71 years of age and are called "mayoras". They are largely in charge of transmitting their knowledge to the following generations, as Campi (2021), quoting Solanilla in her records, concludes:

"Being a weaver in Central and South America has always been a job that is carried in the DNA, passed down from grandmothers to mothers and daughters, and is a basic pillar of their economy. In the weavings, we will have to see and "read" their ways of thinking and believing" (p.38).

In fact, data on the artisan panorama in Colombia confirm that the transmission of the craft is mainly hereditary: 43.6% of artisans obtained their apprenticeship through a family member, 23.6% are self-taught, 12.7% learned from other artisans, 10.5% were trained in an institution, 5.6% learned in private workshops and 2.8% did so through other options (Artesanias de Colombia, 2020). Within the framework of the project, this knowledge is shared among the artisans through the practice of manual work, where weaving becomes "a repository of feelings, knowledge, and craft; it is, at the same time, creation and imitation of nature" (Reyes, 2021, p.7).

1.3 Indigenous Object

Changes in social contexts, generated by forced displacement and the scarcity of raw materials, have caused the loss of traditional practices and knowledge in indigenous communities. This process not only alters manufacturing techniques but

also transforms over time the symbolic and cultural meanings of the objects that these communities create in their territories. Many of these objects have become mass-produced [*handcrafted objects*], decontextualized, and stripped of their symbolic or ritual charges and traditional uses. These objects, due to their high demand in the handicraft sector, become susceptible to being replicated, redefined, and commercialized by industries that do not recognize patrimonial, moral, and creative rights (Reyes, 2021, pp. 13,41).

As Cid Jurado (2015) points out, objects are an accumulation of interpretations that generate diverse meanings determined by the context. Thus, [*Indigenous crafts*] are approached as a tangible manifestation of the culture of ethnic communities, determined by the physical and social environment, which originates useful, ritual, and aesthetic objects (Quiñones Aguilar, 2003). This approach implies considering not only the techniques and raw materials used for their manufacture but also the cultural imaginaries that determine their form and symbolic load.

In this sense, it is essential to analyze the [indigenous object] of [daily and non-ritual use], from its symbolic dimension, which refers to the metaphorical concept concerning its meaning (Cid Jurado, 2002). Although the symbolism present in the textiles woven by the Nasa indigenous people is not generalized throughout the community, some basic shapes predominate, such as rhombuses, triangles, rectangles, and squares. Through these geometric figures, they abstract forms associated with nature, spirituality, cosmovision, and experiences.

The artisans of the different ethnic groups of the Department of Cauca, such as the Nasa-Paéz, preserve the traditional technique of finger weaving, one of the oldest inherited from their elders[2]. Using sheep wool, thread or cabuya, the Nasa make cuetanderas and jigras, objects that the elders use to transport food from the marketplace to their homes or to carry the coca leaf they chew while working. This craft practice not only keeps a technique alive, but also reinforces the symbolic and cultural connection with their environment and traditions.

Finally, the analysis of the information gathered on the transformation of the indigenous object from an everyday, non-ritual use to a handicraft object reveals the importance of considering both material and intellectual aspects, influenced by the geographical context. This analysis made it possible to identify various signs and symbols that a group of craftswomen from the Nasa-Paéz community have constructed over time.

[5] "elders" name assigned to grandmothers and grandfathers as a synonym of wisdom.

2. Materials and Methods

This research is part of the project "Integral Program of Commercial, Productive, and Business Management Transfer to Promote Access to Slow Fashion Markets for Indigenous Women in the Department of Cauca, Colombia". Executed by the NGO CODESPA Foundation, Colombia delegation. Its purpose was to create sustainable economic generation options that promote the economic and political empowerment of women in situations of inequality.

The project was implemented through the "Association of Artisans and Craftsmen of Cauca Enredarte con identidad", a network of six artisan workshops. These workshops developed handicraft products for everyday use using traditional weaving techniques, such as vertical loom, crochet, and finger weaving, using natural raw materials. This article is the result of the technical assistance and training component of the design adaptation process. Figure 1 shows the general methodology developed in the project.

2.1 General Methodology

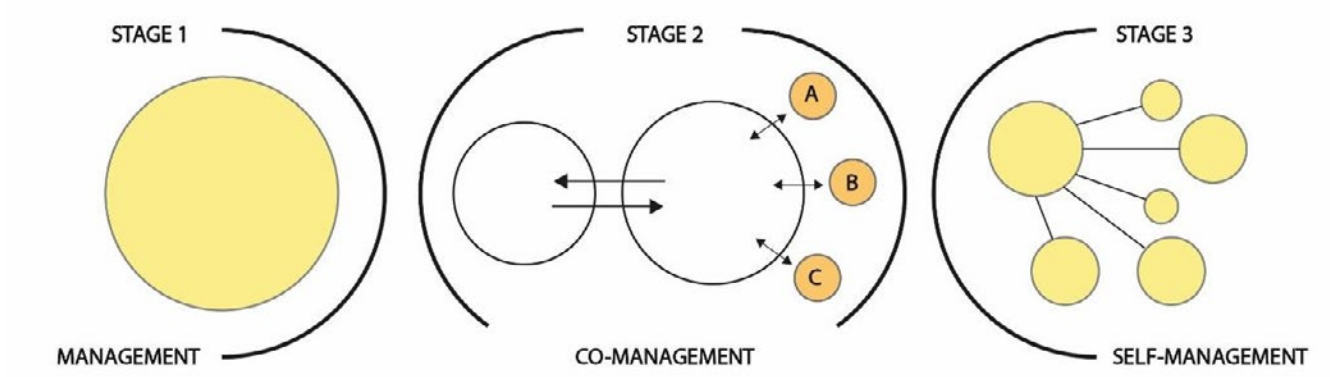

Figure 1. General methodology. *Note.* Adapted from Project Intervention Methodology. All rights reserved 2019 by NGO CODESPA Foundation. Reproduced by permission of the author.

CODESPA Foundation's methodological intervention approach aims to guarantee the operational and financial sustainability of the project, for which it develops three stages:

1. Management stage: Organizational conditions are generated and strategies, priorities, and responsibilities are defined by the communities. This phase implies a permanent accompaniment.
2. Co-management stage: Functions and responsibilities are gradually transferred between CODESPA and the "Association of Artisans and Craftsmen of Cauca Enredarte with Identity". The objective is that the organization can continue autonomously improving their living conditions and participation with economic and social impact. This stage involves periodic monitoring.

3. Self-management stage: The transfer of functions and responsibilities to the organizations is completed, with specific support in aspects that are still deficient for a defined time. Subsequently, the organizations continue to carry out their activities autonomously, with advisory support.

2.2 Co-management Stage

In the methodological stage of co-management, a large part of the component of adaptation of the design processes for the elaboration of indigenous handicraft products for daily use was developed. This phase required training and technical assistance from design professionals, in collaboration with artisan weaving technicians. The development of this component made possible the implementation of commercial strategies, which were later consolidated to strengthen the association's internal processes. Figure 2 shows the components that articulate the co-management stage.

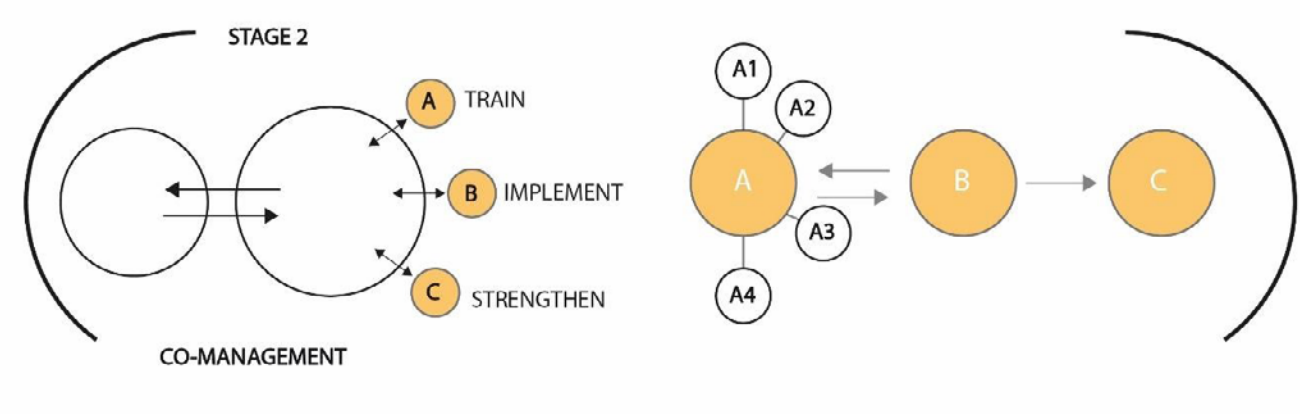

Figure 2. Stage no. 2 Co-management: Components. *Note.* Own construction from the implementation of the Project Intervention Methodology.

The co-management stage addresses the following three components:

a. Training in adapting design and production processes to meet the specific demands of the slow fashion market.

b. Implementation of a commercial strategy for the establishment of commercial agreements with stable and sustainable markets.

c. Strengthening internal business management processes

2.3 Adaptation Component of Design Processes.

The training component for the adaptation of design processes was developed in four major phases: exploratory, conceptual development, detailed design, and manufacturing. During these phases, both qualitative and quantitative methods of data capture and analysis were used, through field visits, participant observation, semi-structured interviews, and multidisciplinary working groups. Cycles between phases were iterative, allowing for analysis and adjustment of actions as needed. Each phase of the process was developed collaboratively with members of the partnership, ensuring knowledge transfer. Figure 3 highlights the phases of the adaptation component of the design process.

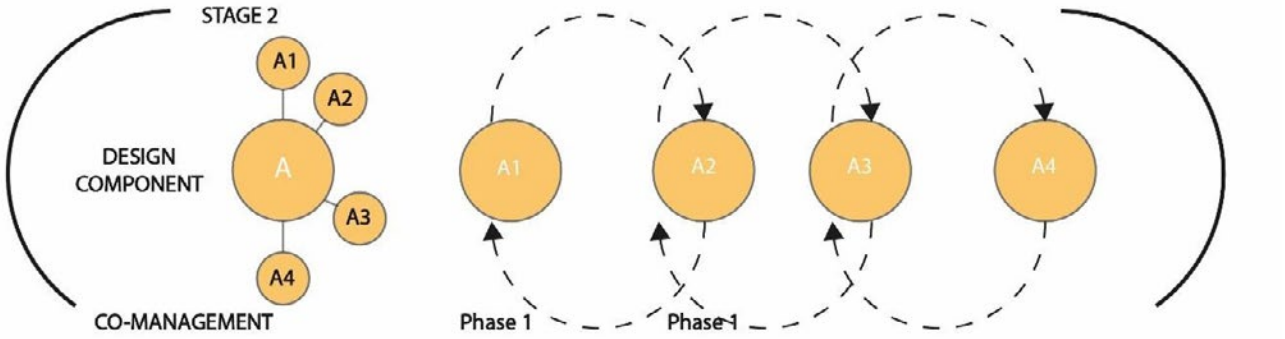

Figure 3. Stage no. 2 Co-management: Phases of the design adaptation process.
Note. Own construction from the implementation of the Project Intervention Methodology.

The adaptation component of the design addresses four phases:

A.1 Exploratory phase:
In this phase, the internal and external variables of each workshop associated with the network are identified. Factors such as dialect, ways, and forms of relating and communicating in the artisan community are determining elements for their characterization. Also considered are the technical skills of the artisans, the type of products manufactured, the raw materials used, the territorial characteristics that include road access to the workshops, and their digital connectivity, among others.

A.2 Conceptual and design phase:
This phase maps the associations between the collective meaning generated by the associations and the representations of forms of their physical and natural environment on the woven objects. It also analyzes knowledge in terms of extraction, transformation, and conservation of natural raw materials traditionally used in the manufacture of handicrafts.

A.3 Detailed design phase:
In this phase, product specifications are constructed based on the analysis of the data collected. In addition, preliminary actions are implemented to improve the technical execution of the product through training in vertical loom and crochet weaving techniques. The objective is to achieve certification of labor competencies for the 200 artisans associated with the network.

A.4 Production phase:
In this phase, the manufacture of products by each artisan workshop begins. The production capacity, availability of raw materials and tools, and production costs are constantly evaluated. In addition, the process is fed back to consumers' perceptions to outline the target market.

3. Results

The information obtained in the development of the four phases of the design adaptation component was analyzed in terms of the transition from the indigenous object of daily and non-ritual use to the artisan object, considering the material and intellectual variables that are determined by the geographic context. This analysis made it possible to identify some of the signs and symbols that a group of craftswomen from the Nasa - Paéz community have constructed over time.

To reflect the scope of the results obtained in the adaptation process, it is important to highlight that the development of the handicraft objects was carried out through a process of co-creation. This process involved constant interaction and experimentation, where the traditional knowledge of each of the participating artisan workshops was integrated.

Figure 4. Co-creation workshop: Design adaptation process. Note: The image corresponds to the activities of the detailed design phase executed in the artisan workshop in the municipality of Vitoyó. All rights reserved 2019 by NGO CODESPA Foundation. Reproduced by permission of the author.

The following sections focus, first, on the characterization of the indigenous object, exploring the dynamics related to their ancestral knowledge and practices. Secondly, the development of the indigenous handicraft object is addressed, integrating the characteristics of signs and symbols, specifically applied to the typology of the traditional backpack, which allows evidence of the transition from [indigenous object] to [handicraft object] from the four phases of design adaptation proposed in the methodology.

3.1 Characterization of the Indigenous object

The baseline of the design adaptation component was built from the identification of internal and external variables of each workshop associated to the network. Among the factors considered were geographic location, dialect, owned and adopted craft techniques, type of objects manufactured, and traditional and substitute raw materials.

The characterization process, before the intervention, showed that most of the artisans live in the high and medium mountain zones. Although the predominant language is Spanish, Nasa Yuwe is their native language, used mainly by long-lived artisans. The

most common techniques are crochet for weaving backpacks and the vertical loom, used as a complementary technique in the manufacture of parts of both the cuetandera and the backpack. Some artisans still use the ancient technique of finger weaving, one of the oldest in the territory,

To weave their textiles, they use sheep's wool, thread, or cabuya, although synthetic fibers currently predominate, which function as substitutes for the traditional raw materials of plant and animal origin. The typologies of objects common among the six artisan workshops were:

Mochila, Cuetandera, Jigra, Chumbe, Ruana, and Capisayo. Table 2 groups the information obtained in the characterization of the six artisan workshops.

Tabl2 2. Characterization of artisan workshops

Artisan workshop	No. Artisans	Native language	Weaving technique	Raw materials	Indigenous object typology
SEK DXI Municipality of Jambaló High mountain zone	55	Nasa Yuwe Spanish	Finger-knotting Vertical loom Crochet	Sheep wool Fique Polyester	a. Mochila b. Cuetandera c. Chumbe d. Jigra e. Ruana f. Capisayo
VITOYÓ Municipality of Jambaló High mountain zone	30	Nasa Yuwe Spanish	Vertical loom Crochet	Fique Polyester	a. Mochila c. Chumbe
WAKAT KIWE NASA Municipality of Toribío Mid-mountain zone	33	Nasa Yuwe Spanish	Finger-knotting Vertical loom Crochet	Sheep wool Fique Polyester	a. Mochila b. Cuetandera c. Chumbe
UMA Municipality of Tacueyo Mid-mountain zone	28	Spanish	Vertical loom Crochet	Sheep wool Polyester	a. Mochila c. Chumbe e. Ruana
Kwesxksxawnxi Municipality of Caloto Flat zone	30	Spanish	Vertical loom Crochet	Fique Polyester	a.Mochila c. Chumbe
KUMBIAXCA Municipality of Corinto Flat zone	24	Spanish	Vertical loom Crochet	Polyester	a.Mochila c. Chumbe

Table 3 a,b1,b2,c,d,e,f below shows the typologies of objects identified and relates the common and ritual uses assigned to them by the Nasa-Paez community.

Indigenous object	Traditional use
a. Mochila	It is an object with which the girls acquire identity as women by learning to weave it, measuring their capacity and knowledge. The first two knitted backpacks are kept according to tradition so that their energies and skills accompany them. Later, they learn to weave the ruana and the anaco.
b1. Cuetandera	Woven in synthetic fiber, it is a medium-sized backpack for daily use by the thë wala also called traditional doctor.
b2. Cuetandera	A small backpack specially woven in natural wool, it allows the thë wala to carry dry coca leaves to then mambear while performing rituals of refreshment, its use is occasional.
d.Jigra	Expandable body backpack is woven in fique and allows the transport to their homes of food grown in the Tul or those purchased in the marketplace.
c. Chumbe	A woven ribbon that allows newborns to be strapped to their mothers' backs, it is also part of the clothing and is sometimes knotted to the baton of the members of the cabildo.
e.Ruana	It is part of their daily attire, especially those made of natural dark brown sheep wool.
f.Capisayo	Garment in the form of a sackcloth or anaco used in special ceremonies.

The characterization process also included the identification of the methods of extraction, transformation and conservation of raw materials. It was identified that, traditionally, fibers of vegetable origin, such as fique, and of animal origin, such as sheep's wool, are used. However, in many cases these fibers are substituted by synthetic fibers since they do not require prior transformation and shorten the traditional manufacturing process.

The transformation of sheep's wool into yarn involves several steps: cutting the wool from an adult sheep, washing it, untangling it, cleaning it, and spinning it. If it is desired to modify its color, plants that provide the required shade are selected, and the fiber is cooked with the plants and then washed and dried. This whole process is guided by the lunar calendar.

Fique, a natural fiber of vegetable origin, also requires intense transformation processes before being woven. Its main advantage is that the region is one of the largest producers at the national level, which makes it easy to obtain. It is a resistant fiber that must be harvested in the shade. The process begins with the cutting of the maguey leaves, which are then manually scraped to extract the fiber. Subsequently, it is washed with water until a white color is obtained, and then it is dried in the shade. Finally, it is braided manually to achieve greater elasticity and obtain the thread. If it is desired to add color, the same steps of wool dyeing are followed, after the scraping phase.

Although fique and wool are materials that contribute to the natural sustainability of the territory, synthetic fiber is the second most used material for the manufacture of products. It is used to expand or complement the color ranges that natural materials do not offer and does not require physical effort for its extraction and transformation. However, the logistics for its delivery in medium and high mountain territories raise the acquisition costs. Table 4 shows the steps for the transformation of traditional fibers into yarn and the woven objects derived from each process.

Raw material	Transformation	Weaving technique	Woven object
Animal fiber a1) Hand-spun sheep's wool a2) Hand-spun sheep's wool, with dyeing process from traditional plants of the territory.	**1.** Cutting the sheep's wool **2.** Wash **3.** Untangle **4.** Clean **5.** Spinning Color modification: **6.** Select plants **7.** Cooking fiber and plants **8.** Wash **9.** Dry	Vertical loom: It is the technique of interweaving threads at right angles using a loom. This is composed of the warp (threads arranged lengthwise along the loom) and the weft (threads placed horizontally). weft (threads placed horizontally).	a. Mochila b. Cuetandera c. Chumbe e. Ruana f. Capisayo
Vegetal fiber. b) Fique (Cabuya), Without dyeing process.	**1.** Cutting of the maguey leaves **2.** Manual scraping of the fiber **3.** Wash **4.** Drying in the shade **5.** Manual braiding **6.** Spinning Color modification: **7.** Select plants **8.** Cooking fiber and plants **9.** Wash **10.** Dry	Crochet: It is a succession of loops of yarn, intertwined one inside the other, using a needle. Finger-knotting: A technique of interlacing or knotting yarns performed without the use of tools.	d. Jigras

3.2 Indigenous handicraft object

In the words of Ana Cielo Quiñones (2003), craftsmanship is conceived as:

"Those forms of production of material goods before the industrial revolution have existed and remain by a complex set of social, cultural, technological and economic realities different for each historical moment" (p.1).

This has led to changes in the dynamics of the territories, where artisanal production processes are tending towards the automation of manufacturing, increased energy consumption due to the replacement of low-impact tools and processes, and increased consumption of synthetic and non-renewable materials. This generates pressure on small and family organizations, which are the most predominant in the territories. These handicraft production systems are characterized by the fact that they respond to subsistence economies where families living in the peripheral areas of the municipalities are the ones who develop the traditional handicraft trade.

To understand the transition from the indigenous object of daily and non-ritual use to the artisanal object, we sought to identify and record the forms of representation of the signs and symbols woven into the backpacks, since this type of object presents the greatest variability in figures, sizes and materiality. This allows us to explore the relationship of these signs with the physical and cultural landscape of the territory.

To this end, meetings were held with long-lived artisans to inquire about the meanings of the various figures that have been woven for many years in their territory. This dynamic was repeated in each artisan workshop with the objective of consolidating a total of 170 records. Figure 7 shows the digitalization of 30 signs belonging to the SEK DXI artisan workshops in the municipality of Jambaló and WAKAT KIWE NASA in Toribio, and is complemented by Table 6, which describes and categorizes the meanings of each of the recorded signs.

Figure 5. Digitalization of signs.

Table 6. Categorization and symbolic description.

ORALITY AND KNOWLEDGE TRANSMISSION		
1.	THE CONVERSE	The orality is the main traditional tool. It is the way Indigenous can express themselves, their feelings and their thoughts.
2.	THE THOUGHT	The know-how exchange offers a learning experience when walking through orality labyrinths.
3.	STOVE	Place where everyone meets around the fire to share and exchange food; It is also the place where elders used to educate, discipline, solve, and transmit ancient norms and laws knowledge of the Misak authority to others.
4.	MORROCOY	Town´s mythology is contextualized in the territory reading and the relationship between oral tradition and cultural dynamics.
5.	PEOPLE	The tulle ritual, the Windom job, and the food awareness.
6.	THE MEETING	Caldono is the main fique producer in the Cauca region, this characteristic has allowed this natural fiber to become a meeting point.
7.	THE DRINK	Corn tradition, drink, and food are a fundamental part of people's lives as a collective town.
COSMOGONY AND SPIRITUALITY		
8.	COSMIC SPACE	This is the sun representation, the father "Tata Sek o Tay" who is the one in charge of giving life and protecting NASA people. It also symbolizes the solar calendar, "The Wala", the man, and the cosmic space, a place where spiritual beings live.
9.	ELF	Protective spirit of Tul, the territory spirituality is the reserve of the ancestral guidance of its seeds and knowledge.
10.	BEING NASA ORIGIN	According to the legend the star fell in love with the lagoon that quietly lived high in the mountains. It began to conquer it and over time they understood each other and there was a lot of harmony, so the star with one of its points penetrated the lagoon eye, giving rise to Nasa being.
11.	DOWNPOUR SPIRIT	This is the protector spirit that gives life and allows sharing with those who need it. It comes from the lower region, going straight towards the mountain with thunders by its side.
12.	SPIRIT OF PARAMO	It is the protection and balanced spirit. He gets angry and appears when strangers and invaders want to harm the territory or to counter the downpour spirit: he goes toward them in a horse form or as a spiral to deviate them from the path.
13.	OUR LANDS RECOVERY	The community's survival is sustained by its cosmogony strength and its windom abundance.
14.	OUR MEDICINE	The origin and essential purity return.
15.	MANTEY DXI PHANDENXI	This is the Path from good to bad. The belly patience, the seed path.

WEAVING AND CULTURAL REPRESENTATION	
16. OVERFLOW	The weaving process is a way of representing the territory and people's traditions, knowledge, and experiences, much of its iconography shows up while weaving.
17. MINGA	The weaving process is a way of representing the territory and people's traditions, knowledge, and experiences, much of its iconography shows up while weaving.
18. WEAVER HANDS	The ruana is more than an accessory, it is the protection expression and represents the weaving hand's strength
19. THE WEAVER	A complementary vision between children and weaver hands who give life to the territory.
20. NAMUY LUTE	The weaving knowledge is enclosed within the loom framework: tulle, house, knowledge transmission, and women's strength.
21. SEEDS	The contour of the tulle´s job shapes couples' unions and families' foundations.
22. TULLE	The three balance, seed, soil, and water.
GENDER ROLES AND LIFE CYCLE	
23. LIFE GIVER WOMAN	When a woman is germinating seeds, she must do the awakening seed ritual from the second month. The whole ritual comprises three rituals that must be completed at the ninth month, to obtain a good seed.
24. PEASANT	In the peasant culture, women play an important role, they are always taking care of the home and housework, and they also help their partner in the field's daily activities. Women are a silent actor in a macho environment, where some of them are single mothers.
25. WEAVER PATH	The Spiral represents the original people´s life cycle, the Tampalkuari is a reference of continuity and survival.
26. COFFEE GROWING	To facilitate coffee crops, the farmer seeds the plants in rows, leaving a space between row and row, this way the harvesters can move easily between the plants during the harvest process
27. COFFEE BEAN	Coffee crop is one of the main employment sources for mestizo-peasant families in northeastern Cauca, this activity involves men and women at all process stages to contribute to the family incomes.
MEDICINAL PLANTS AND NATURAL BALANCE	
28. MEDICAL SHEET	Marijuana is a medicinal plant that allows the body to relieve itself, it is a natural element.
29. OREJUELA	It works as an element to calm, appease, and balance negative or positive natural environment energies; the excessive use of this plant makes the person calm.
INSTRUMENTS AND COMMUNITY CELEBRATIONS	
30. DRUM	It is one of the must-have instruments in community celebrations such as mingas, weddings, house building, and harmonization rituals.

The above categories allow us to understand the interrelationships between the meanings of each sign around the transmission of knowledge, the indigenous cosmovision, weaving as a symbol of identity and territorial representation, the importance of the role of women, and the deep connection between people, nature and spirituality.

The systematization of the figures and their associations fed the conceptual phase of the design process, starting with the identification of the collective meaning generated by the associations and the representations of forms of their physical and natural environment. Subsequently, progress was made towards a detailed design phase, which made it possible to interrelate the data obtained in the characterization phase, such as geographic location, dialect, own and adopted craft techniques, typology of manufactured objects and traditional and substitute raw materials together with their various conceptual approaches.

The result of the detailed design phase is a digitized register of signs integrated to a measurement system adapted to the capabilities of the craftswomen, which allows a clear interpretation to control dimensionally and proportionally the handcrafted objects. To achieve this, proportion concepts were implemented, defining the points and turns necessary to reach the required dimensions.

This information is consolidated in a technical sheet that expands the chromatic offer of the handcrafted objects. This is because Indigenous objects, as they move towards the handicraft industry, determine their meaning, in many cases, based on the attribute of the material. As Baudrillard (1981) points out, “Color is loaded with psychological and moral allusions. ...tradition subjects color to meaning” (p.31). This strategy makes it possible to adjust the production process according to the chromatic variability of the raw material. Figure 6 shows the color variations on the data sheets and the results obtained.

Figure 6. Datasheet records with color variation.

4. Conclusions

The development of the "Integrated Program for Productive Trade Transfer and Business Management to Promote Access to Slow Fashion Markets" demonstrates a valuable integrative approach, combining the preservation of traditional knowledge with adaptation to global markets. The project not only facilitated the artisans' access to new economic opportunities but also catalyzed the strengthening of their cultural identity.

One of the relevant advances was the consolidation of a handicraft production system that respects and enhances the signs and symbols of the Nasa-Paez community. The digitalization of these symbols allowed not only their preservation but also their adaptation to new marketing contexts, ensuring that the identity and meaning of the objects woven by this group of artisans remain intact, even when they are integrated into broader markets. The systematization and digitization process highlights the importance of recognizing the symbolic value of the [*Indigenous handicraft object*] as an expression of the physical, social and spiritual environment of Indigenous communities.

A key aspect of the project was the implementation of a training, evaluation, and certification program in labor competencies for the artisans, to promote and recognize the learning and expertise acquired throughout the artisan lives of 200 women. However, this process went beyond technical training, as it addressed the structural barriers faced by indigenous women, such as low levels of schooling and linguistic limitations. To ensure effective and equitable participation, evaluation methodologies were adjusted, including translations into Nasa Yuwe, in an inclusive approach that achieved a transformative impact.

The project emphasizes that the strengthening of the artisanal production chain must be deeply connected to the territory and its resources, contributing to economic development from a perspective of environmental and cultural sustainability. For this reason, priority was given to the use of local raw materials, such as fique and sheep's wool, which reflect environmental diversity and their influence on ways of conceiving, appropriating, and relating to the territories. This not only reduces dependence on synthetic materials but also places local knowledge and natural cycles as essential components in handicraft production.

Finally, the project has contributed to greater visibility and recognition of the role of women artisans within the Indigenous community of Cauca, relying on collaborative structures that create support networks and ensure both the continuity of artisan practices in the long term and economic autonomy through the empowerment of women artisans. In this context, the handicraft object emerges as a vehicle for the transmission of knowledge and traditions

that reaffirm identity and strengthen the sense of belonging to the territory. The project has contributed to improving the living conditions of the indigenous women of Cauca and is presented as a model to be followed in future initiatives that seek to empower vulnerable communities without compromising their identity or their relationship with the environment.

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A MATERIALS DESIGN PRACTICE BETWEEN CRAFTS, CREATIVITY AND TECHNOLOGY

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ABSTRACT| Combining craft and design processes with technologies and digital tools creates a positive tension in which a hybrid approach emerges. This approach can be recognised by the fusion of analogue and digital perspectives. This combination has demonstrated great potential in design research with and for new materials. In the experimental process of materials design, where the final aim is to foster responsible design, this practice is becoming more popular. It is argued that combining material tinkering, crafts practices and digital tools can expand the possibilities of emerging materials design and future materials applications, fostering local materials' cultural and economic values. This argument is supported by the resulting pathways from an international collaborative workshop organised by the National Taiwan Craft and Development Institute (NTCRI). The results reveal the potential of this combined creative practice by using a local biobased material from fish scales and 3D printing as a manufacturing method. Two pathways' narratives describe how this hybrid practice can be unfolded, highlighting the use of local materials and a collaborative, explorative approach. To conclude, recommendations for this hybrid and collaborative practice of materials design are elaborated based on the reflections of the workshop.

KEYWORDS | HYBRID PRACTICE, MATERIALS DESIGN, 3D PRINTING, COLLABORATION, BIOBASED MATERIALS

1. Introduction

Integrating digital tools into crafts and design has significantly influenced contemporary design practices (Marion & Fixson, 2021). This fusion of analogue and digital methods has gained attention across various design disciplines. In the territory of materials design, an emerging field within industrial and product design (Pedgley et al., 2021; Rognoli & Levi, 2005), this hybrid approach has been essential in generating novel material concepts, applications, and experiences (Nimkulrat, 2021). The potential for materials design to expand creative horizons and explore the development of materials and products through practices such as Material Tinkering (Parisi et al., 2017) and the incorporation of digital tools (Rognoli & Ayala-Garcia, 2021) has also been theoretical and practical studied.

Explorations in materials design, for example, using bioplastics algae-based and 3D printing for creating objects by Atelier LUMA, Studio Klarenbeek & Dros[1], have highlighted the promise of combining crafts and design practices that involve working with emerging DIY-Materials (Rognoli et al., 2015) and digital fabrication. This combination accelerates the development of material prototypes and final artefacts, highlighting the potential of self-making tinkering with materials and digital tools while fostering materials' embodied knowledge (Groth, 2016). In addition, incorporating digital fabrication is a great advantage because of its accessibility and speed, in contrast to traditional manufacturing processes, making it a valuable tool for experimentation and improvement (Romani et al., 2021). In this scenario, hands-on and digital practices complement each other, and designers, craftspeople or makers can actively participate in the process while modifying analogue or digital elements and tinkering with them. Within this dynamic, combining the self-manufacturing of materials and integrating digital tools and technologies, such as 3D printing, becomes an exciting practice for these practitioners.

Due to its experimental nature, this hybrid practice allows considering alternative and

1 For more information visit: www.designtransfer.udk-berlin.de/en/projekt/english-studio-klarenbeek-dros/

local resources as raw materials, creating new aesthetics and designed languages. In addition, it enables the exploration of production processes different from the industrial ones to favour ondemand local production, fostering local economies and aiming at environmentally sustainable manufacturing, seeking to reduce the use of materials and energy resources (Romani et al., 2023b).

Through this hybrid practice that includes materials tinkering, crafting and digital tools, the emerging materials design and its future applications can be leveraged, and local materials, cultural and economic values can be fostered. This argument, as well as a further investigation of this approach, is hereinafter supported by analysing two pathways from an international workshop involving designers and researchers with rich backgrounds in materials, craft, design, and digital manufacturing. This workshop brought together international participants to explore a biobased material from discarded fish-scales developed by the National Taiwan Craft and Development Institute (NTCRI) and its potential applications through 3D printing. Its objectives included exploring the material possibilities and collaborating for speculative materials and product design applications suitable for the local market. The workshop also intended to bring physical outcomes to present an enhanced and meaningful materials experience, demonstrating a commitment to drive production towards new perspectives of local circularity and sustainability. Participants' and organisers' insights from the workshop were collected and transformed into narratives for qualitative analysis.

This paper aims to emphasise the possibilities of this hybrid analogue-digital practice for materials design and reflect on how it can foster local materials' cultural and economic values. It explores how tinkering and DIY-Materials empower this process and how designers and researchers can foster collaborative, interdisciplinary environments to work creatively with locally available resources. The structure of this paper is as follows. Section 2 provides the background of this work. Section 3 is the methodology. Section 4 delves into the workshop journey. Section 5 discusses the two pathways. Section 6 resumes the final considerations and recommendations, and section 7 presents the conclusions.

2. Perimeter and related background

2.1 Crafts, Design and Digital tools

Crafts and design have always been related and are complementary domains (Bettiol & Micelli, 2014). Nimkulrat (2012) states that thinking and knowledge are inseparable from making in crafts and design practices. These practices are deeply intertwined, although they are recognised for their differences in approaches and outcomes (Rissati, 2009).

According to some scholars (Nitsche & Zheng, 2018; Temeltas, 2017; Tung & Chen, 2013), there are general differences between crafts and design and the practitioners who carry out these activities. Principally, differences are in methods and actions and the production size and scalability of the artefacts they produce. Often, craftspeople are seen as specialists in particular materials, carrying experiential processes for creation and fostering skills that result in cultural products. Their production process is self-contained, from concept to creation, frequently blending traditional techniques with modern methods. In contrast, designers usually receive diverse, interdisciplinary training, using various materials to address multifaceted design challenges. They employ a division of tasks, professionalised procedures, machines, and automation for efficient and scalable production, usually favouring standardisation to meet broad public demand.

Crafts and design practices have often been differentiated because the latter incorporates new tools and techniques provided by technological advances, and the former is related to ancient procedures and methods passed down from generation to generation (Lin & Lin, 2022). However, thanks to the maker movement, craftspeople now have enhanced access to technologies that enable them to design objects digitally and produce them using computerised tools (Nimkulrat et al., 2019).

This evolution positions craftspeople to adeptly embrace new technologies and explore digital realms. As Nitsche et al. (2014) predicted a decade ago, traditional crafts skills are increasingly merging with digital capabilities. These integrations open new opportunities for traditional and digital approaches (Nimkulrat et al., 2019; Zoran, 2013; Zoran et al., 2015).

Concurrently, the design field has changed, merging with crafts and with the advances of the DIY movement (Kuznetsov & Paulos, 2010). A brunch of design adopted approaches related to small productions, merging with self-fabrication and encouraging crafting and making with digital fabrication technologies. This shift underscores a resurgence in crafts and design, where selfproduction and digital technologies converge (Rognoli et al., 2015).

The integration of crafts and design with analogue-digital methods is increasingly gaining popularity. This process is characterised by creating objects with the support of a computer and digital fabrication machines (Zoran & Buechley, 2013). Integrating these elements changes the conception and experience of the materials, the final artefacts, and the design process. The convergence of these approaches -crafts, design, and digital- is forging new creative frontiers, material exploration, and applications that have yet to be discovered.

The perimeter of this study emphasises the use of designed and crafted biobased materials from fish scales and 3D printing (as part of digital fabrication methods) for the development of speculative artefacts.

2.2 DIY-Materials and Tinkering in Materials Design

Materials Design has been recognised as a field and practice within industrial and product design for almost two decades (Rognoli & Levi, 2005). The field has evolved, and much of the progress has been driven by rudimentary experimentation inspired by arts and crafts techniques, such as the process of 'making' and the increasing interdisciplinary collaboration (Duarte Poblete et al., 2023). Hands-on approaches and studies about materials, expressions and experiences expanded this field (Ayala Garcia, 2019). Furthermore, the DIY movement encouraged designers interested in the material side of design, which drove the increasing phenomenon of DIY-Materials (Rognoli & Ayala-Garcia, 2021), updating the vision of materials design practices and practitioners, i.e., materials designers.

By exploring the convergence of crafts, design and digital, enabling a hybrid practice within materials design, DIY-Materials can be connected as facilitators of the creative process of materials and product design. This approach is based on the contemporary materials design practice based on experimentation and materials experience (Giaccardi & Karana, 2015; Karana et al., 2015; Rognoli et al., 2015).

The DIY-Materials approach (Rognoli et al. 2015) can be summarised as a procedure that involves the creation of materials and artefacts, starting from personal or collaborative self-production, frequently applying methods of crafting and experimentation by the designer or makers. This process includes making materials using non-conventional ingredients as building blocks or enhancing pre-existing materials through modifications. These methods are closely related to material tinkering (Parisi et al., 2017). Materials tinkering is conceived as an experimental, iterative, and systematic stage in which creative manipulation and fine-tuning are used to discover material qualities and forms. It is based on learning-by-doing and trial-and-error to create samples and demonstrators. Materials demonstrators (Rognoli & Parisi, 2021) represent advanced prototypes exploring the formal potential and feasibility of future processes, shapes, and techniques (Béland & Granberg, 2023; Rognoli & Ayala-Garcia, 2021).

DIY-Materials and tinkering are recognised practices in the materials design process. These approaches can leverage emerging materials creation and their applications. In addition, these approaches are becoming particularly interesting for integrating Traditional Craft Knowledge (TCK)[2] into product design and vice versa.

The intersection of physical and digital experimentation, focusing on materials, crafts, and design, has been theoretically and practically explored. This intersection is

2 European projects which focus on the potential of traditional craft knowledge (TCK) are exploring DIY-Materials to achieve an enhanced economic and societal valuation of crafts and design in line with a future-oriented approach of heritage in Europe. For more information visit https://tracks4crafts.eu

evident in numerous instances displayed in museums, exhibitions, and online, showcasing their vast potential. One notable example is the GCODE. Clay[3] series, where 3D-printed artefacts are made using traditional crafts and modern techniques. This series includes various formulations, such as recycled clays, and employs 3D printing in a novel way to produce controlled errors that lead to new expressions and applications. Another illustrative example can be seen in Figure 1, where the exploration of crafting DIY-Materials and products through 3D printing exploits waste by converting it into a material filament for 3D printing artefacts.

In both cases, tinkering works at a hybrid level, which means experimentally adjusting both the physical materials and the digital settings of technological tools to enhance materials and product design and their functionalities, aesthetics, and experiences.

Significant advances have been made in the integration of digital tools with craft practices and emerging materials design and its applications (Kretzer, 2021; Moyer et al., 2024; Romani et al., 2021; Sauerwein et al., 2020; Veen et al., 2019; Yogiaman et al., 2020). This study recognises such integrations and explores them through a different lens, an international workshop. Moreover, this work explores how this hybrid practice can be further enhanced, e.g., using local materials, discussing the cultural and economic values of the region, and fostering interdisciplinary collaboration across borders.

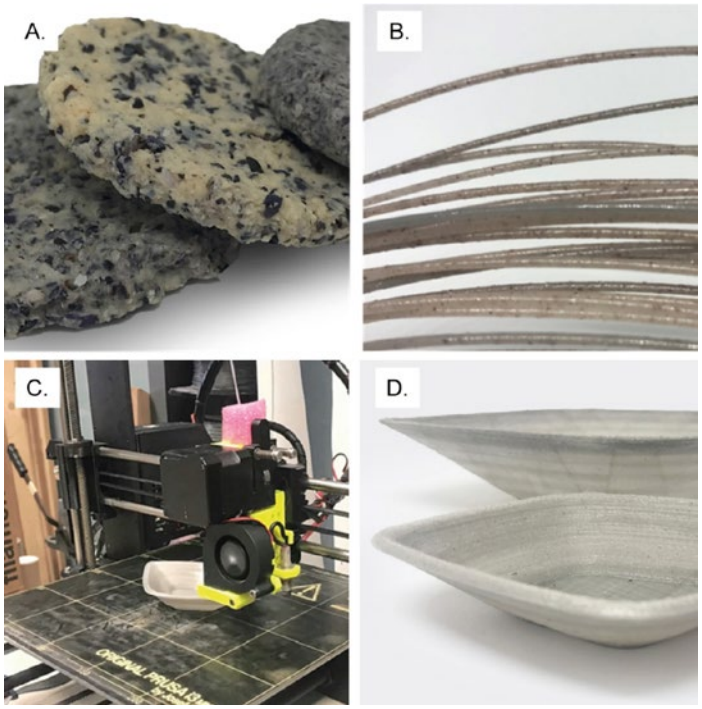

Figure 1 - Crafting local DIY-Materials and products based on mussel shells and a 3D printer. (a) crafted material by hand. (b)filament; (c) 3Dprinting process; (d) prototype. Credits: Chiara Stopponi (2018).

3 https://emergingobjects.com/project/gcode-clay

3. Methodological approach

To grasp the possibilities of hybrid analogue-digital practices in materials design, e.g., materials tinkering, crafting, and digital tools, and reflect on how these practices can foster local materials, cultural, and economic values, two pathways of design processes resulting from a materials design workshop are explored. The workshop functioned as a development platform where participants created new material applications and design processes, emphasising material design's practical and experiential aspects. At the same time, it served as a structured research approach to gather data and knowledge on hybrid analogue-digital practices (Ørngreen & Levinsen, 2017).

The workshop used hands-on experimentation as a research activity to delve into practical challenges and generate new theoretical insights (Reich, 2017; Schön, 2017). The workshop's agenda was defined to explore the potential of the materials design practice, venturing into speculative tinkering (Romani et al., 2023a) and maximising the value of fish-scale materials through the hybrid approach to advance these materials closer to market readiness.

A Material-driven Design (MDD) method was implemented to guide the participants. This method prioritises designing for Materials Experience (Giaccardi & Karana, 2015) and working with tinkering and DIY-Materials. This approach fosters the development of materials and their applications by treating the material itself as the starting point for exploration (Karana et al., 2015). Pragmatic exploration and direct engagement with materials were instrumental in transforming conceptual ideas into tangible outcomes (van Bezooyen, 2014).

To study this hybrid practice, the investigation is grounded in the principles of autoethnography. This qualitative research and analytical method integrate personal experience and self-reflection into both the research process and the analysis, providing deep insights into design inquiry (Forlano, 2021; Tomico et al., 2012). Autoethnography enables researchers to develop a personal and emotional connection to their research, which is crucial when engaging with materiality in design (Bochner, 2017). Such connections are essential for understanding the features, meanings, and experiences associated with materials (Rognoli, 2010). Among the authors of this paper, two attended as participants and two as organisers in the workshop, ensuring a diverse range of insights into both the design process and the workshop's creation.

4. "Re:Fish" workshop

The "RE:Fish" workshop belongs to the third phase of the "Fish Scale Project". It was launched in 2019 by NTCRI. This project aims to promote the development of contemporary crafts in Taiwan, with several instances of craft-based design interventions. In previous workshops, NTCRI collaborated with the

Materials Experience Lab to give fish scales waste a new appearance through art, crafts, and design. In the second phase, launched in 2021, NTCRI focused on transforming fish scales into a material that could be used in 3D printing, further studying such material, and developing equipment modifications to process it, such as custom extruders.

The third workshop was performed in 2023 through a collaborative development approach as a new phase of the Fish-Scale Project. It was designed to refine the material and propose product concepts for the local market. This paper focuses only on the third workshop and its outcomes.

4.1 Aims and objectives

Biobased materials, DIY-Materials, and other emerging materials derived from fish scales have been studied (Pasanaphong et al., 2024; Qin et al., 2022; Wu et al., 2021). However, the Re:Fish workshop had a specific focus. Its goal was not only to develop a new material or discover new applications for discarded fish scraps. Instead, the aim was to emphasise the possibilities of a hybrid analogue-digital practice for crafting materials and products and reflect on how it can foster local materials' cultural and economic values using a collaborative approach. Therefore, the workshop was necessary to examine the systemic aspect of the material and its stakeholders, as well as the significance of potential applications.

The workshop was structured as a "Research through Materials Design" (RtMD) initiative to improve the application of the already developed fish scale material, which could serve as an organic and locally sourced alternative to fossil-based resources. 3D printing technologies, crafts and design were leveraged. This workshop facilitated knowledge sharing among students and researchers from diverse geographic and academic backgrounds. Participants were encouraged to rethink the use of materials, promoting the transformation of waste into valuable creative resources and moving towards tangible applications. By considering the entire life cycle of the material, from collection to End-of-Life, this approach also aims to consider environmental sustainability. By raising awareness among local industries and potential stakeholders in developing this material and its applications, the workshop encouraged participants to think about design for economic and social sustainability and circularity.

4.2 Participants and teams

Thirteen were the participants of the workshop, creating a diverse group of students and researchers with expertise in crafts, design, materials, and digital fabrication. The selection was based existing collaborations with participants' home institutions, ensuring a rich but small mix of perspectives from Europe, Japan, and Taiwan to enhance cooperation and creativity. Participants were divided into three

interdisciplinary but heterogeneous teams—two consisting of four members each and one comprising five members—to maintain a focused and productive environment.

4.3 Support and Operations

Two organisers and five additional staff members from the organising institution supported the workshop. Operating in rotational teams, three staff members were present each day to assist with preparing materials, setting up machines, and purchasing necessary resources. This structured approach ensured continuous technical support and facilitated the participants' creative processes throughout the workshop.

The final, comprehensive analysis of the data, combined with the overall fish-scale project conducted by the organisers, falls outside the scope of this paper.

4.4 The format and agenda

Hosted by NTCRI, the workshop combined collaboration, fieldstrips, materials tinkering, crafting, and digital tools to explore meaningful materials design and applications, aligning with the spirit of the previous workshops and deepening interdisciplinary relationships. As shown in Figure 2, the workshop was structured into two basic phases with different activities, each designed to progressively build on the knowledge and skills from the previous steps. Each day of the workshop was programmed to last eight hours.

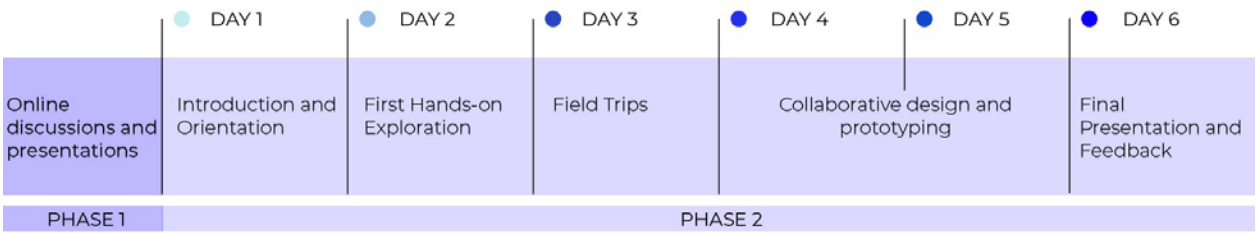

Figure 2 - Workshop timeline.

Phase 1. Preliminary phase

- Online meetings

The journey began with two preliminary online meetings of around one hour for presentation and short discussions with the organisers to provide participants with general information for the workshop. This stage set the foundation for the collaborative work that followed.

Phase 2. Physical workshop

- Introduction and orientation

On the first day, the workshop officially opened with a comprehensive introduction to the aims and objectives of the project. Participants shared their diverse academic and professional backgrounds, and the research centre's facilities were showcased. Working groups were mixed, combining expertise in crafts, design, and digital tools. This day was concluded with cultural exchanges, emphasising the importance of diverse perspectives and positionality in the research process (De Coen et al., 2023).

- First hands-on exploration

The second day marked the beginning of practical projects. Lab assistants introduced the formulas for DIY-Materials and provided training on the 3D printing tools. The developed paste biobased materials and custom-modified 3D printer tools were then showcased. Participants engaged in various activities: preparing and tinkering with materials, exploring digital software, and preparing gcodes for testing. The day was dedicated to brainstorming and integrating these newly acquired concepts.

- Field trips

On the third day, activities expanded beyond the lab setting. Participants visited a 3D printing machinery company to explore various additive manufacturing techniques and speculate on potential collaborations. Later, a visit to a fishpond of Tainan, a fish farm, provided insights into the local ecology and the processes of fish-scale removal. During this visit, discussions about logistics, such as the distance and stakeholders involved in raw material collection and transportation, helped participants understand the local production processes. These insights were crucial for conceptualising business strategies and connections for a circular material business, linking local ecological and production contexts.

To conclude, participants visited a local museum dedicated to the milkfish, the source of the scales used for material development. Museum staff provided insights into the current uses of this biobased by-product, including its applications, typically in cosmetics. This visit highlighted the historical significance of the milkfish in Taiwanese culture and drove group discussions on potential market niches where these materials could make a significant impact. Other traditional crafts from the region were showcased. The exploration enhanced participants' understanding of local biological resource use's cultural and commercial dimensions, thus increasing appreciation of the materials in the area.

- Collaborative design and prototyping

Days four and five were dedicated to intensive group work, where participants leveraged both digital tools and traditional crafting methods to foster a

collaborative and speculative approach to material and product design. During this phase, participants worked together to conceptualise, craft, design, and 3D print materials and artefacts. The facility provided two custom-modified 3D printers and a robotic arm for 3D printing paste-based materials for testing and prototyping. Participants also accessed conventional tools and spaces from the research centre's woodworking, rocks and ceramics labs.

These resources were used in various combinations to explore materials and technique integrations. Over these two days, groups were free to organise their tasks and collaboratively develop their chosen concepts, speculating on potential scenarios. By the end of the second day, the results demonstrated a blended approach to the projects, reflecting the diverse methodologies and creative insights contributed by each group.

- Final Presentation and feedback.

The workshop culminated on the sixth day with a presentation to an open audience, including university members and the community. This session served as a knowledge-sharing platform, showcasing the groups' projects, discussing the possibilities of this hybrid practice for crafting materials and products, and reflecting on how it can foster local materials' cultural and economic values.

5. Resulting pathways discussion and findings

The workshop's open and flexible approach to materials exploration empowered participants to explore multiple directions. This freedom led to the development of two distinct pathways, each guided by a hybrid practice of materials design that integrates material tinkering, crafts, and digital tools. These pathways demonstrate how expanding the possibilities of emerging materials design and future applications is possible. The pathways also emphasised how participants considered the role of local materials in adding cultural and economic value.

It is important to note that while the workshop explored three distinct pathways, this paper focuses primarily on two. The third pathway, though valuable, is not covered in this analysis because of limited data availability and overlapping with the two main pathways detected from this study.

5.1 Pathway 1: Materials-driven and analogue-focused

This pathway demonstrates the integration of material-driven and analogue techniques, enriched by the capabilities of digital tools to give textures and final shapes. The process commenced with participants examining base materials' properties, qualities, and composition. They focused mainly on enhancing their expressive-sensorial dimensions,

exploring colour and surface characteristics not investigated in previous workshops.

Participants started by assessing and experimenting with the elemental compositions, ingredients, and combinations proposed by the workshop organisers. After understanding the base material, they modified its qualities for new expressions and experiences. They selected additional natural and discarded scraps, such as bamboo and oyster shells, to grind and use as fillers. A typical tinkeringbased experimentation process involves various combinations to alter the base formula and the perception of the final materials.

Different locally sourced waste was searched for developing new compositions. Using the research centre's woodworking and ceramics labs, the participants found additional secondary raw materials and transformed them into powder. These powders were mixed, and quantities were changed with the base materials. Each new mixture underwent testing with 3D printing processes to ensure its processability while modifying aesthetic properties. This iterative process involved material and digital tool tinkering to ensure the printability of the materials and textures. The need for dynamic digital tinkering became apparent as new material compositions emerged. This involved continuous adjustments of 3D printing settings to accommodate the unique characteristics of each bio-composite formulation. Parameters such as extrusion speed and layer height were tuned with iterative loops of 3D printed small test pieces to observe the effects of different settings on material behaviour and 3D printing quality.

The participants followed some characterisation to understand the materials' features and experiences better. After creating a materials and texture palette, they prototyped preliminary artefacts to understand the application possibilities. For instance, adding shell scraps yielded a shiny, translucent material ideal for light-related applications. Another example involved the addition of wood scraps, which absorbed water during mixing and evaporated upon drying, altering the final shape of the 3D printed objects.

As participants explored the use of culturally significant local materials such as bamboo and shells, they recognised the potential of these well-known natural materials to create culturally relevant and economically valuable products with storytelling. They hypothesised the development of a circular materials business involving waste collectors, powder suppliers, material manufacturers, and crafts designers. The proposed materials design considered biodegradability due to the natural composition aiming for environmentally sustainable product disposal. The participants envisioned lamps and souvenirs for the local market. They were inspired during the field trip to the museum, where they understood the visitors' typical purchase of local products. This insight led to souvenirs showcasing local materials and cultural elements, presenting

a new opportunity for the local community. This approach highlighted the discussions on the cultural and economic benefits of using locally sourced materials, also fostering integration between traditional local products and digital technology. Images about the process and results of this group can be seen in Figure 3.

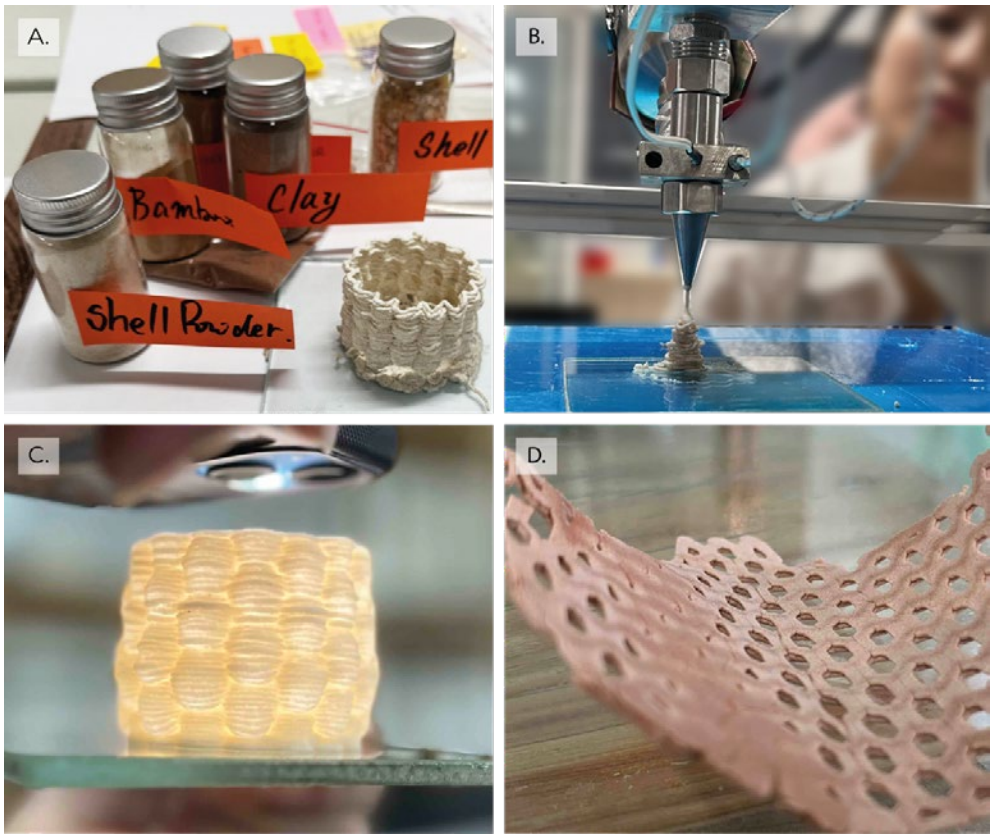

Figure 3 - Pathway 1 process and results: (a) Collection of additional ingredients; (b) Dynamic digital tinkering, observation and noted for replication; (c) new expressions and suggestions from the materials; (d) conceptualising with the material behaviour.

5.2 Pathway 2: Technology-driven and digital-focused

The second direction shows using digital tools and technologies as the main experimentation engine. It demonstrates how expanding the possibilities of emerging materials design and its future applications is possible. In other words, digital fabrication tools mediate the manipulation activity embedded in the tinkering approach for and with materials.

Participants in this group aimed to explore the possibilities enabled by 3D printing, shifting the focus to manufacturing technology. This fact meant that the tinkering activities focused on the technology's use rather than on the variation of the material formulations, investigating the changes in the expressive-sensorial qualities by modifying the 3D printing process parameters.

The participants' journey examined the impact of technologies on the development of emerging materials and their properties. This analysis also considered the interplay between crafts techniques, analogue and digital realms, and the dynamic interaction between technology and creativity. Experimenting with digital tools and technologies facilitated reflection on possible contaminations of local traditional crafts, exploiting new ways of valorising their cultural meanings.

The group started with a tinkering activity of experimentation within the digital domain, creating a set of 3D patterns and shapes to explore the potential exploitation of the main workshop's emerging material (Figure 4a). They then reflected on the possible integration of a bamboo-based structure in the 3D patterns, trying to combine the technical properties and the sensory qualities of the two materials. This choice implied complementary experimentation with bamboo and possible digital tools to process it, such as laser cutting, leading to different formal explorations (Figure 4b).

Considering the consolidated traditional crafts connected to bamboo, e.g., basketry from the milkfish museum, further investigation was performed on conventional crafts and this method of waving.
Some participants in the group had previous experience in making basketry, facilitating the integration of these traditional practices with modern techniques. This fusion combines weaving processes with contemporary materials and reinterpreting conventional materials, introducing bamboo into modern crafts. By experimenting with a first-person approach with bamboo bending techniques (Figure 4c), they embed this material in the 3D patterns.

The tinkering activities finally resulted in a set of 3D patterns with knitted-like bent bamboo, obtaining new potential expressive-sensorial qualities from the combination of materials and techniques (Figure 4d). The selected approaches unlock possibilities for valuing the digital-analogue context, creating innovative ways to combine crafts and design.

Figure 4 resumes this second pathway by showcasing the creation of "Trellis," a conceptual craft element designed for customised gardening structures. The Trellis concept is inspired by conventional structures made from intersecting pieces of wood or bamboo. In this case, Trellis was crafted as a lattice structure using the material from fish scale through 3D printing, in which bamboo was then interwoven to create gardening decorative objects. This group explored the potential of combining such emerging materials with locally valued materials like bamboo, which hold significant cultural and economic value within the community. By employing digitally driven structures for their integration, they envisioned innovative structures and combinations that could offer new material experiences on decorative applications.
They hypothesised that communities of

craftspeople and makers could collaborate to develop craft products and enhance their skills to be competitive in the contemporary world, keeping the value of traditional crafts and enhancing them through digital domains.

Figure 4 Pathway 2 process and results: (a) exploration of the material possibilities through 3D printing; (b) experimentation with additional elements and digital tools during the tinkering activity; (c) combination of crafts, digital techniques, emerging and traditional materials, during the hands-on activities; (d) one result of the tinkering activity: Trellis (Product for Nature), a conceptual craft element for customised gardening structures.

6. Considerations

The two pathways resulting from the workshops demonstrate that the integration of practical tinkering approaches with materials, crafts, DIY-Materials and digital tools - such as 3D printing and laser cutting – broaden the possibilities in designing emerging materials and their future applications.

This approach encouraged reflections on the use of local materials and the valorisation of cultural and economic values, as well as encouraging discussion on environmental sustainability. Combining these emerging materials and concepts with meaningful materials from the local culture was also promoted through the pathways. They also recognised the role of craft techniques, seeking to activate the local economy by creating new products.

However, it is important to recognise that the promising and speculative results of this hybrid approach are not only due to the analogue-digital practice of materials design but also to the interdisciplinary collaboration between participants from different regions and the whole nature of the workshop. Collaborative dialogue between practitioners from various disciplines is essential for developing materials, products, and processes. In addition, immersion in the region where these materials and techniques were developed, complemented by participation in local cultural activities, allowed participants to learn from laboratory work and deepen their understanding through field experiences and everyday activities, such as gastronomic rituals and temple visits. This interaction with the local environment enriched the cultural dimensions of the materials.

Based on the outcomes of the workshop, recommendations have been formulated to implement this hybrid materials design practice:

- Comprehensive and graphic documentation. Thorough documentation is essential to capture the knowledge generated during all project phases. This documentation includes recording spontaneous conversations, experimentations, and all trial-and-error processes, which offer a rich source of learning. Complete documentation ensures that projects can be analysed, understood, and replicated by others in the future.
- Process reproducibility. Detailing the steps involved in material development and digital exploration is crucial. Documenting material compositions, fabrication steps, and
- methodologies allows others to replicate and validate findings, which is essential for materials design practice's evolution and scientific credibility.
- Expand knowledge. Developing skills in traditional techniques and new technologies enhances designers' ability to adapt to different production contexts and learn from other participants, e.g., through informal discussion with locals or though collaborative work. Expanding these approaches helps maintain relevance in an ever-changing field and promotes a more versatile and creative design practice.
- Encouraging collaboration. Interdisciplinary collaboration and diverse perspectives enrich the design process. Encouraging cooperation among artisans, designers, scientists, and other experts from different regions can lead to unexpected innovations and more culturally adapted paths.
- Local understanding. Deepening knowledge of local practices, materials, and meanings ensures that products are culturally pertinent and enhances the responsible use of local resources. Understanding the regional actors in the manufacturing process and how materials are managed can lead to more environmentally, socially, and economically concious practices.

- Valuing local resources. Recognising the abundance of local raw materials and using them responsibly can lead to lower the environmental impacts of materials and products. This approach aims to preserve natural resources and strengthens local economies by promoting industries based on locally available resources.
- Research collaborations. Establishing partnerships with research centres interested in promoting local culture and economy can amplify the impact and development of materials design. These collaborations can provide access to resources and foster to real development of new products.

7. Conclusion

The aim of this paper is to investigate the possibilities of the hybrid analogue-digital practice for materials design that lies between crafting, creativity and technology and reflect on how it can foster local materials' cultural and economic values. It explores how tinkering and DIY-Materials empower this process and how designers and researchers can foster collaborative, interdisciplinary environments to creatively work with locally available resources.

The results of the collaborative workshop organised by NTCRI in Taiwan exemplified the potential of this hybrid approach, highlighted their value, encouraged reflection on local culture, as well as on sustainability initiatives, and possible avenues for material design.

It underlined the importance of using local and abundant raw materials, ingredients, or other elements, employing traditional techniques and aesthetics specific to a region, and the relevance of creating material experiences and expressions in final applications to enhance product design.

This combined practice demonstrates significance in speculating about possible futures of production. Furthermore, interdisciplinary and cross-boundary collaboration proves to be efficient in this context. This research is significant for the fields of design and crafts and generates valuable reflections to advance on the intersection of materials design and emerging technologies.

To address the limits of this research, such as further composite material testing with digital technologies, future research should broaden the scope through different workshops and involve more participants. Furthermore, it is advisable to explore how these methods could be applied to other cultural contexts, as well as different types of materials and technologies.

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HIGHER-ORDER FACTORS OF CREATIVITY: AN ANALYSIS OF AN ATTRIBUTES DATABASE

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ABSTRACT | Alluding Guilford's work in the finding of the intellectual abilities subsisting in his Structure-of-Intellect Model, this study intended to derive the main components of creativity by factor analyzing a set of attributes that synthesize the abilities (traits and characteristics) of creativity established by Guilford and other authors since 1950 up to date. The study sample (N = 501) comprises professionals from creative disciplines living in Mexico who assessed a database of 38 variables. The hypothesis is that emerging factors will help to illustrate a correlation between the abilities of the creative person and the essential steps of the creative process. Results rendered four higher-order factors of creativity: the affective, cognitive, volitive, and empathic aspects that accompany the person during the creative process. The current stage of research focuses on the design of tools to enhance student's creativity through the practical implementation of the obtained results.

KEYWORDS | CREATIVITY; FACTORS; ATTRIBUTES; GUILFORD; PRINCIPAL COMPONENT ANALYSIS

Introduction

J. Paul Guilford's research significantly advanced the understanding of creativity through factor analysis of intelligence. "Guilford (1950) himself did a great deal for this field. He argued cogently that we should study creativity . . . and gave us techniques that could be used to do so" (Runco, 2000-2001, p. 245). His work, of taxonomic nature, started with the search of empirical behavioral regularities that could be hypothesized as abilities to finally constitute essential components with the use of statistical methods.

> The only hope of human understanding of natural phenomena is the fact that there are regularities in nature. Such regularities are what we are seeking within the sphere of our investigations. They offer the possibilities of principles and scientific laws. Principles and laws provide a shorthand type of apprehending information, enlarging the scope of our understanding and our powers to operate with phenomena. (Guilford, 1967, p. 47).

By the mid-20th century, psychometric studies on human intelligence had not yielded universally applicable concepts. Jean Piaget, influenced by his background in biology, argued that understanding intelligence involves examining how individuals acquire and utilize knowledge. He identified three intellectual functions: content (observable behavior), function (principles of intellectual activity), and structure (acquired knowledge) (Guilford, 1967).

1.1 The Structure-of-Intellect Model

In 1955, Guilford began correlating validated intellectual abilities from the Aptitudes Research Project, culminating in the Structure-of-Intellect (SI) model, which delineates 43 distinct abilities (Guilford, 1966).

> A three-dimensional information-processing theory of intelligence conceptualized by Guilford in which any one of five types of psychological operations process any one of four kinds of content, or given information, to generate any one of six forms of products, or new information (Michael, 1999, p. 785).

The SI model categorizes permutations across three axes: operations, content, and products, resulting in 120 independent cubes indexed by a trigram of three code letters (Guilford & Hoepfner, 1971). The dimensions are as follows:

- Contents or the types of information that the person discriminates: F - figural, S - symbolic, M - semantic, and B - behavioral.
- Operations or the intellectual activities required to process the information contained in a stimulus: C - cognition, M - memory, D - divergent production, N -convergent production, and E - evaluation.
- Products or the form that the information processed by the person can assume: U - units, C - classes, R - relations, S - systems, T - transformations, and I - implications.

For detailed descriptions of these dimensions, refer to original sources (Guilford, 1967, pp. 4668; Guilford & Hoepfner, 1971, pp. 17-32).

1.2 The Structure of the Intellect Problem-Solving Model

In 1960, Guilford conceptualized creative thinking as a problem-solving mechanism, leading to the Structure-of-Intellect Problem-Solving (SIPS) model in 1965. This model was partly a response to the linear problem-solving process established by Dewey (1910), which includes identifying difficulties, proposing solutions, and evaluating outcomes. The SIPS model emphasizes input as the starting point, with a filtering stage determining the input's relevance. Memory and evaluation are integral to this self-regulating process, which continues until a solution is found (Guilford 1967, pp. 312-345).

Favoring the notion "that creativity, whatever its range of application, is by no means a unity but is rather a collection of different component abilities or other traits" (Guilford, 1957, p. 110), Guilford identified eight key characteristics of creativity: sensitivity to problems, fluency, flexibility, originality, analysis, synthesis, redefinition, elaboration, and evaluation (Guilford, 1968). This differentiation allows for a multivariate approach to creativity, enabling the description of individuals through profiles rather than single scores.

This path represents an essential condition for the enhancement of abilities in a personalized fashion, Lubart (1999) suggested that "The identification of potentially creative people involves a comparison between an individual's profile over the set of components for creativity and the profile of components needed for creativity in a particular task" (p. 299). In this regard, the finding of abilities with discriminative meaning and explanatory effectiveness has represented a widespread exercise on creativity research. On literature it is common to find lists of creative abilities; however, they remain isolated, without being altogether contemplated for the setup of correlations in the form of what Guilford would call high-order factors.

1.3 The analysis of the attributes of creativity

This research utilizes factor analysis to identify higher-order factors among Guilford's and subsequent authors' lists of creative attributes. According to Guilford "A good factor analysis does give attention to two important sources of determination of results: the selection of the sample of individuals and the selection of the experimental variables" (Guilford, 1967, p. 42). The current study examines 38 creativity attributes (experimental variables) derived from a qualitative categorization of 509 creative abilities identified by 96 authors, presented in Flores, Esnal, Hernandis, & Agudo (2020).

The study sample includes professionals from various creative fields who validated the attributes. The hypothesis posits that most variables will achieve empirical validation and cluster into three primary components of creativity. This is supported by Lamberth's (1982) framework for measuring attitudes, which encompasses affective, cognitive, and behavioral components.

These components align with Rodriguez-Estrada's (1985) characteristics of the creative personality: cognition (fineness of perception, intuitive ability, imagination, critical capacity, intellectual curiosity), affect (self-esteem, freedom, passion, audacity, depth) and volition (tenacity, tolerance to frustration, ability to decide); and Urban's (1991) interaction model of creativity : cognition (divergent thinking, general and specific knowledge), personality (commitment to the task, motivation, tolerance for ambiguity), and performance (dimension of the individual, local or historical-social). This set of characteristics can also be found in Plucker and Runco (1999) components for the enhancement of creativity: cognitive (intellectual aspects), affective (emotions of the person), and attitudinal (recognition of one's own capacity to create).

2. Method

This study employs a quantitative correlational approach, utilizing a survey to assess the significance of the 38 attributes of creativity on a scale from 1 (not significant) to 10 (very significant). The sample consists of architects, artists, and designers in Mexico.

Since the exact number of professionals in these disciplines in Mexico is unknown, the population considered for this study is deemed indeterminate. Therefore, to establish a meaningful level of significance and generalizability for the sample population, validation relies on the following expression for the confidence interval:

$$n = \frac{Z_\alpha{}^2 * p * q}{d^2}$$

Where:
n = samples
Z_α = confidence level
p = probability of success
q = probability of failure
d = maximum permissible error

501 surveys considered valid for data processing represent the value of □, selected confidence level is 95% and therefore □□ = 1.96. The value assigned to both the probability of success and the probability of failure is 0.5. To obtain the precision □ value is resolved. Consequently, the precision □ value is obtained through the following equation:

$$d = \sqrt{\frac{Z_\alpha{}^2 * p * q}{n}}$$

Using the expressed values:

$$d = \sqrt{\frac{1.96^2 * 0.5 * 0.5}{501}} = 0.04378317105$$

The error level obtained is: 0.04378.

To ensure a meaningful level of significance, 501 valid surveys were analyzed using SPSS Statistics v11.5 software (Weinberg & Abramowitz, 2008).

3. Results

Sample characterization began with an outline of the descriptive statistics for frequency distributions. To compare the sample profile variables, the eight items were encoded as whole numbers. Quantitative items were standardized by grouping them into regular frequency intervals to ensure equivalence between variables and eliminate scale differences: Age [≤ 28], [29-34], [35-41], [≥ 42]; Years since obtaining the degree: Bachelor [≤ 3], [4-9], [10-16], [≥ 17]; Master [≤ 3], [4-7], [8-15], [≥ 16]; Doctorate [≤ 1], , [3-8], [≥ 9]. Qualitative items did not require standardization due to their inherent definitions: Gender (Male, Female); Profession (Architecture, Art, Design); Educational Level (Bachelor, Master, Doctorate); Teaching Status (Teacher, Not Teacher). The sample's qualitative characteristics are as follows: Age (n = 502, Mean = 36.99), Years since obtaining the degree (Bachelor: n = 502, Mean = 12.11; Master: n = 216, Mean = 10.59; Doctorate: n = 38, Mean = 6.32) (see Table 1).

Table 1. Demographic Characteristics of Participants (n = 501)

Characteristic	n	Mean	Median	Mode	SD	Var.	Range	Min.	Max.	C.V.
Age	502	36.99	35.00	35	10.56	111.62	59	22	81	0.28
Bachelor	502	12.11	10.00	1	10.51	110.59	72	1	73	0.86
Master	216	10.59	8.00	1	9.33	87.05	50	1	51	0.88
Doctorate	38	6.2	3.50	2	7.64	58.49	42	1	43	1.21

Note. The interpretation for value 1 of Mode for the Bachelor and Master degrees is understood when visualizing that a considerable number of these degrees have been recently accomplished.

Frequencies for the participants' qualitative characteristics are as follows: Gender (Masculine n 285, 56,8%; Feminine n 217, 43,2%), Profession (Architecture n 242, 48.2%; Arts n 177, 35.3%; Design n 83, 16.5%), Scholar degree (Bachelor n 271, 54.0%; Master n 187, 37.3%; Doctorate n 44, 8.8%), and Teaching (Teacher n 231, 46.0%; Not-teacher n 271, 54.0%). Chi-squared values were reviewed for every two-item combination among the eight items that constitute the sample, revealing significant associations ($p \leq 0.05$) for the following combinations Age: Gender, Profession, Scholar degree, Bachelor, Teaching (see Table 2); Gender: Profession, Teaching (see Table 3); Profession: Scholar degree, Bachelor, Master, Teaching (see Table 4); Teaching: Scholar degree, Bachelor, Mater (see Table 5).

Table 2. Observed Frequencies and Percentages for Age – Gender, Age – Profession, and Age – Scholar degree, Age – Bachelor, Age – Teaching

		Age				
		<=28	29-34	35-41	>=42	Σ
Gender	Masculine	56 (11.2)	68 (13.5)	72 (14.3)	89 (17.7)	285 (56.8)
	Feminine	55 (11)	62 (12.4)	56 (11.2)	44 (8.8)	217 (43.2)
Σ		11 (22.1)	130 (25.9)	128 (25.5)	133 (26.5)	502 (100)
Profession	Architecture	67 (13.3)	31 (6.2)	69 (13.7)	75 (14.9)	242 (48.2)
	Art	31 (6.2)	67 (13.3)	39 (7.8)	40 (8.0)	177 (35.5)
	Design	13 (2.6)	32 (6.4)	20 (4.0)	18 (3.6)	83 (16.5)
Σ		111 (22.1)	130 (25.9)	128 (25.5)	133 (26.5)	502 (100)
Scholar degree	Bachelor	107 (21.3)	75 (14.9)	43 (8.6)	46 (9.2)	271 (54)
	Master	3 (0.6)	49 (9.8)	74 (14.7)	61 (12.2)	187 (37.3)
	Doctorate	1 (0.2)	6 (1.2)	11 (2.2)	26 (5.2)	44 (8.8)
Σ		111 (22.1)	130 (25.9)	128 (25.5)	133 (26.5)	502 (100)
Bachelor	≤ 3	89 (17.7)	18 (3.6)	3 (0.6)	7 (1.4)	117 (23.3)
	4-9	22 (4.4)	75 (14.9)	21 (4.2)	1 (0.2)	119 (23.7)
	10-16	0 (0.0)	37 (7.4)	87 (17.3)	13 (2.6)	137 (27.3)
	≥ 17	0 (0.0)	0 (0.0)	17 (3.4)	112 (22.3)	129 (25.7)
Σ		111 (22.1)	130 (25.9)	128 (25.5)	133 (26.5)	502 (100)
Teaching	Teacher	14 (2.8)	49 (9.8)	72 (14.3)	96 (19.1)	231 (46.0)
	Not-teacher	97 (19.3)	81 (16.1)	56 (11.2)	37 (7.4)	271 (54.0)
Σ		111 (22.1)	130 (25.9)	128 (25.5)	133 (26.5)	502 (100)

Note. Percentages of the total appear in parentheses. Age – Gender $\chi2 = 0{,}037$. Age – Profession $\chi2 = 0{,}000$. Age – Scholar degree $\chi2 = 0{,}000$. Age – Bachelor $\chi2 = 0.000$. Age – Teaching $\chi2 = 0.000$.

The relationship between age and gender indicates a tendency toward balance in the number of men and women practicing creative professions. This is particularly evident when comparing the age group [≥ 42], which comprises 89 men and 44 women, to the age group [≤ 28], which includes 56 men and 55 women. This projection suggests a shift in behavior and the expression of disciplines such as art, architecture, and design, thereby influencing the socio-cultural landscape of Mexico. The relationship between age and profession reveals a balance in the distribution of individuals across age groups within each profession. In terms of age and educational attainment, individuals aged 34 and older show an increasing prevalence of master's degrees. Doctorate degrees become more common after the age of 42 (see Table 2).

Table 3. Observed Frequencies and Percentages for Gender – Profession and Gender – Teacher

		Gender		
		Masculine	Feminine	Total
Profession	Architecture	151 (30.1)	91 (18.1)	242 (48.2)
	Art	92 (18.3)	85 (16.9)	177 (35.3)
	Design	42 (8.4)	41 (8.2)	83 (16.5)
Σ		285 (56.8)	217 (43.2)	502 (100)
Teaching	Teacher	145 (28.9)	86 (17.1)	231 (46)
	Not-teacher	140 (27.9)	131 (26.1)	271 (54)
Σ		285 (56.8)	217 (43.2)	502 (100)

Note. Percentages of the total appear in parentheses. Gender – Profession $\chi 2 = 0{,}048$. Gender – Teacher $\chi 2 = 0{,}012$.

Considering the gender-profession relationship, it is observed that the balance between the number of men and women practicing in various disciplines breaks down in the case of Architecture, where the number of men (151) surpasses that of women (91). A similar trend is noted in the field of Teaching, with 145 men and 86 women (see Table 3).

Table 4. Observed Frequencies and Percentages for Profession – Scholar degree, Profession – Bachelor, Profession – Master, Profession – Teaching

		Profession			
		Architecture	Art	Design	Total
Scholar degree	Bachelor	108 (21.5)	111 (22.1)	52 (10.4)	271 (54)
	Master	117 (23.3)	53 (10.6)	17 (3.4)	187 (37.3)
	Doctorate	17 (3.4)	13 (2.6)	14 (2.8)	44 (8.8)
Σ		242 (48.2)	177 (35.3)	83 (16.5)	502 (100)
Bachelor	<=3	61 (12.2)	46 (9.2)	10 (2)	177 (23.3)
	4-9	40 (8)	49 (9.8)	30 (6)	119 (23.7)
	10-16	60 (12)	49 (9.8)	28 (5.6)	137 (27.3)
	>=17	81 (16.1)	33 (6.6)	15 (3)	129 (25.7)
Σ		242 (48.2)	177 (35.3)	83 (16.5)	502 (100)
Master	<=1	15 (6.9)	22 (10.2)	9 (4.2)	46 (21.3)
	2	33 (15.3)	16 (7.4)	7 (3.2)	56 (25.9)
	3-8	35 (16.2)	10 (4.6)	14 (6.5)	59 (27.3)
	>=9	42 (19.4)	10 (4.6)	3 (1.4)	55 (25.5)
Σ		125 (57.9)	58 (26.9)	33 (15.3)	216 (100)
Teaching	Teacher	132 (26.3)	68 (13.5)	31 (6.2)	231 (46.0)
	Not-teacher	110 (21.9)	109 (21.7)	52 (10.4)	271 (54.0)
Σ		242 (48.2)	177 (35.5)	83 (16.5)	502 (100)

Note. Percentages of the total appear in parentheses.
Profession – Scholar degree $\chi 2 = 0{,}000$. Profession – Bachelor $\chi 2 = 0{,}000$. Profession – Master $\chi 2 = 0{,}000$.
Profession – Teaching $\chi 2 = 0{,}001$.

The relationship between profession and academic degree indicates that Master's degrees are particularly significant for architects, representing 50% of their population. However, the majority of the most recently acquired Master's degrees (those obtained within the last year) belong to artists (see Table 4).

Table 5. Observed Frequencies and Percentages for Teaching – Scholar degree, Teaching – Bachelor degree, Teaching – Master degree

		Teaching		
		Teacher	Not-teacher	Total
Scholar degree	Bachelor	68 (13.5)	203 (40.4)	271 (54.0)
	Master	126 (25.1)	61 (12.2)	187 (37.3)
	Doctorate	37 (7.4)	7 (1.4)	44 (8.8)
Σ		231 (46.0)	271 (43.2)	502 (100)
Bachelor	≤ 3	20 (4.0)	97 (19.3)	117 (23.3)
	4-9	44 (8.8)	75 (14.9)	119 (23.7)
	10-16	73 (14.5)	64 (12.7)	137 (27.3)
	≥ 17	94 (18.7)	35 (7.0)	129 (25.7)
Σ		231 (46.0)	271 (54.0)	502 (100)
Master	≤ 1	24 (11.1)	22 (10.2)	46 (21.3)
	2	40 (18.5)	16 (7.4)	56 (25.9)
	3-8	46 (21.3)	13 (6.0)	59 (27.3)
	≥ 9	48 (22.2)	7 (3.2)	55 (25.5)
Σ		158 (73.1)	58 (26.9)	216 (100)

Note. Percentages of the total appear in parentheses. Teaching – Scholar degree $\chi 2 = 0{,}000$. Teaching – Bachelor $\chi 2 = 0{,}000$. Teaching – Master $\chi 2 = 0{,}001$.

In the context of teaching and academic degrees, the sample reveals a balance between the total number of teachers and non-teachers. Within the group of teachers, Master's degrees represent the highest percentage. Additionally, as more time passes since obtaining the degree, the number of individuals who teach tends to increase (see Table 5).

The statistics for the initial solution of the correlation matrix revealed a Kaiser-Meyer-Olkin Measure of Sampling Adequacy of 0.908, a Bartlett's Test of Sphericity with an approximate Chisquare of 6,942.955 and a significance level of 0, and a Correlation Matrix Determinant of 6.528E-07. Therefore, applying Principal Component Analysis (PCA) (Jolliffe, 2011; Lever, Krzywinski, & Altman, 2017) is an appropriate mathematical procedure for analyzing the correlation matrix and explaining the highest variance with the fewest components.

The initial factor extraction using values higher than 1 and an unrotated factorial solution yielded 9 principal components (see Table 6 in the supplementary materials). To reduce residual values and obtain a clearer, more orderly representation of the observed behavioral diversity, thus facilitating the interpretation of results, the coordinate axes were rotated using the Varimax method (see Table 7 in the supplementary materials). The rotated solution explains 58.14% of the total data variance, with the following percentages attributed to each component: C1 = 8.07%, C2 = 7.70%, C3 = 7.57%, C4 = 7.08%, C5 = 6.51%, C6 = 5.80%, C7 = 5.26%, C8 = 5.18%, and C9 = 4.99% (see Table 8 in the supplementary materials).

To explore the groups of principal components that could enhance understanding of the categorizations identified in the literature (Lamberth, 1982; Plucker & Runco, 1999; RodríguezEstrada, 1985; Urban, 1991), available content was sequentially analyzed in groups with 9, 8, 7, 6, 5, 4, and 3 main components. Among these, the group with four high-order factors was selected for further examination (see Table 9).

Table 9. Factor Loadings for Varimax Orthogonal Four-Factor Solution for the Items of the Attributes of Creativity Questionnaire (n = 501)

Item	Factor loading				
	1	2	3	4	Communality
Research	**0.66**	0.14	0.10	0.04	0.47
Analysis	**0.66**	0.16	0.11	-0.08	0.47
Problem solving	**0.59**	-0.01	0.18	0.29	0.46
Knowledge	**0.58**	0.15	0.02	0.22	0.41
Critical thinking	**0.58**	0.06	0.24	0.28	0.48
Problem finding	**0.57**	0.11	0.36	0.04	0.47
Adaptation	**0.57**	0.17	0.00	-0.02	0.35
Synthesis	**0.54**	0.18	0.20	0.03	0.36
Intelligence	**0.53**	0.22	0.09	0.20	0.38
Proactivity	**0.49**	-0.08	0.25	0.40	0.46
Contribution	**0.43**	0.01	0.06	0.41	0.36
Abstraction	**0.37**	0.36	0.08	0.00	0.27
Elaboration	**0.37**	0.12	0.25	0.30	0.30
Imagination	0.06	**0.64**	0.11	0.29	0.51
Curiosity	0.12	**0.64**	0.12	0.02	0.44
Flexibility	0.26	**0.57**	0.07	0.09	0.41
Fantasy	-0.12	**0.53**	0.24	0.37	0.49
Divergent thinking	0.36	**0.52**	0.17	0.19	0.47
Remote associations	0.16	**0.52**	0.23	-0.11	0.36
Personality	0.12	**0.51**	0.40	0.11	0.45
Insight	0.11	**0.47**	0.26	0.17	0.33
Fluency	0.21	**0.45**	0.07	0.34	0.37
Incubation	0.10	**0.39**	0.31	0.22	0.31
Frustration tolerance	0.26	0.18	**0.72**	-0.03	0.62
Risk tiling	0.17	0.05	**0.70**	0.21	0.56
Will-power	0.27	0.09	**0.64**	0.06	0.50
Ambiguity tolerance	0.19	0.31	**0.59**	0.04	0.48
Humor	-0.09	0.26	**0.48**	0.12	0.32
Resistance to closure	0.24	0.17	**0.46**	0.26	0.36
Motivation	0.12	0.30	**0.45**	0.18	0.34
Self-realization	0.17	0.18	**0.43**	0.43	0.43
Self-esteem	0.07	0.30	**0.39**	0.25	0.31
Originality	0.09	0.19	0.09	**0.71**	0.56
Innovation	0.20	0.14	0.00	**0.70**	0.55
Metacognition	0.01	0.34	0.18	**0.60**	0.51
Aesthetics	0.07	0.10	0.23	**0.60**	0.43
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Invention	0.14	0.43	0.10	**0.51**	0.47
Communication	0.40	-0.14	0.26	**0.44**	0.44

Note. Boldface indicates highest factor loadings.

Table 11. Selected solution for Four Main Components of Creativity, with attributes definition and factor loading

	Items of questionnaire	Factor Loading
	Component 1: Cognition	
Research	Systematically perform intellectual and experimental activities with the purpose of increasing knowledge about a specific subject.	0.66
Analysis	To separate one whole in its constitutive parts to examine its qualities, and to understand the whole at greater detail.	0.66
Problem solving	Transform a given situation into a desirable one. It requires the precise definition of the current state, the expected state, and the set of operations to fulfill.	0.59
Knowledge	Assembled information that turns essential in the solution of a problem; It consists of data and experiences obtained, systematized and available to memory.	0.58
Critical thinking	The reasoning used to consider, evaluate, and debug the available options.	0.58
Problem finding	Capacity to be open and interested in identifying and working out incomplete or failed situations.	0.57
Adaptation	Ability to either accommodates oneself to the existing conditions or to modify something into a new condition.	0.57
Synthesis	The composition of a whole through the articulation of its independent parts to achieve a higher value.	0.54
Intelligence	The ability to understand and to thrive into the context; It involves ideas generation, its evaluation, and its effective communication.	0.53
Proactivity	The character of those persons that take control and decide what to do in anticipation of events.	0.49
Contribution	Provide a higher value to the environment.	0.43
Abstraction	The Rational exercise that consists of deriving the qualities of an object or a fact to consider them in its pure essence.	0.37
Elaboration	Give shape and life to a purpose through painstaking work, moving further from the obvious to address the unpredictable details at first instance.	0.37
	Component 2: Affection	
Imagination	Mental faculty to produce and associate images out of which it is possible to envision the past or forecast the future.	0.64
Curiosity	Natural interest to wonder and understand a situation or phenomenon in depth.	0.64
Flexibility	The openness to devise and explore various categories of responses for the solution of a problem.	0.57
Fantasy	Readiness to explore the inner worlds by allowing the mind to wander and to create non-existent things.	0.53
Divergent thinking	Reasoning that goes in several directions to produce multiple logical responses out of the same source.	0.52
Remote associations	Distinguish similarities between different class phenomena —the farther the distance between topics greater the discovery.	0.52
Personality	Quality of recognizing oneself as a unique person, who has the privilege to decide how to act assuming the responsibility of the effects.	0.51
Insight	Instant of clarity and certainty that arises unexpectedly, generally as the result of dedicated work.	0.47
Fluency	The ability to quickly produce many ideas for the solution of a problem.	0.45
M. Flores-Miranda, B. Hernandis-Ortuño		
Incubation	Stage of the creative process in which the solution of a problem automatically operates while relaxing the mind by performing other activities.	0.39

	Component 3: Volition	
Frustration tolerance	Show commitment to one's ideas at the light of refusal or criticism of the context.	0.72
Risk-taking	The strength of mind that moves a person to undertake an action that could have unwanted consequences.	0.70
Will-power	Decide and order one's behavior, in front of actions that involve difficulty and effort.	0.64
Ambiguity tolerance	Withstand the uncertainty and the chaos that occurs when it is not clear how a problem will be solved.	0.59
Humor	Talent to present reality highlighting a relevant incongruence of things, that moves to laughter.	0.48
Resistance to closure	Ability to keep working until the desired result is achieved.	0.46
Motivation	Primary intention without which there is no action. The energy that originates in the person and underlies behavior while executing an activity.	0.45
Self-realization	The satisfactory achievement of personal aspirations. Tendency to realize own potential.	0.43
Self-esteem	To think and act legitimately according to one's convictions; it represents the distinction and recognition of true self.	0.39
	Component 4: Empathy	
Originality	Produce unique and surprising ideas, which do not derive from existing things and that offer new values to the context.	0.71
Innovation	Effect of transforming something to improve it by adding novel aspects.	0.70
Metacognition	Ability to think about owns mental processes.	0.60
Aesthetics	Harmonious order of the elements that configure a whole that delights the senses.	0.60
Invention	A proposal that rises from the existing to offer something that is not yet present.	0.51
Communication	Ability to transmit a message to others in a convincing manner.	0.44

4. Results and Discussion

Results of the study indicate that the 38 attributes of creativity identified through comprehensive literature review achieved empirical validation. Principal Component Analysis (PCA) demonstrated its efficacy as a method for synthesizing these attributes into four explicable components explaining 42.78% of the total variance: C1 (12.33%), C2 (10.50%), C3 (10.11%), and C4 (9.85%) (See Table 10 in supplementary material). The analysis demonstrated statistical significance ($p < 0.05$) with an error margin below 4%. The rotated matrix revealed the following groupings (see Table 11):

- Component 1 (Cognition): research, analysis, problem-solving, knowledge, critical thinking, problem-finding, adaptation, synthesis, intelligence, proactivity, contribution, abstraction, and elaboration.
- Component 2 (Affection): imagination, curiosity, flexibility, fantasy, divergent thinking, remote associations, personality, insight, fluency, and incubation.

- Component 3 (Volition): frustration tolerance, risk-taking, willpower, ambiguity tolerance, humor, resistance to closure, motivation, self-realization, and self-esteem.
- Component 4 (Empathy): originality, innovation, metacognition, aesthetics, invention, and communication.

While previous researchers (Lamberth, 1982; Plucker & Runco, 1999; Rodríguez-Estrada, 1985; Urban, 1991) proposed three-component models, PCA results revealed a four-component structure, providing a nuanced understanding of the underlying structure of creative attributes. Notably, the emergence of Empathy as a distinct factor underscores the importance of applicability in creativity, balancing originality with appropriateness (Runco, 1988; Stein, 1953).

- Cognition includes attributes related to conscious information processing.
- Affection involves attributes that capture emotional aspects of environmental interactions.
- Volition groups attributes connected to willpower, attitudes, and personality traits.
- Empathy encompasses attributes related to creative product qualities and interpersonal skills that support the social acceptance of creativity.

This revised structure offers a robust empirical foundation for further research into the componential nature of creativity, potentially leading to more comprehensive models of creative processes and more effective strategies for fostering creativity. The identified components were found to correspond to Lubart's (1999) four phases of the creative process (p. 296):

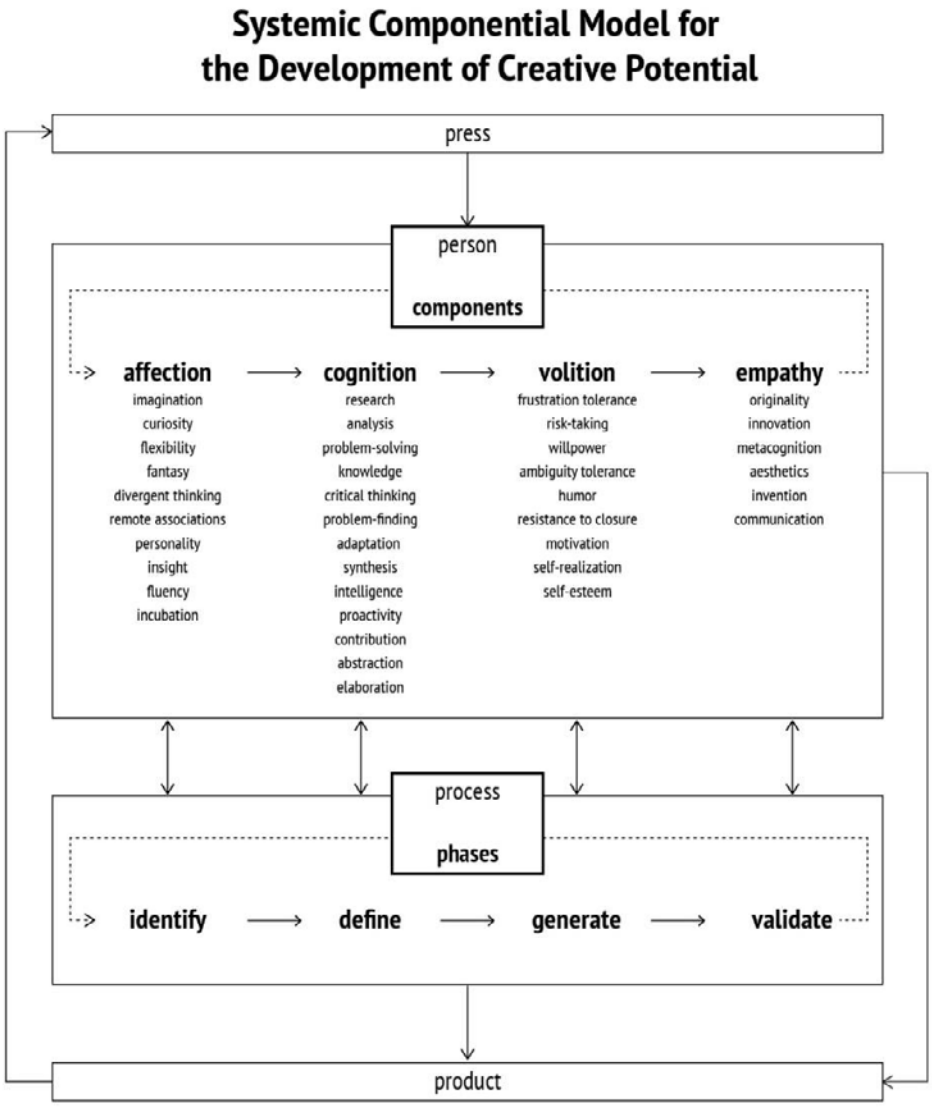
- Affection: problem identification (sensitivity to environmental relationships)
- Cognition: preparation (clarity regarding the problem and potential solutions)
- Volition: response generation (the strength to realize projected ideas)
- Empathy: response validation and communication (social validation of creativity)

This alignment provides a concrete framework for understanding creativity's attributes not as isolated elements but as integrated subprocesses of a larger creative process, offering a structured interpretation of how different aspects of creativity function throughout each phase.

5. Future Research Directions

Building on these findings, the study proposes a systemic componential model that integrates the four identified components with Rhodes' (1961) and Mooney's (1963) 4Ps of creativity: person, process, product, and press (environment). This model posits that creative potential development results from the dynamic interaction between the components and elements of creativity, with the person serving as the catalyst (Figure 8).

Figure 8. Componential model for the



development of creative potential. Source: Own elaboration.

The model's dynamic nature is illustrated by the specific relationships between creativity components and process phases: affect–identify, cognition–define, volition–generate, and empathy–validate. This correspondence provides a structured approach to developing and assessing creative potential.

6. Conclusions

This research contributes significantly to the field by providing an empirically-validated framework for understanding the components of creativity and their connection to the creative process. It challenges existing three-component models and offers a more comprehensive four-component structure that includes the often-overlooked aspect of empathy in creativity

To advance the understanding of the creative process, future theories must detail how creative abilities organize into effective subprocesses, accommodating individual variations. This refined perspective has important implications for creativity development, assessment, and training across various fields.

Future research should focus on:

1. Examining the subprocesses involved in each creativity stage
2. Developing methods for optimal measurement of these subprocesses
3. Creating targeted approaches to creativity training based on the four-component model
4. Investigating how individuals can effectively master and apply these abilities in problem-solving tasks

This study lays the groundwork for more effective methods of nurturing and harnessing creative potential, potentially revolutionizing approaches to creativity enhancement in educational, professional, and personal development contexts.

7. Supplementary material

Table 6. Factor Loadings From Principal Component Factor Analysis Without Any Factor Rotation for Items of the Attributes of Creativity Questionnaire (n = 501)

	Factor loading									
Item	1	2	3	4	5	6	7	8	9	Com
Divergent thinking	0.63	-0.06	0.09	0.25	-0.21	-0.02	-0.15	0.02	0.00	0.54
Self-realization	0.60	-0.11	-0.12	-0.22	0.35	-0.22	-0.14	-0.06	0.09	0.63
Critical thinking	0.59	0.34	-0.09	-0.03	-0.26	0.06	0.03	0.06	-0.21	0.59
Frustration tolerance	0.58	0.01	0.39	-0.36	-0.11	0.06	0.15	-0.06	0.22	0.70
Invention	0.57	-0.24	-0.25	0.16	-0.17	-0.13	-0.27	-0.18	0.01	0.62
Ambiguity tolerance	0.57	-0.11	0.31	-0.22	-0.19	0.04	0.00	-0.11	0.23	0.59
Personality	0.57	-0.26	0.23	0.02	0.26	0.00	-0.07	0.28	-0.14	0.61
Problem finding	0.57	0.34	0.19	-0.07	-0.20	-0.08	0.16	-0.22	-0.18	0.63
Risk-taking	0.56	-0.03	0.13	-0.47	0.08	0.06	0.16	-0.06	0.11	0.61
Resistance to closure	0.56	-0.02	0.03	-0.21	-0.06	-0.10	-0.18	0.22	-0.22	0.50
Will power	0.54	0.06	0.26	-0.37	0.19	-0.01	0.01	-0.06	0.10	0.55
Metacognition	0.54	-0.32	-0.34	0.00	0.09	0.20	0.05	-0.05	-0.06	0.56
Problem solving	0.54	0.39	-0.13	-0.03	-0.32	-0.28	0.06	-0.19	-0.16	0.71
Imagination	0.54	-0.38	0.00	0.29	0.11	-0.06	0.21	0.17	0.13	0.62
Proactivity	0.53	0.32	-0.23	-0.15	-0.04	-0.26	-0.14	0.26	0.22	0.67
Fluency	0.53	-0.16	-0.11	0.23	-0.07	-0.30	0.14	0.30	-0.02	0.57
Intelligence	0.53	0.25	-0.03	0.18	0.11	0.25	0.12	0.05	-0.25	0.53
Elaboration	0.52	0.13	-0.09	-0.06	0.11	0.28	0.25	-0.10	-0.13	0.48
Motivation	0.52	-0.17	0.13	-0.15	0.26	-0.06	-0.25	-0.08	-0.21	0.52
Originality	0.52	-0.19	-0.51	-0.01	-0.09	0.11	-0.14	-0.12	-0.02	0.61
Incubation	0.50	-0.22	0.06	0.00	-0.13	0.34	0.13	-0.07	0.02	0.46
Knowledge	0.50	0.34	-0.09	0.20	0.42	0.11	0.06	0.00	0.00	0.60
Insight	0.50	-0.24	0.12	0.10	-0.06	-0.10	0.14	0.11	-0.40	0.54
Self-esteem	0.50	-0.21	0.04	-0.12	0.30	-0.24	-0.29	-0.18	-0.15	0.60
Flexibility	0.50	-0.13	0.14	0.35	-0.09	-0.29	0.27	-0.13	0.15	0.61
Synthesis	0.49	0.30	0.15	0.09	-0.16	0.11	-0.08	-0.17	-0.15	0.46
Research	0.49	0.43	0.10	0.17	0.02	0.28	-0.20	-0.05	-0.09	0.60
Aesthetics	0.48	-0.15	-0.38	-0.17	0.09	0.29	0.20	0.09	0.08	0.58
Contribution	0.46	0.25	-0.30	0.02	0.38	-0.10	0.08	-0.06	0.15	0.54
Curiosity	0.45	-0.27	0.24	0.32	0.24	0.07	0.06	0.06	-0.08	0.52
Analysis	0.45	0.44	0.21	0.18	0.13	0.15	-0.21	0.11	0.29	0.65
Abstraction	0.42	0.09	0.17	0.25	-0.23	0.08	-0.25	0.24	0.19	0.48
Remote associations	0.41	-0.17	0.36	0.19	-0.07	0.16	-0.28	-0.09	0.17	0.50
Humor	0.38	-0.30	0.17	-0.24	-0.23	-0.17	0.06	0.09	-0.12	0.43
Adaptability	0.38	0.37	0.11	0.24	0.17	-0.33	0.32	-0.14	0.15	0.63
Fantasy	0.49	-0.49	-0.06	0.07	-0.23	0.16	0.12	-0.09	0.20	0.63
Innovation	0.50	-0.06	-0.54	0.06	-0.13	-0.04	-0.12	-0.27	0.14	0.68
Communication	0.48	0.27	-0.28	-0.23	-0.19	0.04	0.04	0.51	0.07	0.74

Table 7. Summary of Items and Factor Loadings for Varimax Orthogonal Nine-Factor Solution for the Items of the Attributes of Creativity Questionnaire (n = 501)

	Factor loading								
Item	1	2	3	4	5	6	7	8	9
Innovation	**0.75**	0.04	0.02	0.21	0.07	0.06	0.20	-0.01	0.11
Originality	**0.71**	0.07	0.02	0.11	0.17	0.04	0.01	0.16	0.16
Invention	**0.61**	0.26	0.01	0.23	0.28	0.23	0.01	-0.10	0.04
Metacognition	**0.57**	0.24	0.13	-0.03	0.21	-0.02	0.01	0.34	0.07
Fantasy	**0.52**	0.43	0.35	-0.05	-0.04	0.14	-0.15	0.06	-0.06
Aesthetics	**0.48**	0.12	0.26	-0.10	0.03	-0.09	0.08	0.42	0.26
Imagination	0.25	**0.67**	0.15	-0.12	0.11	0.12	0.15	0.14	0.06
Fluency	0.19	**0.61**	0.00	0.14	0.13	0.05	0.13	0.00	0.33
Flexibility	0.16	**0.61**	0.18	0.26	-0.01	0.13	0.27	-0.10	-0.11
Insight	0.06	**0.52**	0.08	0.28	0.31	-0.03	-0.17	0.23	0.06
Curiosity	0.03	**0.52**	0.08	-0.06	0.27	0.25	0.09	0.27	-0.15
Frustration tolerance	0.00	0.14	**0.76**	0.20	0.11	0.19	0.06	0.07	0.10
Risk-taking	0.12	0.04	**0.67**	0.10	0.24	-0.04	0.11	0.19	0.16
Ambiguity tolerance	0.15	0.18	**0.63**	0.18	0.13	0.28	-0.02	-0.04	0.04
Will power	-0.01	0.01	**0.57**	0.11	0.36	0.11	0.20	0.13	0.11
Incubation	0.31	0.25	**0.36**	0.08	0.01	0.19	-0.13	0.33	-0.04
Humor	0.08	0.33	**0.36**	0.16	0.24	-0.07	-0.26	-0.08	0.15
Problem solving	0.21	0.06	0.11	**0.74**	0.06	0.03	0.19	-0.03	0.23
Problem finding	0.01	0.11	0.32	**0.67**	0.09	0.11	0.14	0.16	0.04
Critical thinking	0.16	0.07	0.13	**0.56**	0.06	0.17	0.03	0.29	0.34
Synthesis	0.08	0.02	0.14	**0.51**	0.11	0.33	0.07	0.22	0.00
Self-esteem	0.22	0.13	0.15	0.09	**0.69**	0.05	0.13	-0.03	-0.05
Motivation	0.13	0.11	0.20	0.09	**0.64**	0.13	0.03	0.14	-0.01
Self-realization	0.30	0.11	0.28	0.00	**0.55**	0.00	0.35	0.02	0.17
Liberty	-0.02	0.44	0.20	-0.07	**0.50**	0.20	-0.01	0.25	0.15
Resistance to closure	0.11	0.15	0.19	0.24	**0.43**	0.12	-0.11	0.11	0.38
Analysis	-0.07	-0.03	0.14	0.12	0.05	**0.63**	0.39	0.17	0.19
Abstraction	0.07	0.22	0.07	0.12	0.00	**0.59**	-0.01	0.00	0.24
Remote associations	0.11	0.20	0.24	0.02	0.18	**0.57**	-0.06	0.00	-0.17
Research	0.05	-0.09	0.03	0.36	0.12	**0.50**	0.18	0.39	0.07
Divergent thinking	0.27	0.37	0.11	0.29	0.17	**0.43**	0.00	0.05	0.10
Adaptability	-0.10	0.28	0.11	0.35	-0.03	0.05	**0.64**	0.01	-0.01
Contribution	0.24	0.03	0.05	0.08	0.18	-0.01	**0.60**	0.20	0.19
Knowledge	0.08	0.08	-0.01	0.13	0.19	0.21	**0.54**	0.45	0.10
Intelligence	0.08	0.16	0.01	0.31	0.11	0.19	0.17	**0.56**	0.11
Elaboration	0.20	0.09	0.25	0.24	0.07	0.00	0.17	**0.52**	0.05
Communication	0.16	0.05	0.16	0.15	-0.03	0.09	0.05	0.20	**0.78**
Proactivity	0.20	0.02	0.15	0.21	0.15	0.17	0.34	-0.08	**0.62**

Note. Boldface indicates highest factor loadings.

Table 8. Eigenvalues, Percentages of Variance, and Cumulative Percentage for Nine-Factors Solutions of the Items of the Attributes of Creativity Questionnaire (n = 501)

	Sum of the saturations of the extraction			Sum of the saturations of the rotation		
Factor	Eigenvalue	% of variance	Cumulative %	Eigenvalue	% of variance	Cumulative %
1	10.12	26.63	26.63	3.07	8.07	8.07
2	2.55	6.71	33.33	2.92	7.70	15.77
3	1.98	5.21	38.55	2.88	7.57	23.34
4	1.61	4.24	42.78	2.69	7.08	30.41
5	1.48	3.90	46.68	2.47	6.51	36.92
6	1.21	3.20	49.88	2.20	5.80	42.72
7	1.09	2.86	52.74	2.00	5.26	47.98
8	1.04	2.74	55.47	1.97	5.18	53.16
9	1.02	2.67	58.14	1.89	4.99	58.14

Note. Extraction method: Analysis of main components. Rotation converged in 20 iterations.

Table 10. Eigenvalues, Percentages of Variance, and Cumulative Percentage for Four-Factors Solutions of the Items of the Attributes of Creativity Questionnaire (n = 501)

	Sum of the saturations of the extraction			Sum of the saturations of the rotation		
Factor	Eigenvalue	% of variance	Cumulative %	Eigenvalue	% of variance	Cumulative %
1	10.12	26.63	26.63	4.68	12.33	12.33
2	2.55	6.71	33.33	3.99	10.50	22.82
3	1.98	5.21	38.55	3.84	10.11	32.94
4	1.61	4.24	42.78	3.74	9.85	42.78

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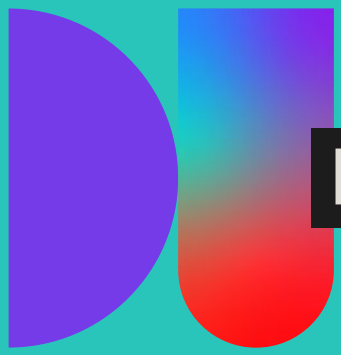

POSTERS

THE EVOLUTION OF GRAPHIC POSTER DESIGN: A META-ANALYSIS OF MEDIA TECHNOLOGY'S INFLUENCE ON CREATIVE PRACTICE

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TRACK 1: DESIGN FOR CHANGE

DESIGN ACROSS BORDERS UNITED IN CREATIVITY

The Evolution of Graphic Poster Design: A Meta-analysis of Media Technology's Influence on Creative Practice

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Track 1: Design for Change

INTRODUCTION

In the digital age, the amalgamation of art, design, and technology has become a potent force for creative evolution. This research examines the reciprocal relationship between media technology and graphic poster design, focusing on the transformative role of digital tools such as TouchDesigner, After Effects, and Augmented Reality (AR) in advancing design practices. The study explores the works of notable designers, including Onformative, Yusuke Murakami, INSgraphizm, Takuya Onuki, Liu Zhizhi, and Toan Vu-Huu, highlighting the profound impact of media technology on design methods and audience engagement.

Figure 1. (From Left to Right) The User Interfaces of TouchDesigner, After Effects and the Visual Effect of Augmented Reality. Credit by Matthew Regan, Medium and Reydar.

RELATED WORKS

Takuya Onuki's "Hiroshima Appeals 2021," which utilizes AR ***(see Figure 2a)***, and Liu Zhizhi's poster for the 10th Beijing Film Festival, blending dynamic 2D and 3D elements ***(see Figure 2b)***, showcase the potential of media technology to push the boundaries of traditional design.

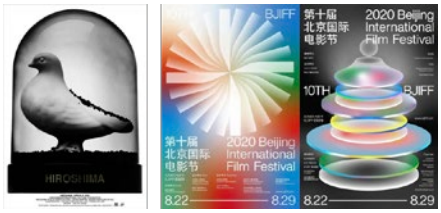

Figure 2. (a) Hiroshima Appeals 2021; (b) the 10th Beijing Film Festival - 2D & 3D Display.

Furthermore, Toan Vu-Huu's poster for the EDHEA Art School ***(see Figure 3a)*** demonstrates the capacity of technology to create dynamic, resonant designs.

Figure 3. (a) Journée portes ouvertes 2020 L'EDHEA; (b) Otherworks by the same Designer.

In parallel, Onformative's "Meandering River," created using AI and algorithm ***(see Figure 4, 5)***, and Yusuke Murakami's "Soundbook", developed through After Effects, illustrate the power of these digital tools in fostering complex, algorithmically generated designs and enhancing traditional design methodologies. Insgraphizm's motion poster for "Interstellar," a blend of digital tools including Cinema 4D and After Effects, underlines the potential of technology to captivate audiences and evoke thematic elements.

Figure 4. Meandering River, audiovisual art installation, 2018.

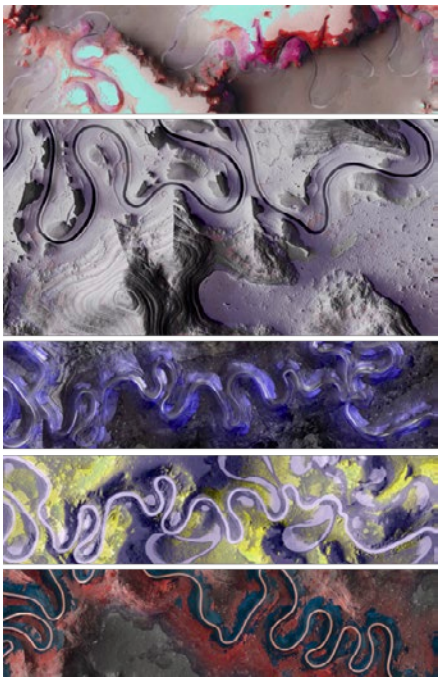

Figure 5. Work Details of Meandering River.

CONCLUSION

This research underscores a significant paradigm shift in graphic poster design, propelled by the evolution of media technology The findings highlight the potential of digital tools as catalysts for creativity and viewer engagement, emphasizing the interdependence of media and graphics and the fluid, dynamic nature of their interaction.

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ENHANCING CHILD DEVELOPMENT THROUGH INTERACTIVE ILLUSTRATION DESIGN IN PICTURE BOOKS: AN INTERDISCIPLINARY APPROACH

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TRACK 3: EDUCATION IN ART AND DESIGN

DESIGN ACROSS BORDERS UNITED IN CREATIVITY

Enhancing Child Development through Interactive Illustration Design in Picture Books: An Interdisciplinary Approach

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Track 3: Education in Art and Design

INTRODUCTION

Children's picture books serve as a vital educational tool, offering a window into the world through which children initiate their journey of reading and comprehension. The role of illustrations within these books extends beyond decoration; they are foundational to a child's learning and development ***(see Figure 1 and 2).*** As the artistic and cultural landscapes evolve, so does the concept of picture book illustrations, with a growing emphasis on interactivity to engage young readers actively. This document examines the progression from traditional illustration to interactive design in children's picture books, highlighting the need to consider children's psychological and physiological characteristics in design to captivate and educate effectively.

Figure 1. Works from Carson Ellis, the Title of this Picture Book is Homes.

THE EVOLVING ROLE OF ILLUSTRATIONS

Traditionally, illustrations in children's picture books have been static, serving to complement the text. However, researchers note a paradigm shift towards illustrations encouraging active participation and engagement in children ***(see Table 1)***. The interactive illustrations can significantly enhance a child's reading experience by aligning with their cognitive development stages and aesthetic preferences.

The Dawn of Illustration: Ancient Expressions	The Renaissance Revolution: Art Meets Science	The Industrial Impact: Printing Press and Mass Production	The Golden Age of Illustration: A Flourish of Creativity	The Advent of Photography: A New Visual Language	The Modernist Movement: Breaking Traditions	The Digital Revolution: From Pencil to Pixel	The Rise of 3D Illustration: Adding Depth to Creativity	The Fusion of Art and Technology: Interactive and Motion Illustration
• **Ancient Cave Drawings**: Early illustrations on cave walls served as a means of communication and storytelling. • **Egyptian Hieroglyphs**: These pictorial writings were historical records and artistic expressions. • **Greek and Roman Pottery**: Illustrated pottery depicted scenes from mythology and daily life. • **Medieval Manuscripts**: Illuminations in religious texts conveyed spiritual themes and narratives.	• **Leonardo da Vinci and Albrecht Dürer**: Their works integrated scientific precision with artistic expression. • **Printing Technology**: Johannes Gutenberg's printing press facilitated mass production of illustrated books, spreading Renaissance ideas.	• **Woodcut Prints**: Allowed for both text and illustrations to be printed simultaneously, increasing efficiency. • **Lithography and Steel Engraving**: Enabled finer details and a greater range of tones, enhancing the aesthetic quality of illustrations.	• **Renowned Illustrators**: Arthur Rackham, Howard Pyle, and Edmund Dulac created imaginative and intricate drawings. • **Children's Book Illustration**: Iconic characters by Beatrix Potter and E.H. Shepard emerged during this period. • **Color Printing**: Became more affordable and widespread, making illustrations more engaging.	• **Impact on Illustration**: Photography complemented and enhanced traditional illustration, leading to greater accuracy and realism. • **Stylized and Abstract Representations**: Illustrators began to use photography as a reference, pushing the boundaries of illustration.	• **Experimentation with Form and Color**: Illustrators like Pablo Picasso and Wassily Kandinsky embraced abstraction and emotional expression. • **New Technologies**: Screen printing and lithography allowed for greater experimentation.	• **Graphic Tablets and Design Software**: Tools like Adobe Photoshop and Illustrator opened up new possibilities for creativity and efficiency. • **Global Reach**: The internet allowed illustrators to showcase work and access a global market.	• **3D Modeling Software**: Created lifelike and intricate images, revolutionizing fields like architecture, medicine, and entertainment. • **VR and AR**: 3D illustrations enhance user experience and offer interactive ways to communicate ideas.	• **Interactive Illustration**: Engages audiences by allowing viewer participation. • **Motion Graphics**: Brings illustrations to life through animation, prevalent in digital media.

Table 1. From Pencil to Pixel: The Evolution of Illustration. (Source: https://kreafolk.com/blogs/articles/evolution-illustration)

Figure 2. Works from Julia Sarda.

IMPORTANCE OF INTERACTIVITY IN ILLUSTRATION

Interactivity in illustration design plays a crucial role in aesthetic value and fostering a child's reading initiative and aesthetic development. By creating an environment that promotes exchange between family members and children, interactive illustrations can significantly enhance the reading experience. This approach can lead to a deeper understanding of content, improved vocabulary, and a more profound love for reading ***(see Table 2)***. Furthermore, interactive design can cater to modern technological advancements, bridging traditional storytelling with contemporary digital experiences.

Enhanced Understanding of Content:	Improved Vocabulary:	Fostering a Love for Reading:
Interactive illustrations often include elements that children can manipulate, such as characters or objects that respond to touch or gestures. For instance, in an interactive e-book, a child might tap on a character to hear it speak or see it move. This engagement helps reinforce the narrative and aids in comprehension. Studies have shown that children who engage with interactive illustrations tend to better grasp the story's plot and characters than those who read static illustrations.	Interactive design can integrate features like clickable words or phrases that provide definitions, synonyms, or pronunciation guides. For example, an interactive storybook might allow children to tap on unfamiliar words, hear them pronounced, and see their meanings. This feature not only helps in the acquisition of new vocabulary but also encourages curiosity and independent learning. Research by ??? indicates that children using interactive storybooks exhibit a 20% increase in vocabulary acquisition compared to traditional books.	By making reading a more engaging and dynamic experience, interactive illustrations can cultivate a lifelong love for reading. Features like animated scenes, sound effects, and the ability to make choices that affect the story's outcome make reading more enjoyable and immersive. For instance, a digital storybook might allow children to choose different paths for the characters, creating a personalized narrative experience. This level of engagement can transform reading from a passive activity to an interactive adventure, thereby nurturing a child's enthusiasm for books.

Table 2. The Three Contents of the approach.

INTERACTIVE STRATEGIES IN ILLUSTRATION

The study explores several strategies for interactive illustration, such as color interaction, which plays a crucial role in attracting the attention of children and stimulating their imagination. We discuss how designers can employ various color palettes and contrasts to create moods and themes that resonate with children. Material interaction is another strategy, where the physical aspects of the book, including pop-ups and varied textures, invite tactile exploration. Participation interaction, such as AR and VR technology, is also highlighted, where the narrative invites the child to become part of the story through decision-making or problem-solving activities.

CONCLUSION

Integrating interactive strategies in children's picture books is essential to creating an immersive and enriching reading experience. This integration's success lies in capturing a child's imagination and sustaining their interest, making reading a delightful and educational activity. We encourage designers to continually innovate and embrace interactivity in their illustration designs to cater to the evolving needs of young readers.

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TALAVERA OF PUEBLA, DESIGN AS AN ELEMENT OF CULTURAL IDENTITY OF PUEBLA, MEXICO.

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TRACK 3: EDUCATION IN ART AND DESIGN

DESIGN ACROSS BORDERS UNITED IN CREATIVITY

Talavera of Puebla, design as an element of cultural identity of Puebla, Mexico.

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Track 3: Education in Art and Design

ABSTRACT | The Talavera pottery brought by the Dominican friars to Puebla, Mexico for reproduction in an area where they found similar characteristics of materials for its reproduction, in addition to qualified labor for its reproduction, where there are elements that maintain their characteristics of origin. These are typical of their culture, tradition and customs where the elements that are reflected in the ceramics for their production are expressed in an original way to maintain the characteristics of their origin, with the passage of time this acceptance becomes a recognition of their Puebla roots, today it is an element that gives it cultural identity and in which it has its designation of origin due to the manufacturing that has taken place over time.

KEYWORDS | Talavera, identity, cultural identity, ceramics.

In Mexico, talking about Talavera is a reference for ceramics that is a visual element of the state of Puebla. This type of craftsmanship has characteristics that make it special. Its origin comes from Spain in the region that bears its name in the area of Toledo known as Talavera de la Reina. In Mexico it made its appearance in the 16th century, which has elements that make it different and that show its elegance in its illustrations that cover a glazed clay with elements such as tin, this technique is brought to Mexico by the Dominican friars, described by the chronicler Mariano Fernández Echeverría y Veytia (1612) where he mentions this special glazed blue ceramic with its own characteristics.

The concept of cultural identity comes with the evolution of Talavera, since this cultural manifestation becomes an amalgam of tradition, culture and appropriation of people, which becomes an element of union of a society, this phenomenon that is develops within the state of Puebla, it does not occur massively throughout the entire territorial extension since it only occurs in the city of Puebla since at the state level it has competition with more popular products, since crafts are made in each region with clay with a more everyday intention and not what happens with this one that could have had a utilitarian use in more economically favored sectors. Hugo Leich (1986) mentions where he describes the areas and workshops authorized in the 17th century in the states of Puebla and Tlaxcala, due to the "ordinances" where some of them are still in force today, there are fewer of them, but those that are It represents this tradition that becomes the pride of the city and its residents. These two states of Mexico share the designation of origin, but the city of Puebla is recognized.

La Talavera has generated belonging and a tradition, which makes it an element of fraternity and identity for the people who live there. Cultural identity is defined by many factors such as religion, customs, values, traditions and in this case by the symbols, elements and color palette that surrounds this type of crafts. Collective memory is an important feature, which is what maintains the validity of these elements found on facades, traditional kitchens or vessels that can be used for daily or decorative purposes.

In the case of Talavera, throughout the centuries of its existence in the area of Puebla and Tlaxcala, it has been considered an element that has grown with the community and with their culture, where it has remained on par with many events that have marked history and traditions. Talavera has maintained this ability to transform itself in certain manufacturing processes and maintaining the basic principles of its decoration and essential materials to be recognized and appropriated as a distinctive symbol of the people who were born here. This type of craft has won the attacks of interculturality, maintaining its visual elements, color palette and the clay with which it is made, today it is recognized and distinguished from others that are made in the same region, by its lines. , color, the same clay that is different from that used by its popular competition that has been adapting to the moments of the state of Puebla and the manipulation carried out by the artisans for a search in the innovation of processes, themes and colors that can be found in those pieces, which gives a diversity with the other ceramics that are not considered Talavera.

In Puebla, given the history of the city, the establishment and flourishing of a culture affected by the arrival of the Spanish and the appropriation of elements brought as part of that luxury and non-popular tradition such as the Talvera, marks in society an element of identity that over time is appropriated and defined as an identity element of the Puebla culture.

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DIGITAL FASHION EDUCATION: A COLLABORATIVE APPROACH TO PREPARING STUDENTS FOR INDUTRY 4.0

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TRACK 3: EDUCATION IN ART AND DESIGN

DESIGN ACROSS BORDERS UNITED IN CREATIVITY

Digital Fashion Education: A Collaborative Approach to Preparing Students for Industry 4.0

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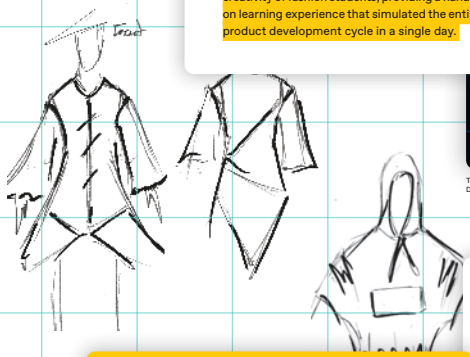
Track 3: Education in Art and Design

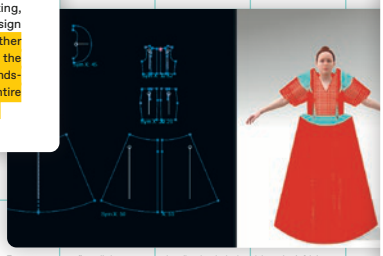
The fashion industry is undergoing a transformative shift towards digitalization and sustainable practices. As educators, it is crucial to equip students with the necessary skills and knowledge to thrive in this evolving landscape. This poster presents a collaborative initiative between academia and industry leaders, aimed at bridging the gap between traditional fashion education and the cutting-edge technologies shaping the future of fashion.

This image shows the final project submission after students completed the process from initial sketches and digital simulations to the finished sewn product. The fabrics and patterns used were scanned in advance.

In a unique "Product in a Day" course, Bezalel Academy of Arts and Design in Jerusalem partnered with Delta Galil, a global leader in innovative design, manufacturing, and marketing, and Browzwear, a pioneer in 3D clothing design software. This collaboration brought together the expertise of industry professionals and the creativity of fashion students, providing a hands-on learning experience that simulated the entire product development cycle in a single day.

These sketches were created after receiving the topic and concept, taking into account the textiles and patterns from Delta.





To ensure a garment fits well, the pattern must be tailored to the body and the project's fabrics. Digital simulation allows students to test the fabric before sewing and refine their projects.

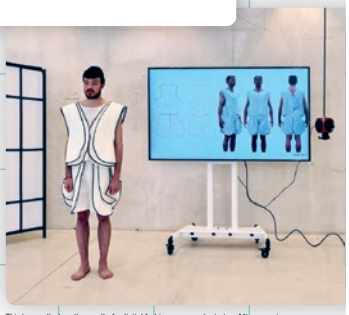
The event challenged students to create leisurewear outfits using Browzwear's VStitcher software, which allows for the creation of digital twins of physical garments. Delta Galil provided custom 3D garment blocks, digital assets, and physical fabrics, enabling students to explore volume, texture, and draping while working with industry-standard materials.

Under the guidance of Bezalel Academy's faculty and Browzwear's experts, students developed patterns based on Delta Galil's blocks, designed their garments, and simulated realistic renderings before stitching and presenting the physical pieces. This immersive experience not only taught students the technical skills required for 3D fashion design but also fostered their creativity and problem-solving abilities.

The collaboration between Bezalel Academy, Delta Galil, and Browzwear highlights the importance of industry-academia partnerships in preparing students for the future of fashion. By exposing students to cutting-edge technologies and real-world challenges, this initiative equips them with the necessary tools and mindset to succeed in an industry that is rapidly embracing digitalization and sustainable practices.

Furthermore, the integration of 3D design software into the academic curriculum empowers independent designers to establish their own design studios and cater to one-on-one clients, expanding their career opportunities and fostering entrepreneurship in the fashion industry.

This collaborative approach to fashion education not only enhances students' technical skills but also cultivates a mindset of innovation and adaptability, crucial for navigating the ever-changing landscape of the fashion industry. By embracing digital solutions and optimizing non-digital processes, aspiring fashion professionals can create unique experiences and contribute to a more sustainable and efficient fashion ecosystem.



This image displays the result of a digital fashion course submission. After scanning the fabric and simulating it on an avatar, the model is shown in the picture. The combination of digital simulation, the avatar, and the patterns allows students to be creative and gain a deep understanding of pattern making.

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GLOBAL COLLABORATION FOR SUSTAINABILITY: AN INNOVATIVE EDUCATIONAL APPROACH

TRACK 3: EDUCATION IN ART AND DESIGN

DESIGN ACROSS BORDERS UNITED IN CREATIVITY

Global Collaboration for Sustainability: An Innovative Educational Approach

Track 3: Education in Art and Design

AHEA Association for Higher Education and Accreditation

ISEP International Student Exchange Programs

COIL Collaborative Online International Learning

GNLA Globally Networked Learning Academy

Collaborating with ***AHEA/ISEP/COIL/GNLA*** offers students a unique global connection. Many haven't traveled abroad, so this networked course lets them engage with diverse cultures remotely. Through intercultural projects and discussions, students broaden perspectives by interacting with peers from varied backgrounds. I, from Iran, see this as a starting point to connect my country to the world despite increasing isolation due to government restrictions. The program cultivates essential intercultural communication skills and a global mindset. We're eager to facilitate cross-border collaboration and knowledge beyond classroom limits.

Cross-Cultural Collaboration for Sustainability: Insights from a Globally Networked Education Project

This poster examines a collaborative project between international students developed through the **AHEA/ISEP/COIL/GNLA**. The goal is for **4D (animation) and Sustainable Systems for Buildings** students to collaboratively propose solutions for sustainability challenges worldwide, guided by the UN Sustainable Development Goals.

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AHEA/ISEP COIL/GNLA program

spring 2023

Development Process

1 Collaboration Contract

My peer and I drafted a collaboration contract outlining guidelines to enable an effective partnership. We established shared expectations for communication, conflict resolution, and accountability to facilitate a successfully collaboration.

2 Crosscultural Icebreaker

We designed impactful icebreakers to foster cultural exchange and empathy among diverse students. Crafting connective experiences broke barriers, cultivated understanding, and enhanced collaboration between differing worldviews.

3 Identifying Intersections Between Our Courses

The next critical step was identifying intersections between our three courses to find potential common ground for the COIL collaboration. In an online meeting, we each described key aspects of our individual courses while capturing keywords on a Miro Board. We then highlighted areas of overlap or possible connections between the courses.

4 Sustainability as a Common Theme

Our analysis revealed sustainability as a common theme between the courses. Though we explored sustainability distinctively, the UN's 17 Sustainable Development Goals provided a shared framework. We decided to use these goals to guide our integrated curriculum and collaborative project.

5 Final Project's Instructions

Our collaborative course converged on a project where students would identify a real-world problem using the UN Sustainable Development Goals, research it, approach the issue, ideate solutions, and propose an approach, communicating it visually. We structured the 9-week project into timed phases: introduction and team connections, topic development, research, ideation, proposal creation, production, and presentation.

Socially and Environmentally Responsive Initiative

Visual Communication and Architecture Collaborative Project

The 7-week project takes students through establishing cross-cultural connections, researching the site and model, developing sustainability proposals, designing branding, adapting systems, simulating features, animating, presenting, and final deliverables. This comprehensive initiative enables students to apply analysis, 3D modeling, animation, and collaboration skills while creatively designing for environmental and social impact. Peer feedback and international cooperation help students synthesize diverse views to refine their work.

Week 1 Oct 1-7 — **Introduction and Connection**

Students have their first video conference to start intercultural interactions. They play an icebreaker game with questions to introduce themselves, share facts, and build agreements. Students also share cultural backgrounds to increase mutual understanding. More video conferences are scheduled to continue developing connections throughout the program. **The initial activities and relationship building set the foundation for meaningful collaboration.**

Week 2 Oct 9-13 / **Week 3** Oct 16-20 — **Research and Brainstorming**

Students select a building site and researched climate, social issues, and environmental concerns in the surrounding area. Referencing UN Goals, they identify improvement opportunities. After placing their Revit model on the site and analyzing energy consumption, they research socioeconomics, culture, community needs, and local environmental issues. With this research, students brainstorm building adaptations to respond to the climate and provide social and environmental benefits per UN goals. They then propose solutions for social and environmental improvements based on their research.

Week 4 Oct 23-27 — **Logo Sketch and Solution Proposals for the Building**

Students brainstorm logo designs that reflect the vision and values of their organization. Students analyze the climate data for their building site, considering factors like temperature, humidity, wind patterns, and solar exposure. Based on this climate analysis, they propose architectural adaptations to optimize the building for the local environment.

Week 5 Oct 30-Nov 3 — **Storyboarding and Solution Proposals for the Building**

Students storyboard and plan their logo reveal videos. They analyze the modified Revit model to evaluate energy performance vs. the baseline. Students align passive proposals with sustainability goals in their logo design. To visualize ideas, they create concept sketches and renderings showcasing proposed enhancements. Students share feedback to refine proposals.

Week 6 Nov 6-10 — **Submission**

Students animate initial logo reveal drafts and provide peer feedback for improvements. They then refine animations based on critiques to clearly convey logo meaning. Students also justify proposed passive strategies with simulations, quantifying potential energy savings and comfort improvements. They verify alignment with sustainability and performance goals.

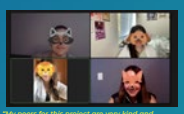
Week 7 Nov 13-17 — **Animations and Finalizing the Proposal +Reflection Video**

Students present research, logo animations, and building conclusions, explaining their analysis and decisions for optimal location-based systems.

For a final video, students record scripts, visuals and narrative to showcase their work. They edit this into a cohesive, engaging video summarizing research, proposals, logos, and learning.

Objectives:

- Foster intercultural exchange and teamwork between students.
- Facilitate direct global communication and idea exchange between students to broaden worldviews.
- Serve as a pilot collaboration between the two universities to open the door for more extensive global partnerships and networked learning projects worldwide.
- Equip students with real-world experience in sustainability problem-solving to empower them as ambassadors capable of spearheading positive change.
- Inspire creative thinking about sustainable community-oriented designs aligned with UN Sustainable Development Goals.



"My peers for this project are very kind and welcoming people. I got to learn a lot about their cultures, favorite foods, and love for family. I am very excited to work on this project and learn more from them."

"We all played the card game and chatted with each other, and overall had a very good time. I'm very excited to meet with them again, and work on this project together with them! They all seem like incredibly nice and smart people."

Final Animations

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Tecnológico de Monterrey Escuela de Arquitectura, Arte y Diseño

HUMAN MOBILITY AND DESIGN

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TRACK 4: TRANSLOCALITY

DESIGN ACROSS BORDERS UNITED IN CREATIVITY

HUMAN MOBILITY AND DESIGN

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Track 4: Translocality

INTRODUCTION

During the research seminar course, students of the industrial design bachelor's degree must develop design projects based on complex social problems that provide design solutions for the common good. in this poster you can see the solutions proposed by some of the students.

The problem addressed here is the migration and homelessness that are relevant issues today that impact various aspects of society, such as decent employment, the reduction of inequalities, peace and justice. In this study, we focus on understanding how the current social context affects people's perception of migration, within the framework of the Sustainable Development Goals of the World Health Organization.

These research projects were carried out in order to generate products or services that can assist in the daily life of this social problem for the common good.

According to the National Migration Institute in 2022, 444,439 migrants from different nationalities, mainly from the northern triangle,
Honduras (72,928), Guatemala (69,515) and El Salvador (27,245) were registered in Mexican territory. This represents:

METHODOLOGY

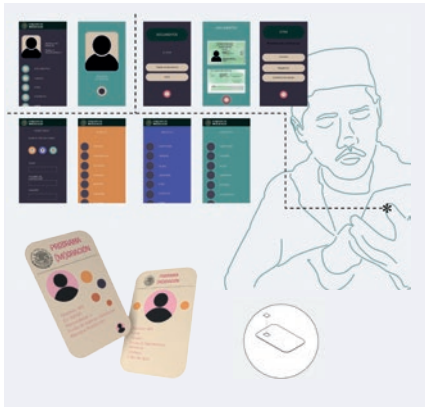
The students across different stages: accompanying by design methodologies and mainly ased on the "Designing Social Experience for the Common Good" Guide and the theoretical framework "Design from Peace", a product of González, Lilián's doctoral program.

DESIGN SOLUTIONS

1. **"El morral",** by Sofia López Sánchez.
This bagpack is designed for homeless people who do not feel safe leaving their belongings in one place and need to take them with them, as well as not having a stable place to sleep. It is a portable, easy to transport, durable and accessible, avant-garde backpack for homeless people with foldable shelter, hygiene products, inflatable pillow and thermal blanket .

2. Identification Card and App for migrants, by Rodrigo Ortiz Cruz. The app is a tool for the migrant designed to give them autonomy, freedom, and a proper way to exer- cise their rights under the rule of law. The objective of this project is to create a path not only for access to the Mexican legal system, but also to generate a legal and digital identity that helps to make visible the migrant and their temporary or permanent status and integration in the country. At the same time, it provides the opportunity to improve their overall quality of life through courses in different areas of knowledge to apply and train themselves in different fields and possible professions.

The migrant obtains an object that provides them with a sense of belonging and physical identity that will be digitized and secured every time they take a course or experience a change in their life as a migrant in Mexico.



3. "Structure to load" by Eduardo Murillo Zavala
After conducting interviews at the Casa Peña shelter in Mexico City, it was discovered that they face a big problem regarding their personal belongings, since most of them do not have backpacks that can withstand the physical demand of the long trip through Mexican territory. This problem is especially difficult for those traveling with children, since they must carry their children's belongings in addition to their own.

The project consists of an ergonomic structure designed to protect and carry the objects of migrants in irregular transit situations. The design has a rigid external structure that conforms to the user's back, allowing them to carry a large amount of weight.

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Cumulus Association

UDEM | UNIVERSIDAD DE MONTERREY

Tecnológico de Monterrey Escuela de Arquitectura, Arte y Diseño

WORKSHOP ABSTRACTS

DESIGNING FOR SOCIAL JUSTICE AND HUMAN RIGHTS: BUILDING NETWORKS FOR VICTIMS OF VIOLENCE AND FAMILIES OF THE DISAPPEARED

Frederique Krupa

ABSTRACT |

This 90-minute workshop explores the intersection of design and social justice, focusing on creating international education-based networks to support families of the disappeared and victims of violence in Latin and South American communities. Participants will engage in collaborative activities and discussions to understand how design can be a powerful tool in addressing human rights issues, preserving memories, and fostering social interventions.

KEYWORDS | DESIGN FOR SOCIAL INNOVATION, DESIGN FOR SOCIAL JUSTICE, HUMAN RIGHTS, PARTICIPATORY DESIGN, VICTIMS OF VIOLENCE AND DISAPPEARANCE

CMF STRATEGY DESIGN USING GENERATIVE AI

Juan Carlos Marquez Cañizares and Grisaelda Oyervides

ABSTRACT |

Objectives:

Identify the potential of generative AI for CMF strategy creation.
To provide participants with state-of-the-art tools for CMF strategy design using generative AI.
Develop skills for the application of CMFs in products.

Audience: product design professionals and students

Number of participants: 20

Agenda:

15 min Introduction to CMF strategy
25 min Identification and analysis of trends and users
20 min Moodboard development
20 min Generative AI tools for CMFs
10 min Break
20 min Design and communication using prompts
70 min Implementation of CMF strategies

Equipment required:

1 color laser printer
100 sheets of opaline for the printer
20 scissors
10 glue sticks

5 double-sided tape
5 transparent adhesive tape
3 blue masking tape
10 white Foamboard
20 sharpie markers of different colors
200 post its of assorted colors

Space requirements: projector, worktables (6), chairs with casters (22), (5) whiteboards with casters

KEYWORDS | CMF, AI, PRODUCT DESIGN

NEW TURN IN DESIGN RESEARCH AND EDUCATION - A PANEL DISCUSSION

Satu Miettinen, Nicola Morelli, Mari Suoheimo, Heidi Pietarinen and Amalia Amalia de Götzen

ABSTRACT | This proposal suggests a panel discussion about the new turn in design research and education.

This panel explores the new turn in the design research and education paradigm where there is a higher recognition of addressing the systems and complexities. The design discipline is evolving with the social, economic, and technical systems it interacts with, and this context is now severely challenged by multiple crises concerning environmental aspects, social inequalities, wars, migrations, and deep cultural changes.

This panel discusses the turn in the service design paradigm from the micro-level operational and methodological practice towards designing at the macro level, which concerns more complex and strategic systems. This turn is discussed first through a literature review, then with service design researchers in a co-design workshop, and verified through data collected in industry interviews. This panel asks if a new turn in service design research and education has occurred.

It was already Papanek (1971) who initiated the discussion of complexities in design. The issues of sustainability and social context need to be considered when designing. Buchanan (2001) addressed the knowledge production and the epistemologies of design. He was asking for the value of design research. Krippendorff's (2006) book "The Semantic Turn" has been a cornerstone in outlining a new way to look at design as a science that helped designers both to review the semantic concerns in design history and present the philosophical background to this as well as argue for the user-centredness that the new technologies pose the design artifacts. This panel proposes that design research and education have grown into a new era and the questions they are facing are even more complex than in the last turn.

KEYWORDS | NEW TURM, PARADIGM SHIFT, DESIGN EDUCATION, DESIGN RESEARCH, PANEL DISCUSSION

DEAR AI, WHAT DO I WANT TO SAY AND WHAT DOES IT LOOK LIKE? TOOLS AND METHODOLOGIES FOR IMAGE MAKING

Jasmin Rubinovitz and Nomi Geiger

ABSTRACT | In the era of information overload, designers face the challenge of navigating a constant stream of thoughts, ideas, and data. This workshop explores the art of choosing compelling subjects, finding personal connections, and defining one's voice. Participants will explore methodologies for visual self-expression by using classic image-making techniques alongside innovative tools, including artificial intelligence (AI) capabilities such as generative text and image models. They'll gain hands-on experience with cutting-edge editing and image creation tools, providing them with diverse avenues to express the□mselves visually.

The workshop is inspired by a successful 13-week class we recently piloted at a renowned design academy. This class combined visual design and image-making techniques with cutting-edge AI tools and capabilities, providing insights into the creative process in today's digital and AI-driven era.

ipant in selecting a topic they are curious about. We'll explore identifying the values associated with the chosen topic alongside various searching techniques to uncover valuable references that can aid in the creative process of expressing those values.

Stage two: (40 minutes) Introducing external tools and datasets
Short lecture: AI and generative models tool

In the second phase of the workshop, participants will engage in a hands-on image-making activity. They will utilize the theme and references chosen in the first part of the workshop and introduce new tools that harness generative AI to further explore and perfect their design ideas. The goal is to create an original image that effectively communicates the intended message.

By the end of the workshop, participants will leave with a unique image created in collaboration with the latest advancements in generative AI.

Wrap up and questions (10 minutes)

About us:
Two professionals from contrasting fields - a computer scientist specializing in AI and technology, and a graphic artist adept at creating images and designs. Our diverse expertise allows us to collaborate uniquely in teaching initiatives.

Equipment Needed:

Screen / projector
Laptops with internet access
Participants will need to register for an account on an online platform, announced before the workshop, as we anticipate that the generative AI tools ecosystem will continue to evolve rapidly. We will select the best platform based on its features and suitability for the workshop's purpose.
Drawing materials (optional)
Printer (optional)

KEYWORDS | ARTIFICIAL INTELLIGENCE, IMAGE MAKING, VISUAL COMMUNICATION, GRAPHIC DESIGN, GENERATIVE AI, AI, ART, AI IN ART AND DESIGN, TECHNOLOGY, EDUCATION, SELF EXPRESSION, HUMAN AI COLLABORATION, DIGITAL TOOLS, INNOVATION, HANDS-ON LEARNING, INSPIRATION, ORIGINALITY, CREATIVE PROCESS, DESIGN EDUCATION

PHYSICALISING SYMPTOMS: THE ROLE OF MATERIALS IN SUPPORTING INTIMATE DATA COLLECTION TO IMPROVE AWARENESS AND COMMUNICATION IN HEALTHCARE.

Ginevra Terenghi*[ab] , Arthi Manohar[a], Serena Cangiano[b]

a Brunel University London, UK
b University of Applied Sciences and Arts of Southern Switzerland (SUPSI)
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ABSTRACT | Healthcare is undergoing a transformation, shifting the agency from doctors to patients. This change requires patients to be more involved and informed, especially when facing global health challenges. Improving health and data literacy is essential for enabling patients to collaborate in decision-making and new knowledge definition. To support selfawareness and communication abilities in patients, this proposal suggests a structured workshop based on experimental activities and supported by physical materials to encourage participants to reflect on the experience and externalisation of diseases as both, researchers and patients. The goals are twofold: to promote the use of diverse sensory techniques for sharing personal health data among different backgrounds of researchers, and to contribute to the development of a systematic approach for data representation that includes both visual and tactile elements.

KEYWORDS | DATA PHYSICALIZATION, PATIENT EMPOWERMENT, DATA COLLECTION

1. Introduction

The ability to properly describe and communicate symptoms is critical for patients to support a diagnosis which can inform and facilitate treatment decision-making (Meskó & deBronkart, 2022). To build proper communication between patients and doctors, not only health literacy is required (Feng et al., 2021), but the personal vocabulary of feelings and perceptions also needs to expand. Considering symptoms as expressions of the disease they are caused by (Offenhuber, 2024), this proposal suggests the practice of data physicalisation to explore new modalities of representing and communicating intimate and healthcare information aimed to promote awareness and support people affected by any kind of illness (from common influenza to recurrent complex diseases) in improving communication modalities.

This proposal suggests a structured workshop based on experimental activities and supported by physical materials to encourage participants to reflect on the experience and externalisation of diseases as both, researchers and patients. Outputs and discussion are considered to expand the visual and physical variables contributing to the definition of a multisensory vocabulary. On the other hand, participants are meant to acquire new communication skills that can be integrated into different design research activities.

2. Activity

The workshop takes place in person and is planned to last about 2 hours.

Activities are organised as follows:

- Workshop presentation (10').
- Ice-break: Participants introduce themselves by providing the personal definition of "symptom". Groups are organised (20').
- A set of labels reporting some generic symptoms of common diseases (e.g. fever, headache) is provided. Participants select the most relevant and add what is missing based on their personal experience (15').
- The kit of materials is distributed across groups. The kit includes different units of wood, polyester, and foam available in different shapes (sphere, cube and triangular prism) and two sizes (small and

big). To facilitate the assemblage, pegs are also provided. Units have holes on each side that fit the pegs so they can be combined

· (5').

· A set of labels describing the physical variables (e.g. shape, weight, texture) is brought to the table. Participants are asked to explore and familiarise themselves with the variables based on the material kit previously provided (15').

· Participants work in groups selecting and associating the physical variables to the symptoms (15').

· Based on these associations, participants use material units to recreate the symptoms of the disease they are working on (20').

· Participants present their artefact and explain their motivations (20'). Pictures of the final artefact are taken, while vocal descriptions are recorded. Discussion and feedback close the session.

Preliminary results are meant to drive the final conversation around practices of intimate and healthcare data representation, specifically leading to understanding how materials can support symptom representation and how patients and doctors can benefit from physicalisation practices.

3. Intended Audience

The workshop is part of a PhD in design considering participatory approaches based on data physicalization to promote women's agency in healthcare. The pilot of the format has been run three times with people with different backgrounds. The project originated from the need to address the health and societal threat of antibiotic resistance. As urinary tract infections (UTIs) are among the most common causes of resistance development, and because UTIs affect mainly women due to anatomic factors, the original format addresses women specifically. For the reason of broadening the conference attendees' participation and the research

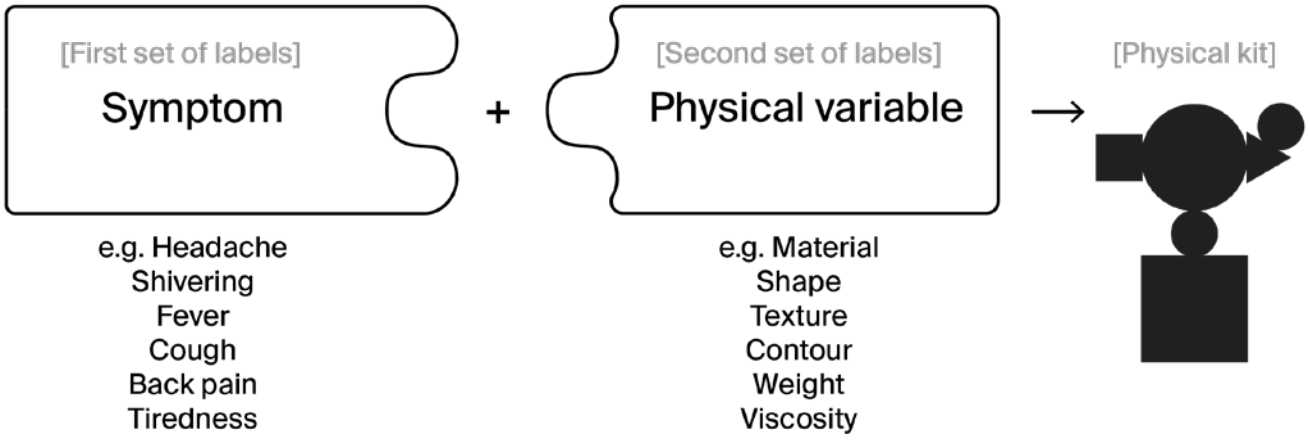

Figure 1. The intended process of the activity.

interest as well, this proposal opens the focus to common diseases, such as influenza. This allows focusing on specific symptoms that can be further studied across different pathologies in the future.

The workshop is designed to have a maximum of 20 participants work in groups of 5 people each (groups can be adapted based on the number of attendees). No specific requirement or prior knowledge is needed. First of all, designers interested in data representation and communication should benefit from taking part, but participation is also recommended for researchers in the field of healthcare, patient-doctor relations, and for those who are interested in intimate data and self-narrative practices.

4. Expected Outputs

The objective of the activity is to encourage the adoption of various sensory methods for conveying personal information and fostering empowerment in health-related issues. Specifically, the workshop aims to encourage the exploration of methods for patient selfnarrative and personal data representation and support the development of a shared language by identifying new correlations based on the translation of data through different sensory modalities. The insights will support the ongoing work to establish a design framework for representing data through both visualization and physicalisation.

5. Space and Equipment Required

The activity will take place in a standard room, with one table for each group and seats organised around. A projector will be used for the initial presentation. A part of the kit provided, pens and stationery to write in various colours are required.

6. Post Workshop Plans

Physical results produced during the activity will be added to the collection of outputs of other workshop sessions. The research environment where these outputs are produced will provide an additional occasion for the research to confront approaches regarding the adoption and understanding of material for communication among different environments and expertise levels. Artefacts will be associated with their verbal description and made available (anonymised) on an open repository. To facilitate the exploration of the association of symptoms, variables and material, the artefacts are planned to be 3D scanned (with the support of tools such as LUMA AI).

As the public interaction with materials for research purposes allows the collection of data which is very often difficult to analyse, this repository is not only meant to promote the workshop strategy but also providing a setting to explore decoding possibilities to facilitate meaning and information deduction from material and artefacts from which the design community can benefit from.

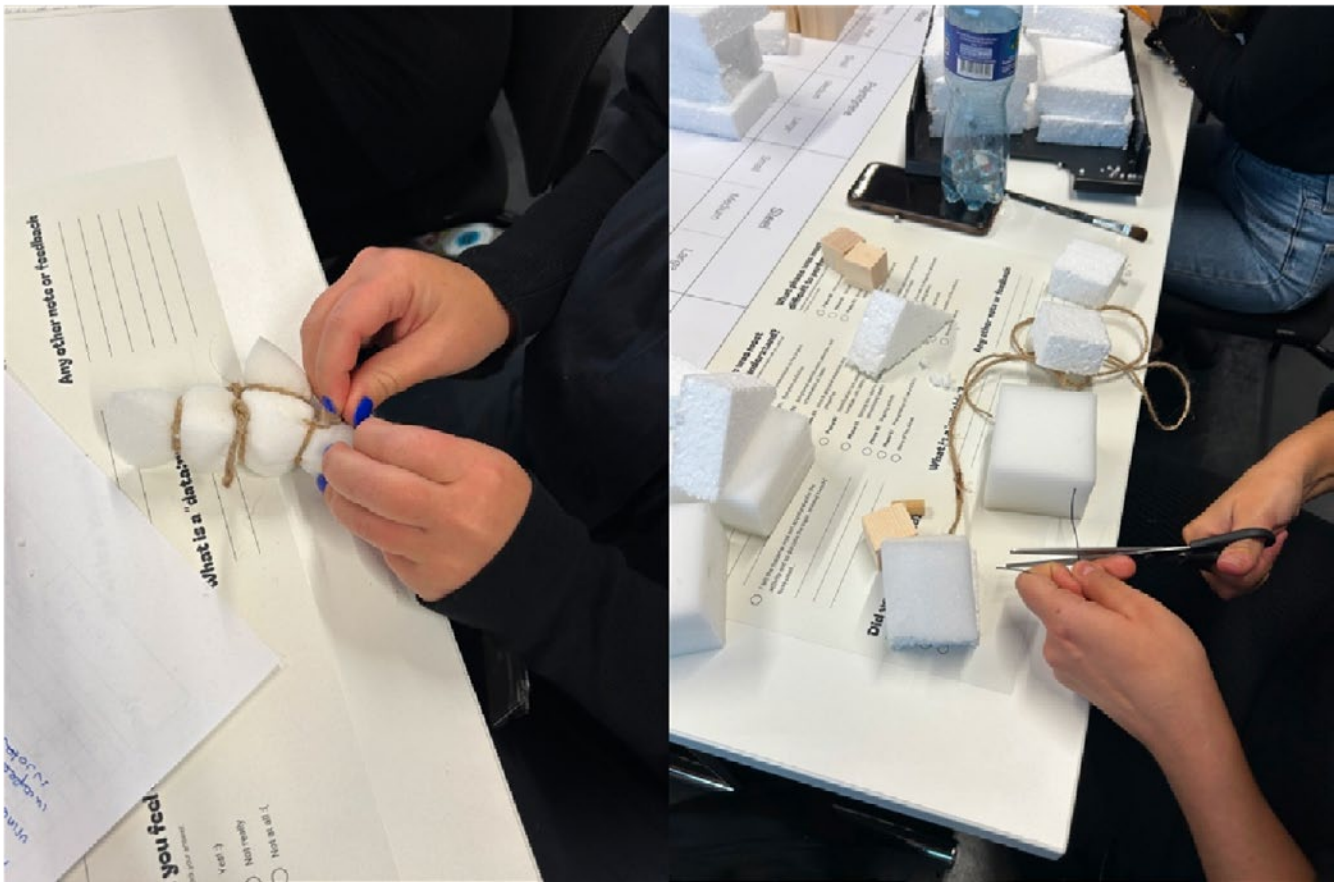

Figure 2. Participants during the pilot workshop. SUPSI, October 2023.

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CODEX ARTIFICIALIA: A NEW CREATIVE ACT TO RESIST THE HYPE OF SMART COMMODIFICATION AND DECOLONISING TOMORROW

Silvio Cioni and Giovanni Caruso

ABSTRACT | In this progressive gathering and collaborative workshop, we explore the symbiotic relationship among artificial intelligence (AI), design, and capitalist structures. The creative endeavour involves assembling a codex – understood here as an organised compilation of information and guidelines – that encapsulates the essence of ownership, labour, and commodification within the expansive realm of AI capitalism concerning the future of design practice.

As we delve into this exploration, it is crucial to acknowledge AI's profound impact on the contemporary design landscape and the risks and opportunities it poses.

Integrating AI technologies redefines traditional paradigms, influencing how designers conceptualise and bring their ideas to fruition, potentially subverting the notions of authorship and creativity. This transformation inscribes itself in the context of capitalism, extending beyond technical aspects and permeating fundamental concepts such as ownership and creativity as commodities. Within this context, the codex from the future aims to provide a nuanced understanding of these complex relationships, offering insights and alternative possibilities for the evolving nature of design within an AI-driven capitalist framework. The goal is to create a new meaningful space that problematizes an imaginary built around the rhetoric of augmentation and improvement of human beings without addressing what these optimistic public discourses fail to surface.

Through synthesising instructions and illustrations, participants will contribute to the codex and actively engage in interpreting the symbolic representations of ownership, navigating the complexities of labour, and offering hints on reshaping this collaboration. This collaborative effort is a collective future exploration of the intersections between design, artificial intelligence, and the economic structures that shape today's creative landscape.

KEYWORDS | AI FUTURES, PARTICIPATORY SPECULATIVE DESIGN, COLLECTIVE IMAGINATION, AI CAPITALISM, COMMODIFICATION OF CREATIVITY, AI-INFUSED DESIGN PRACTICE

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DESIGN AS COMMUNITY CARE: DRAFTING A NEW MANIFESTO FOR DESIGN EDUCATION

Arden Stern and Danielle Foushee

ABSTRACT | Abstract: In an era defined by multiple social, political, and ecological crises in which design has often been complicit, we need a manifesto that sets forth radical new principles for design education rooted in community care and civic responsibility. This workshop will facilitate the co-creation of a set of shared principles and actions with an international group of Cumulus participants, resulting in a draft manifesto to be published in the conference proceedings.

Design history is awash with manifestos that offer principles for ethical practice, ranging from the De Stijl Manifesto (1918) to First Things First (1964) to more recent manifesto-like documents such as the Decolonising Design Editorial Statement (2016). These manifestos guide designers during times of crisis, but few have catalyzed action-oriented practices for civic participation and community collaboration that create new professional pathways for design school graduates. We need a new framework for bringing design students, educators, and communities together.

Traditional community engagements in design education — especially in the U.S. — center the priorities of corporate funders and powerful institutions rather than the needs of people, communities, and ecosystems, and often exacerbate the problems design purports to solve. With this manifesto, we seek to build an international community of care among design educators to activate our collective values in local contexts across the globe.

Though design educators are the target audience for this workshop, all are welcome; our goal is to gather a group of 9-15 attendees, including the two facilitators. Participants will be invited to continue collaborating remotely to revise and expand the manifesto document for a future co-authored publication.

KEYWORDS | MANIFESTO, DESIGN EDUCATION, COMMUNITY ENGAGEMENT, ETHICS

REFUGEOLY GAM

Vicente Esteban

ABSTRACT | This is a project to create awareness of the refugee situation, and the proposed format(s) have been tested for several years with optimum results. Please check the game's website (https://www.refugeoly.org/) to see how the game is played. The requirement for this activity is a black floor space to place a vinyl sticker (3x3 meters) with the game. A TV monitor is also required to introduce the game before playing it. There can be 2 to 3 sessions per day.

Refugeoly is a serious game whose main purpose is not just to play for fun but also to understand a humanitarian crisis. This board game is designed to experience, based on real facts, the dramatic journey of refugees trying to get into a country that can give them asylum. Playing Refugeoly turns the player into a refugee and becomes conscious of the real circumstances a refugee must go through on the journey to safety. Refugeoly has been built into a game with the testimonies of refugees and NGO volunteers in refugee camps in Greece, Turkey, Spain, and France, as well as information from different organisations. This paper aims to explain the design process, the game mechanics, the different tested game formats, the feedback from the general public, academics and students who have played it and its future development.

The proposal is a gaming activity in which the players embody the role of a refugee, and through playing this floor game, they can have an immersive experience of the circumstances that refugees have to go through in their journey to safety. This game has been played in several institutions in the last few years and has received very good feedback, especially as a pedagogical tool to understand and learn the realities around forced migration.

This serious game is supported by a website where users can download, print and play the game: https://www.refugeoly.org/

KEYWORDS | REFUGEE, SERIOUSGAMES, MAFIA, BORDERS, MIGRANTS, NGO

CO-CREATING COLLABORATIVE CULTURES: HOW TO TEACH COLLABORATION IN DESIGN SCHOOL

Peter Martin

ABSTRACT | Design pedagogies have a legacy of promoting an individualistic basis of creativity and expression that persists today within many art school curricula. However, design practices in a deeply interconnected world cannot rely on the "creative genius" of individual designers to be wholly inclusive, relevant, effective, and sustainable. The complex and dynamic social situations and cultural histories require a creative capacity that extends beyond the strengths, skills, and lived-experience any individual designer can provide. The challenges and opportunities we now face require a level of innovation emerging from synergistic processes and collaborative cultures of designing that extend far beyond coordinated assemblies of multiple specializations typically applied within complex projects.

However, co-creating such collaborative cultures require participating creatives to have a basis of awareness and skill that design curricula often do not explicitly address. As a result, many students find collaborative projects to be frustrating and negative experiences. Often, students "survive" these projects by dividing up the work equally and present a coordinated summation at the end without having achieved any creative synergy and integration of the diverse strengths, experiences, and values involved. This, unfortunately, enables dominate cultural norms to prevail and determine the processes, outcomes and recognitions involved in the projects.

How do we teach design students to be "collaborative" when creative processes often depend on vulnerability and intuition that are not easily achieved within the particular social dynamics and distinct emotional dimensions of collaborative spaces?

This 90-minute workshop engages ten-to-twenty design educators in: (1) Forming an understanding of creative collaboration as a cultural process; (2) Co-creating a contextualized narrative of why design students should develop the mindsets, understandings, and skills for

creative collaboration; (3) Considering the social, emotional, and cognitive experience and scope of students learning how to collaborate; and, (4) Gaining resources and examples of design students learning and being assessed in their capacities for creative collaboration.

The scope and approaches within this workshop have been developed with insights from diverse fields such as organizational culture, sociology, critical theories, and innovation studies. The methods and tools introduced in this workshops have been tested by the author in multiple undergraduate design studio courses.

The basis of this workshop is a ten-component framework, developed by the author, organizing collaboration as a cultural process emerging from an integrated environment activated by "cultural" participation. This framework structures a set of practical exercises in-which workshop participants are introduced to critical collaborative mindsets and viable collaboration methods for engaging design students in developing their understandings and skills for creative collaboration. Throughout these exercises participants are provided with tools and applied examples they can utilize in their future experiments in teaching collaboration.

KEYWORDS | DESIGN PEDAGOGY, DIVERSITY INCLUSION AND EQUITY WITHIN COLLABORATION, TEACHING COLLABORATIVE DESIGN METHODOLOGY

RETHINKING DESIGN EDUCATION: TEACHING IF WE COULD BE RISKY

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c University of Missouri, St. Louis, USA

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ABSTRACT | Within contemporary design education, educators are seeking innovative ways to engage students while responding to the shifting needs of industry and the needs of the community in which they work. This session explores current attempts to create new practices while identifying the constraints imposed by institutions against a landscape of ambition and realities that is ever changing. It will reflect on attempts to create new student experiences while analysing those attempts that resulted in failure. It will cover established innovative approaches while proposing new forms of student engagement for future consideration while equipping educators with strategies to challenge the status quo within their programmes.

KEYWORDS | INNOVATIVE DESIGN EDUCATION, DESIGN TEACHING PRACTICES, FUTURE-ORIENTATED LEARNING, CONSTRAINTS IN HIGHER EDUCATION, LEARNING EXPERIENCES

1. Introduction

We have and are teaching differently that we did before. Even if the marks stay on the same scale or the budgets have become more limited or the students busier than ever. Whether it is a flipped classroom or a service learning experience or cross-campus projects in which design students team up with students from other departments and learn valuable (soft) skills they would have never been able to learn without it, many of us are still looking for ways to engage our students in ways that both stretch us and our discipline as well as challenging our students and meeting them where they are. This is not to say all wheels should be reinvented; some skills are simply skills to acquire… but there is so much to be done and so many things to try if we were given the chance.

What would we do if we really could do things differently? If budgets were more friendly, if time and location was not so restrictive, if the course load provided us space to define our own challenges and take on our own themes, if we were given more room to liaise closely with diverse communities or embed further in industry or were able to engage students in a way that their journey is celebrated more than their outcome? What if we could no longer teach as we were taught, or were able to develop media or approaches that reflect technological shifts or even mirrored ways in which we ourselves like to learn?

This session will engage participants in exploring current best practices as well as develop what may become future best practices; reflecting on our own ambitious attempts as well as potential failures in which we, as educators want to do, currently do or did just that. Through an interactive session we will refer to established approaches such as Project-Based Learning, Peer-to-Peer teaching, micro-credentials and gamification etc. but also analyse what makes a learning experience innovative, while proposing new forms for future consideration.

1.1 Objectives

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· Explore and reflect on Innovative teaching practices: gain insights into diverse teaching methodologies and understand the factors that contribute to their effectiveness.

· Identify and (propose ways to) overcome constraints in design education: develop strategies to mitigate common constraints, enabling flexibility and creativity in teaching practices.

· Propose future-oriented design learning experiences: propose concrete, innovative teaching models that can be implemented in their own educational contexts, promoting deeper student engagement and learning.

· To create a small team of motivated educators to continue working together or reflecting on this topic post workshop.

1.2 Target audience

This workshop is designed for design education faculty who teach, with specific focus on post-graduate level, including design education programme directors. Although we will not make a distinction between practice-based and research-orientated coursework, both outcome orientated as well as theory-based practice is welcome. Expected Number of Participants: Approximately 20 participants.

1.3 Format

Participants will start collectively by an explanation and timing of the experience-based session. The format gives participants a chance to be very engaged with a fellow conference attendee, and gain in-depth knowledge into another participant's educational vision and engagement.

These teams will be given a booklet (also available in digital format) which offers 5-7 topics as starting point. The starting points will be in various formats: an audio fragment, a film, a short text, a collection of social media posts) that will instigate a discussion that will happen in small teams (of 2-3 people). The medium and content will drive the discussion, in turn the medium/content will drive a reflection on how they engaged with the content. Each team will be given an assignment to find a space from which to work, which in turn will inform a question regarding spaces to work (ie. what space do students need)... so on and so forth. After the discussions, the teams will return and share their vision on what form would suit the course outline they have been given in their booklet, as well as summarising what shifts (if any) would need to happen for schools to allow this sort of experience. The session will close by itemising steps that they would like to take in their own programme to innovate around curriculum or design education while inviting educators to be involved in a working group on this topic.

About the Authors:

Dr. Andrea Wilkinson is an experienced educational leader with expertise in social design and inclusive interfaces. Actively involved in teaching and research she focuses care-based design initiatives with a focus on aging and inclusion.

Dr. Rita Maldonado Branco is a design researcher focusing on communication design for health. Her work involves designing tools for interaction and support for social relationships with a focus on dementia care.

Jennifer McKnight is an accomplished graphic designer and professor in design. She is passionate about design education and committed to serving her community through design.

Dr. Eve Stirling is a design lecturer interested in digital spaces and their relation to time and space. Her work explores agency and making through speculative design fiction.

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DESIGNING WITH THE DESERT: CROSSBORDER PEDAGOGIES FOR SUSTAINABLE BIOREGIONS

Marysol Ortega Pallanez*[a] , Hazal Gümüş Çiftçi[a], Michelle Fehler[a]

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ABSTRACT | Design education, as we know it, is deeply rooted in Eurocentric teachings dating back to the 20th century that focus on capitalist values of extractive productivity, an emphasis on form and function, and replicability for mass production—a legacy of the Industrial Revolution. However, these priorities are no longer sufficient. Designers must shift towards the sustainment of life. We must repair and unmake the still-prevalent paradigm that fosters overproduction, overconsumption, and disconnection from our local ecosystems. Over the past decades, design doing and thinking have shifted toward more plural and systemic approaches in research and theory. This 90-minute workshop aims to create a platform primarily (but not exclusively) for US and Mexico-based design educators to embrace our shared climates and soil and converse about the transformative potential of unlearning/relearning design and shape novel ways of teaching and learning through bioregional and cross-border collaborations.

We will share our experiences from "Designing with the Desert," an initiative started at Arizona State University (ASU) in the United States. This initiative began in the Spring of 2024 with talks by design professionals and academics who reflected on living and working in the Sonoran Desert—a bioregion with many sustainability challenges. A charette in September of 2024 at ASU titled "Sustaining Life on Earth," explored how design educators and students can collaboratively learn, unlearn, and relearn design practices relevant to the desert by producing the first iteration of a manifesto for designing with the desert. These discussions sparked debates on designing with the desert to sustain its life while also teaching and learning in it.

This workshop is designed for educators, researchers, practitioners, and students in the fields of design, sustainability, and social innovation. It is particularly relevant for those interested in participatory design, cross-cultural collaboration, and social-ecological transitions. We anticipate 15-20 participants, allowing for meaningful interaction and collaboration. Using a values-based framework, participants will examine how current design practices and artifacts prioritize certain relationships with nature while overlooking others. This activity will generate questions and commitments for designers to engage more pluralistically with nature and foster discussions on cross-border and bioregional collaborations for change.

Planned Agenda

This 90-min workshop includes the following activities:

- Introduction (15 minutes)
    - Presentation of Designing with the Desert, highlighting the ecological and cultural significance of the desert regions along the Mexico-US borderlands, and discussing its geopolitical implications. Breakout into teams
- 1st Exercise: how do we value nature in the way we teach design today? (15 minutes)
    - Examining current design education practices and their limitations centered on a values-based approach, prompting participants to share experiences and identify areas for unlearning.
- Share-out (15 minutes)
    - Participants share and walk through the boards to explore unlearnings and build on each other's contributions.
- 2nd Exercise: what if we teach and learn design through a variety of instrumental, intrinsic, and relational values of our bioregions? (15 minutes)
    - Participants consider how design can be practiced and taught with local ecosystems and non-human entities, rather than for or despite them.
- Plenary Closings (25 minutes)
    - Discuss proposed design and pedagogical practices and consider next steps for cross-border bioregional collaborations. This segment emphasizes the importance of cross-border (primarily Mexican-US) design schools' collaboration, focusing on competencies necessary for knowledge production that sustains life.
- Final Remarks (5 minutes)

Equipment Required

- Projector/screen for presentation
- Whiteboards or easel paper pads
- Markers
- Audio system (2 microphones and 2 speakers)

KEYWORDS | CROSSBORDER DESIGN PEDAGOGIES, CO-DESIGN, DESIGN EDUCATION, DESIGN FOR SUSTAINABILITY, MORE-THAN-HUMAN DESIGN

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Michelle Fehler is a Biomimicry Professional and a Visual Communication Designer who focuses on defining a life-centered design thinking methodology by infusing biomimicry thinking into the human-centered design process.

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DESIGNING PLURAL FUTURES

Xochitl Arias and Paula Wuth

ABSTRACT | All design is design of futures. However, when design as a culture explicitly engages with the topic of futures, its contribution displays on at least two levels.

On one level, it involves making different visions of the future tangible, which means to make them communicable. This is, enabling their dialogic nature in two, three, and four dimensions inherent to design languages, whose narrativity produce effective imprints that support projects ranging from future literacy to social innovation.

On a second level, it involves the practice of designing a future on itself; this is, where the object resulting from the design process is precisely an image of some entity's possible future, whether it is a person, an institution, a territory or a nation. This is the level of design as a process, where a future can be a design outcome.

In the profoundly transitional context in which we live, the contribution that design makes to developing anticipation skills and competencies has relevance in design education and in general education. UNESCO considers that "global changes require more inclusive and agile responses," and that future thinking is a competency that improves our ability to shape solutions that prepare us for this by creating "long-term resilience" (UNESCO, Futures literacy 2024) . Within this, the properties of design as a language enrich the field of future studies offering open and effective perspectives, tools, and alternatives.

Thus, referring to the plural consideration of design and futures, or the epistemic-geographical diversity of these fields, "design" and "futures" have an unfinished agenda. We propose a seminar-workshop (a "hands-on reflection" or a "reflective making session") organized by institutions illustrating this in order to:

- Characterize Key Themes: Explore relevant themes for future thinking education and general education from a perspective of futures design from different cultural and geographical origins.

- Initiate Transformative Projects: identify short and medium-term projects able to ignite collaborations in this subject among Cumulus member institutions, translating documented practices in design and futures education into transferable knowledge.

This event would have the format of a design-oriented futures laboratory mixed with a research seminar and could be deployed in two blocks of 120 minutes each.

Participants

The workshop is tailored for academics and researchers from diverse universities who are keen on collaborating on future studies in research, teaching and outreach. Participants will have the opportunity to exchange their experiences and insights in futures design. We aim to foster a diverse mix of backgrounds among participants, enhancing the richness of discussions and collaborative projects. This workshop welcomes those who have undertaken projects, courses, or initiatives in the field of design and future studies, providing a platform to share and develop meaningful initiatives on the matter.

KEYWORDS | ANTICIPATION, PLURALITY, RESILIENCE, SUSTAINABILITY

GREEN THREADS: SUSTAINABLE FASHION JAM

Lourdes Martinez

ABSTRACT | This is an engaging 90-minute social innovation workshop designed for 15 participants. The main objective is to raise awareness of the primary problems associated with fast fashion and then collectively devise innovative solutions.

Some of the numerous consequences of fast fashion include water pollution, excessive waste and landfill usage, high carbon emissions, exploitative labor practices, depletion of natural resources, negative impacts on biodiversity, and overproduction and overconsumption. After gaining a deeper understanding of these issues, participants will embark on an ideation journey where they can unleash their creativity.

We will draw inspiration from various sustainable practices in the fashion industry to initiate an ideation jam, where participants will explore various quick and tangible tools to co-create innovative and impactful solutions. Together, we will brainstorm and develop actionable ideas on how we, as consumers and stakeholders in the fashion industry, can make a meaningful impact and drive change towards sustainability from our unique standpoints.

Participants will join a journey to transform the fashion landscape and craft a more sustainable future.

KEYWORDS | CO-CREATION, SOCIAL INNOVATION, CLIMATE CHANGE, SUSTAINABILITY, PARTICIPATIVE DESIGN, IDEATION, SOCIAL CHALLENGE, DESIGN THINKING, POSITIVE TRANSFORMATION

BEYOND WORDS: IMAGE, GESTURE AND EMPATHY

Pixie Tan, Nidya Shanthini Manokara and Melissa Quek

ABSTRACT | What is lost when we rely solely on data and words in our design research? How can we become more attuned to our participant experiences and develop empathy through embodied experiences?

Drawing on the visceral experience of translating between two distinct artistic languages, in this two-hour workshop we aim to find non-verbal methods to capture and communicate the ephemeral things that words cannot express. We invite participants to explore the ephemeral nature of human feelings through a combination of movement and visual zine-making techniques.

Guided by two facilitators - one from each discipline - the workshop will follow a structured yet creative process. Firstly, In small groups, participants will verbally share experiences centred around the themes of transience, human connection and what's lost in translation when we rely only on words. These experiences will then be expressed through individual and/or collective gestures, allowing each participant to physically embody its meaning - as they comprehend it to be. These gestures will be captured through photography, creating a visual record of the movement.

Secondly, inspired by aspects of applied drama where experiences are shared and authorship dissolved, participants from different groups will then interpret and communicate these photographic captures into 2D visual forms such as collages and drawings, using zine-making techniques to compile their work. This creative process will facilitate the translation of movement into visual art, further exploring the nuances of human connection.

The workshop culminates in a sharing session where participants will present their interpretations, discovering similarities and unique perspectives within the group. The final product of the workshop will be a collaborative embodied zine composed entirely of images—

physical and embodied images such as kinesthetic, aural, and tableau—expressing the rich tapestry of non-verbal communication and movement. This collective experience will highlight the transformative power of decolonizing traditional forms of expression and encourage alternative ways of listening and understanding in the design process.

KEYWORDS | EMPATHY, EMBODIED DESIGN, CROSS-DISCIPLINARY, ZINE MAKING, MOVEMENT, RESEARCH METHODS, GESTURES

APPLICATION WORKSHOP CUMULUS CONFERENCE MONTERREY 2024

Track 3: Education in Art and Design

THEME

Empathy in Design. *Physical Visualization as a creative approach to improve empathy.*

OBJECTIVE

Experiencing an experimental approach to practice your empathy skills.

TARGET AUDIENCE

Design Educators, Professionals in Art & Design.

EXPECTED NUMBER OF PARTICIPANTS

10 to 16

SCHEDULE

90 minutes workshop

NEEDED EQUIPMENT

A classroom with tables where participants can work together is small groups.

Abstract

Communication and Multimedia Design (CMD) is a bachelor level design education programme at Amsterdam University of Applied Sciences (AUAS). At CMD we aim to help develop a critical attitude among our students regarding the complex society we live in. Our students realize that it is essential to be empathetic towards the people for whom they design something, regardless of their beliefs and socio-cultural background.

However, often misconceptions arise when interpreting research-information that we use to get an understanding of the people with whom and/or for whom we design something. How can we explore that information in a way where we are aware of our own biases, and where there is greater understanding of contextual factors that influence everyone's interpretation?

We noticed that our design students need a suitable approach to step out of their own mindset to empathize with other people. As we know empathy is a skill that can be developed (Zaki, 2017), we have created a workshop that uses *physical visualization* as a creative approach to help improve empathy skills. With this workshop, we aim to stimulate social and cultural awareness and understanding through a co-creation making process of tangible *conversation pieces.* These conversation pieces are not the end goal; they are the starting point to discuss the various personal interpretations. We exchange and appreciate these interpretations as they help us to become aware of the diversity in how we understand each other.

Joint physical visualization means reflecting on the stories of people involved on the one hand, and experimenting with different forms of visual language, materials, and physical space to make those stories emotionally insightful on the other hand. (Huron, et al., 2023).

The participants of this workshop take home an experience that can help them empathize with other human beings in an alternative way the next time they start a design or co-creation process.

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ROBOTICS WITH US IN OUR MEANINGFUL PLACES: COMBINING ART-BASED METHODS WITH AI TO BUILD EMPATHY BETWEEN HUMAN-ROBOT INTERACTION

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ABSTRACT | This workshop explores the intersection of empathy and Human-Robot Interaction (HRI) through the art-based method of placemaking. Empathy, traditionally divided into cognitive, affective, and compassionate forms, has expanded to include digital empathy in the context of technology. The workshop will focus on designing empathetic HRI by understanding how robots may affect our connection to environments and places. The workshop includes two sessions: the first builds empathy by exploring meaningful places for participants, while the second envisions future scenarios where robots are integrated into these spaces. Participants will engage with AI tools and performative exercises to explore these future environments, culminating in a discussion on the role of empathy in HRI and how it can be fostered in future interactions with robots. This workshop aims to create new insights into designing empathetic interactions between humans and robots in evolving environments.

KEYWORDS | EMPATHY, HUMAN-ROBOT INTERACTION (HRI), DIGITAL PLACEMAKING, DESIGN FICTION, ARTBASED METHODS

Introduction

Empathy becomes even more relevant in this current era of mobilisation, humanitarian crises, and growing technological and digital advancement. Empathy is traditionally divided into cognitive, affective, and compassionate empathy. Recent years the definition has expanded (Sarantou & Miettinen, 2022) to cover also digital and kinesthetic empathy (Reynolds & Reason, 2012). Digital empathy is a skill related to the use of technology, including ethics and good manners in communication and interaction with other users (Sreejun & Chatwattana, 2023). For empathy to develop in the interaction between a human and a robot, the factors that can be used to build reciprocity during the interaction must be identified (Park & Whang, 2021). Empathy has a long history in human-centered design (Mattelmäki, 2014). The empathic design introduced by Leonard and Rayport (1997) covers techniques that require collaborative skills, an open mindset, curiosity, and advanced observational and emotional skills.

Emerging solutions in robotics, technology, and artificial intelligence (AI) will guide us to approach empathy at different levels. These technological achievements are already affecting our ways to communicate, feel, and act within new kinds of environments combining both human and non-human. This creates a need for solutions for envisioning different futures. Future foresight methods such as design fiction (Durfee & Zeiger, 2018) help to experiment with fictional worlds through diegetic prototypes and scenarios, which shake our thinking when designing new ways of interaction and communication. Future foresight tools combined with art-based methods such as placemaking open ways to evoke curiosity, while dealing with feelings and emotions connected to places.

In this 120-minutes workshop, we aim to gather 20 scientists from diverse research fields to discuss the possibilities of designing Human-Robots interactions (HRI) using the art-based method called Placemaking. Placemaking derives from cultural geography

(Lew, 2017) and is associated with a sense of place (Othman, et al., 2013). We perceive art-based and performative placemaking (Björn, et al., 2023) as a way to express feelings and emotions connected to future environments and places. This workshop aims to foster a shared understanding of imminent research questions at the intersection of empathy and human-robot interaction (HRI). It offers insights into understanding our imaginary future with robots and the effects of the environment on interaction and emotions. New approaches are tested to envision different futures and to build empathy between human-robot interaction by combining artbased and performative placemaking.

The workshop includes two design sessions. In the first session, we build empathy with the place. The aim is to understand a person's needs and emotions and what makes a place meaningful for them. In the second session, the participants envision how a meaningful place will look in the future if robots are brought into that place. The future scenarios are created with the help of AI. Through the performance, we go inside those scenarios. The workshop ends with discussing how these methods help to build and understand empathy in the interaction with humans and robots. The discussion aims to point out the meanings of empathy, and can these meanings be met in future scenarios with robots.

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THE COUNTRY OF ORIGIN EFFECT: MAPPING DESIGN VALUES AND PATTERNS

KEYWORDS: COO, DESIGN, VALUES, STRATEGIC, PATTERNS, SYSTEMS

The Country of Origin (COO) is a complex, multidimensional phenomenon influenced by various factors explored since the 1960s. Initially, this effect was defined through observation and empirical evaluations. However, decades of studies have revealed its intricate impact on a country's economy. A critical aspect is the evolving country-image, shaped by successful storytelling and consumer perceptions. This perception, built through various parameters, affects purchasing decisions and requires strategic promotion. A country's brand and product image, often influenced by renowned categories, can significantly sway consumer decisions.

In the 1990s, Roth and Romeo highlighted the importance of aligning marketing strategies with the country's image and relevant product categories to meet consumer expectations. This alignment considers the consumer's social status, familiarity with the product, and emotional connection to the product's cultural and traditional background. Various factors, including pricing, technology, perceived quality, and aesthetics (linked to status symbols), play crucial roles and can be optimized through precise design strategies.

Moreover, the COO now extends to intangible values such as services, which enhance the positive perception of a product category and impact the overall COO positively. This broader understanding reflects the evolving complexity of consumer perceptions and the necessity for dynamic and inclusive marketing strategies to leverage the COO effect effectively.

The *main objective* of our workshop, is that through a round table format, discuss and map out the COO effect comparing Mexico and Italy to define a set of characteristics or categories. A *specific objective* is to use those categories for a survey or questionnaire for a research project that will be translated into an analytic tool for advanced design.

Our *target audience* are researchers and postgraduate students interested in design management, advanced design and identity that seek to identify the design for value aspects. We expected a small number of *participants between 10-15*.

The *agenda* runs between 1 hour and a half maximum, divided into 3 sections: introduction, mapping and discussion. The *equipment required* is a projector, post-its, whiteboard for collaborative ideas and a space with tables.

As an input we will use systems thinking methodologies, placing research questions, templates and cards. The interaction with the participants registering on this round table workshop will help to produce an interesting output to compare values and patterns for the COO effect.

SYSTEMIC DESIGN INTERVENTIONS: UNDERSTANDING THE TRANSFORMATION TOWARDS THE CIRCULAR PLASTIC ECONOMY THROUGH THE LENS OF AQUACULTURE CASE.

Aleksandra Stasiak

ABSTRACT | The global ocean pollution and increase in plastic resources calls for action. The circular economy (CE) strategies grew in popularity. The implementation complexity is still challenging, with limited practical examples of long-lasting implementation. This doctoral research paper discusses the circular economy transformation in aquaculture. Research by design and System-Oriented Design (SOD) is the major methodological backdrop for exploring the systemic changes within the circular economy transformations. The conducted data collection explores the complexity of the process and interventions of circular practices with the dynamic nature of systemic relations. The doctoral research aims to contribute to open discussion and accelerate progress in better circular practices for plastic resource management from the collaborative work of design practices with the industry. Using the design methodology aims additionally to connect creativity and visualizations in approaching complex problems for transdisciplinary practice.

KEYWORDS | SYSTEM-ORIENTED DESIGN, PRODUCT DESIGN, PLASTIC OCEAN POLLUTION, CIRCULAR PLASTIC ECONOMY, SYSTEM THEORY

1. Introduction

The transition towards a blue economy and aquaculture has led to a significant increase in plastic resource use, which has tripled over the past 50 years (Skirtun et al., 2022). The high use of plastic resources is being identified to have further ripple effects towards global inequality, unsustainable practices, and a triple planetary crisis (UNEP, 2024). The fish breeding industry has been steadily growing with a focus on food production and Norway is among some other countries in Asia and South America where the blue economy is a part of a national strategy (FAO, 2022; Skirtun et al., 2022). Plastics are used in a variety of applications in the major construction of fish pens and supportive elements like ropes, nets, fish pens, feeding pipes, buoys, as well as walkways, handrails (Skirtun et al., 2022; Sundt et al., 2018). The growing focus on aquaculture results in growing production and consequently growing waste of plastic components (Skirtun et al., 2022) with an estimate of 25000 tons ending up in the sea (Huntington, 2019). The debris, along with macro- and microplastic pollution deriving from aquaculture, pose a direct threat to marine life. This, in turn, has a domino effect, impacting human life, recreational activities, and cultural values (Skirtun et al., 2022).

In response to global plastic pollution and resource scarcity, the CE strategies promise more responsible resource use as part of the EU Green Deal international intervention. In aquaculture, the adoption of circular systems can have transformative impacts. These systems are anticipated to substantially decrease plastic use and mitigate climate impacts, contributing to a more sustainable industry. Furthermore, they are aimed for enhancing traceability which can lead to improved accountability, logistics, and management. The reduction of plastic consumption is expected to mitigate environmental burden but also encourage the development of local knowledge and technology. Moreover, such an approach should contribute to process optimization and energy efficiency, further pushing the industry's environmental responsibility and operational effectiveness (Greene et al., 2022). Differing from other types of fishing, aquaculture is characterized by a higher

control level over the materials, where implementation of circular strategies can add up the positive impact on the macro- and possibly microplastic streams. Although the involvement of industry itself is crucial for such a transition, circular plastic solutions would require the development of design systems for best reduction, reuse, repair, and recycling practices. Consequently, these require control measurements along with governmental considerations such as innovation and facilitation of recycling activities (Skirtun et al., 2022).

While looking into the definitions of CE increasingly look beyond merely the 3Rs of reuse, repair, and recycle and turn towards the systemic perspective (Kirchherr, Yang, Schulze-Spüntrup, Heerink, & Hartley, 2023; Superti, Houmani, & Binder, 2021). In a recent study, Kirchherr et al. (2023, p. 2) highlighted the view for "fundamental systemic shifts, particularly with regards to existing supply chains". However, the systemic approach, while being integrated into the scholarly discourse, is often overlooked by practitioners who may prefer implementing minor adjustments (Kirchherr et al., 2023). The practical implementation and the concept of the CE find incoherency and complexity as it remains filled with diverse conventions, definitions, and interpretations, often reducing it to merely a buzzword. Such ambiguity creates overwhelming complexity and difficulties for companies in implementing CE in practice (Desing et al., 2020; Kirchherr et al., 2023), especially if only economic reasons are being addressed (Tosi, Gusmerotti, Testa, & Frey, 2024).

This tension between the growing trend of CE and bottlenecks with implementation finds its direction within collaborative study and flexible design (Tosi et al., 2024). Ecodesign or design for circularity, which uses a lifecycle approach, has a critical role in product development, encouraging business practitioners and designers to consider a product's journey through various life stages of plastics beyond mere recyclability. The CE furthers this concept by transforming design strategies into economically viable practices (Doorsselaer, 2022; Grimstad, Ottosen, & James, 2023). It encompasses an array of areas including products, systems, business models, and services (Kirchherr et al., 2023; The Ellen MacArthur Foundation). The design of fishing gear and aquaculture equipment in plastics differs, however, from consumer plastics due to their specificity of application. The design takes into account multiple factors such as safety, durability, and mechanical properties for use throughout multiple cycles. For plastic as a component, understanding the physicochemical changes during the use phase may be critical for safety and recyclability (Grimstad et al., 2023) that will affect circular solutions.

CE reflects the high level of design, systemic, value chain and business model complexity that meets with various difficulties in applying interventions in practice (De Angelis, 2021; Ghisellini, Cialani, & Ulgiati, 2016; Tosi et al., 2024) and is dependent on local systemic factors (Ghisellini et al., 2016). Plastic, a prevalent material in various industries,

contributes to a layered and complex issue, particularly within the context of systemic immaturity. The circular economy of plastics has been studied from multiple angles, but there is a gap in the exploration of these perspectives from a design viewpoint, particularly in fields like fish farming.

The role of design in sustainability transitions has been gaining attention. It can visualize complex systems, identify key leverage points, and develop strategies for sustainability. Design methodologies could reshape current practices, minimizing plastic waste, optimizing resource use, and enhancing overall sustainability (Ceschin & Gaziulusoy, 2016). Design has therefore widened its spectrum, shifting its intervention focus from solely product design to a 'cradle-to-cradle' approach. This method highlights the full life cycle of a product, spanning from the extraction of raw materials to its eventual waste (McDonough & Braungart, 2002). Consequently, this broadened perspective from the product to its life-cycle stages has significantly lifted the contribution of design to environmental interventions, enabling a more comprehensive and holistic viewpoint on the matter (Tura et al., 2019).

Sevaldson (2022) who worked broadly with the term system-oriented design, identifies that systemic perspective helps in understanding the complexities and interconnectedness in the systems. Such complexities can be translated to what CE represents as entering or being a basis for building new systems. This perspective sees systems as an interconnected whole, paying attention to the dynamics, relations, and complexity of the systems, and subsystems involved. The systemic perspective also addresses the issues of changeability, which finds also its application in the context of the design in CE, given the dynamic nature of resource use, waste generation, and environmental impacts (Sevaldson, 2022). The circularity seems connected to systemic thinking where the challenge lies in effectively communicating these systems due to their inherently non-linear structure. As Meadows (2009, p. 5) notes, "systems happen all at once," signifying the interdependencies of systemic components can be difficult to grasp. The complexity can theoretically explode into infinite constructs in each direction, making it impossible to build knowledge on. Thus, boundaries need to be established and created to fit within human cognition as a form of visualized mental model (Meadows, 2009; Stephens, 2013).

Current barriers recognized in the change towards circular value chains in this study include the challenge of achieving profitability in new business models, insufficient global regulation, and ineffective enforcement of regulations. In the project the access to an adequate volume of secondary resources has been identified as a concern. For such a transition to be successful, new value chains collaborate between all stakeholders in the chain, ranging from producers, fish farmers, and recyclers, to consumers. Such changes in the system and between the systems can be achieved through recognition of leverage

points that play an important role on the interventions. The leverage points in the systems are points that can direct the shift in the systemic dynamics to consciously initiate the change towards the intended goal (Meadows, 2009).

This study explores the systemic interventions in the transformative process toward circularity within the multidimensional landscape of policies, stakeholders, materials, and communication. The study is based in the aquaculture case study with the use of by the methods of GIGAmapping. Research by design and SOD is a practical methodology enabling mapping complexity that allows looking at the system dynamics and having a broader understanding of the complex problem (Sevaldson, 2022). Using design methodology for industrial application has the potential to bring broader perspectives and stronger transdisciplinary transformations toward tackling the global pollution crisis and the local potential for change. The experimental design methodologies can also open for creativity approaching communication between various stakeholders and the complexity for the circular plastic systems in the innovation for sustainability. Specifically, two questions were subtracted:

- What are the CE interventions in the study introduced by the project influencing systemic shift?
- How does SOD methodology impact multistakeholder collaboration towards CE implementation?

2. Background

The Norwegian authorities have ambitions for the country to emerge as a pioneer in the circular economy, allocating extensive financial resources. The Action Plan for Circular Economy, under the umbrella of the EU's Green Deal, seeks to ensure resource consumption remains within the planet's capacity (Stoknes & Rockström, 2018) and to double the use of circular materials in the forthcoming decade.

System theory and CE literature are the backbone for understanding the recent transformation trends in organizations in the doctoral study (Kirchherr et al., 2023; The Ellen MacArthur Foundation). The methodological fundament is leaning on SOD in the context of the aquaculture-specific value chain. Regarding interventions for the CE, these embrace a broad range of actions. Certain actions related to the specific project case are predefined in the aquaculture circular transitions. In terms of other systemic interventions, these are the emergence of the analytical part of the SOD. In SOD the approach towards the problem is dynamic rather than single problem-solving oriented.

The project is set to develop new solutions within value chains for the aquaculture industry by establishing closed loops for plastic equipment. This will be achieved through reuse, repair, lifetime extension, and the incorporation of recycled materials in new products, leading to savings in

material resources, energy, and costs. A more sustainable approach to plastic resource utilization post-end use in the aquaculture industry necessitates changes across the entire value chain. From a circular perspective, an increased focus on material recycling and design for reuse and recycling is prioritized. Additionally, the new equipment designs will also need to factor in resource efficiency requirements following the Taxonomy Regulation (Regjeringen, 2021).

The project owners in the collaborative project case study aspire to generate knowledge that has international reach within the circular economy with their operations spanning multiple countries including Norway, Chile, Iceland, Canada, and the UK. Plastic-made aquaculture equipment constitutes approximately 43% of the turnover, with around 42% dedicated to material recycling. The company aims to raise this to 100% in the following years, which project partners aim towards.

This study aims to facilitate the reuse and extension of the lifespan of various aquaculture equipment such as floats, bottom rings, clamps, walkways, nets, ropes, handrails, feed hoses, and various pipes. Through substantial investments, partners have allocated more funds to the recycling and production technology. This allows for the allocation of human resources towards the development of circular strategies, thereby reducing financial risk for the companies involved. The collaborative nature of the project further enhances the understanding of the multifaceted complexity involved.

3. Methods and research design

The method of GIGA-mapping involves the visualization of complexity to make it available for all participants, to at all times in the process have an overview of the totality of the states of the system (Ashby, 1960) and thus be able to perform analysis upon these variables. The analysis can be performed by identifying flows, expectations, communications and so forth.

GIGA-mapping is therefore a form of visualizing complexity and acknowledging visual communication, dynamics within the system, and changeability aspects to embrace a more holistic approach. SOD is aiming not to solve problems, but rather embrace complexity to understand and navigate through complex situations (Checkland & Poulter, 2020; Sevaldson, 2022). The use of SOD in a multistakeholder project facilitates a holistic analysis and design approach. This is achieved by aligning the products from one process with the starting points of another, enhancing the communicative capacity of key points, and diversifying perspectives within the process. Consequently, the design process employs visualizations to interconnect complex systems, aiming to foster transdisciplinary communication and potentially establish novel communication channels (Giraldo Nohra, Pereno, & Barbero, 2020). In the circular economy process shift, the designers address the complexity, with multiple dimensions to follow from flows of materials, energy, or stocks.

Combination of system thinking, circularity, and transdisciplinary approaches therefore of a system-specific behavior beyond the objects including communications, relations, and possible interventions with the use of the visual GIGAmap tool (Sevaldson, 2022).

GIGAmapping lead further to introduction of the interventions in the system and across the value chain. Data collection is based on the constantly ongoing and developing work packages of the partners involved in the project. Involved partners include the production value chain: solution provider, major suppliers, customers, and a recycler. Additionally, the project involves research centers in polymer science, and an ocean research center.

- Semi-Structured Interviews: This project employs semi-structured interviews to facilitate open communication among project partners. Interviews were conducted with four key partners involved in the value chain and principal operations.
- Additionally, interviews were carried out with research centers specializing in plastics and ocean research based in Norway.
- Partner Workshops: Workshops utilized models and tools from Peter Jones & Kristel Van Ael's "Practice Tools for Systemic Design" (Jones & Van Ael, 2022). The primary goal of these workshops is to establish a common language to address issues, thereby mitigating misunderstandings and miscommunications among various fields. Shared methodologies, such as workshop tools, aim to foster collaboration, addressing cultural and national strategies (Jones & Van Ael, 2022).
- Field Work and Observations: Field visits to fish breeding operation sites were conducted to gain a visual comprehension of the practical challenges.
- Active Generation of Project Documents: All partners participate in the work packages integral to the project, leading to knowledge creation and new project inputs. This dynamic co-creation of knowledge is a part of visualization and gigamapping processes.

4. Results

The major volumes of plastic materials have been pre-identified to apply circular interventions within the studied case. The three major interventions of reuse and recycling of fishing nets, prolong lifetime of load-bearing materials and recycling of plastics from the floating collars have been identified for the project focus. Using the systemic design process the other existing interventions have been mapped and connected to the expanded strategies of the 3Rs: prolonging lifetime, reduce, repair, recollect, reverse logistics, reuse, recycle remanufacture and remarket (The Ellen MacArthur Foundation, 2013; Uvarova, Atstaja, Volkova, Grasis, & Ozolina-Ozola, 2023) (Figure 1).

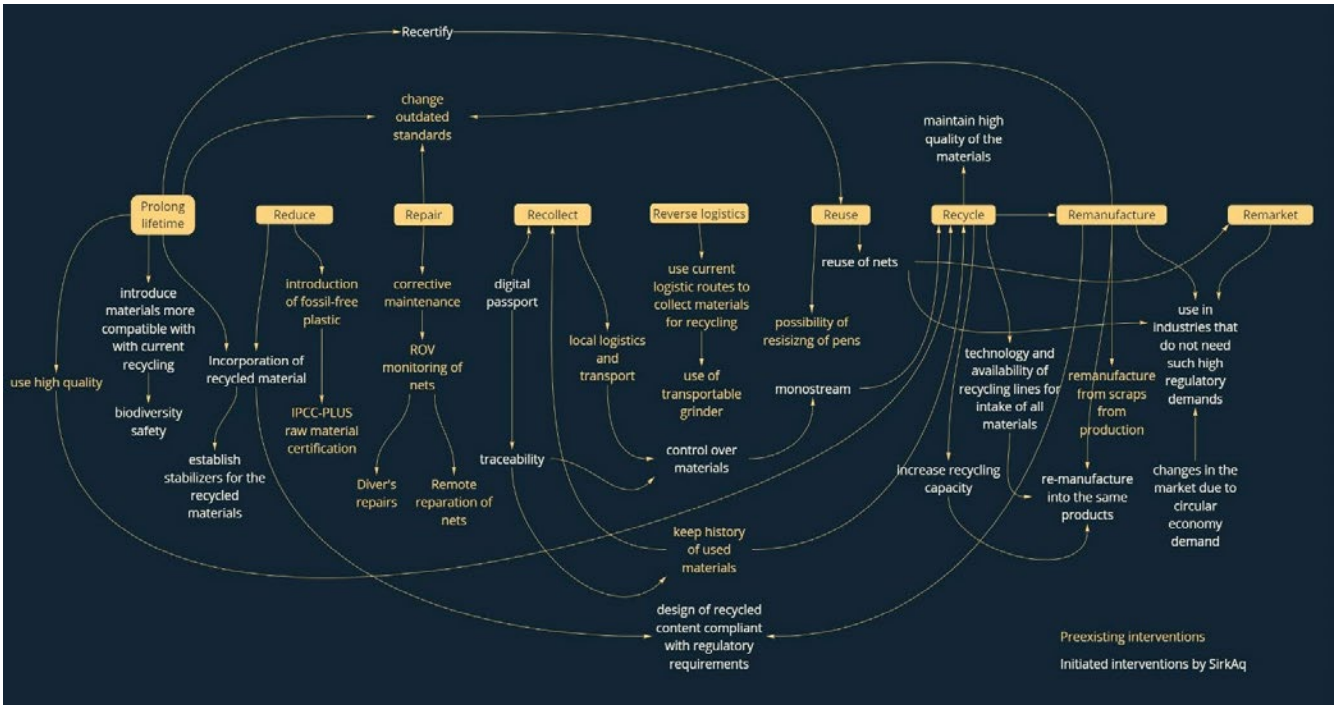

Figure 1. Identified pre-existing strategies within the value chain embracing circular economy.

4.1 Prolonging Lifetime and Standards

In heavily regulated sectors such as those involving load-bearing materials, high-quality and durable materials are used, contrasting with areas like packaging where plastics often have shorter lifespans and does not require any additional construction safety considerations. The use of recycled materials in remanufacturing is currently limited, primarily due to safety and durability requirements, which can present barriers to innovation.

Addressing these challenges necessitates enhanced collaboration at various levels. Stronger connections between organizations at the macro level, involving regulatory bodies, industry groups, and research institutions, could lead to effective national and international frameworks. These frameworks can provide guidelines for incorporating recycled materials into remanufacturing, ensuring safety and durability, and contributing more significantly to a circular economy.

4.2 Reuse

The strategy of reusing components can be applied within the same operation or outside the industrial environment, primarily depending on the quality and potential application of the components. However, implementing reuse strategies outside the organization introduces a new layer of complexity and requires the formation of new partnerships. Often partnerships are not yet mature on the market hence the other level of unpredictability. Despite these challenges, such strategies present significant opportunities for entrepreneurial development. Communication within such

opportunities requires further examination of the accessibility of materials, technological applications, and market demands.

4.3 Recertification

Currently, load-bearing materials are standardized for specific lifetimes. However, there's potential for extended use if weaker elements are replaced and the product is recertified. The project aims to influence standards and prolong the lifespan of materials by incorporating a circularity approach in load-bearing construction and supporting economically viable recertifications. Despite these efforts, a systemic environmental challenge has been identified. The recertification process for new materials can result in substantial emissions and costs, largely due to transportation and reassembly. This creates significant barriers to the implementation of circular strategies. Therefore, it's crucial to thoroughly examine the relationship between circularity and environmental impact.

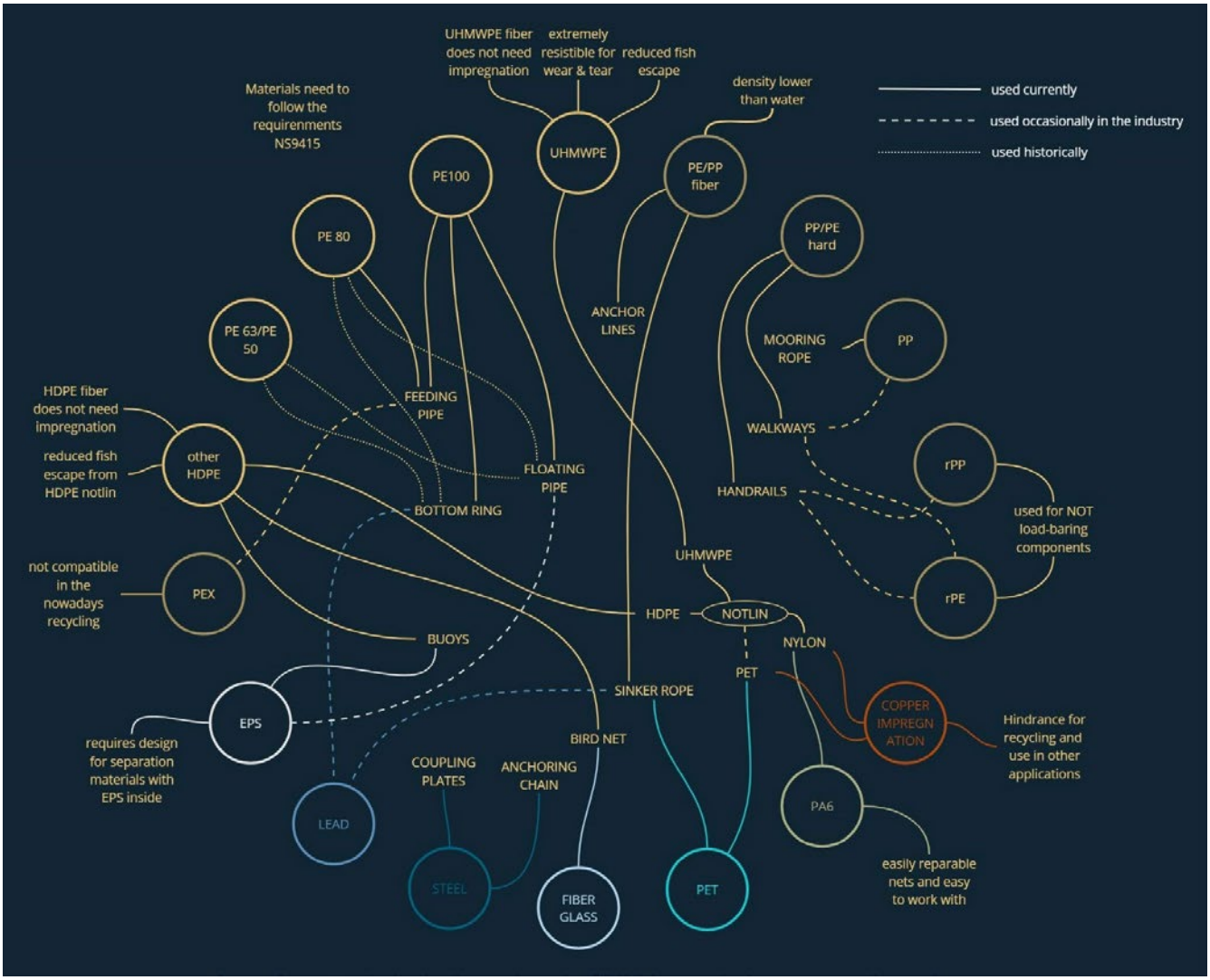

Figure 2. Visualization of different plastic and connected metals used in the major components of fish pens

4.4 Materials in product design

The plastic materials used in the fish pens design consist of multiple types and qualities of plastics (Figure 2). Some are connected to metals that are an integral part of the construction.

The current diversity of materials echoes the challenges inherent in the design process. In Figure 2, the materials that contribute to the major volumes are of a higher number than the amount of the products these are used for. The use and application of materials hinge on various factors such as function, production period, type of application, economic circumstances, location, and the availability of parts in the value chain. However, the selection of materials often overlooks the potential for recycling in a technological sense, as well as the availability of recycling technology locally. Additionally, the relationship with other stakeholders and market needs for reuse purposes is often not taken into consideration. These two interventions from the design for circularity perspective require more attention in the early stage of business development.

Recycled materials, such as rPP or rPE, encounter obstacles from a regulatory perspective as they fail to meet the required properties for load-bearing materials. The widespread expectation that recycled materials should perform identically to virgin plastics often impedes the acceptance of changes in material performance. However, embracing these changes as features rather than flaws could open up new possibilities from a systemic design perspective and prompt a shift in design focus.

From the communication perspective, the study shows the tension between the stakeholders. While designers do not have enough knowledge of materials, engineers don't have enough knowledge about design for circularity. This tension creates a restricted approach towards finding solutions and difficulties in handling complex problems based on long experience and regulatory landscape.

4.5 Changing factors

Regulatory changes and technological advancements have necessitated significant alterations within the material handling process, including repurposing, resizing, and material replacement. Regulations have prompted the substitution of certain materials in construction with higher-quality alternatives, while others have been replaced due to non-recyclability. These interventions, while embodying a commitment to circular design, introduce system delays. Materials produced to date will persist in product stock, eventually reaching their end-of-life phase and requiring new applications, as is the case with materials like polyethylene 63 (PE 63) or PE 80 (Figure 2). From a circular perspective, material loops returning to the same system will not be endless, necessitating the development of new solutions beyond incineration due to the systemic delay

(Meadows, 2009). This unpredictability of supply and end markets, especially regarding recycling facilities, poses a significant challenge.

4.6 Collaboration and Practical Competence

1. Repair & Maintenance

Creating more robust ties with service companies could significantly improve the practical competence involved in introducing superior practices to maintain high quality while closing the loop in aquaculture. A particular area of study is how servicing practices, specifically mechanical and technological interventions, impact the quality of materials post-use.

It is crucial to consider how these servicing practices interact with the materials at hand. The wear and tear on materials due to mechanical stress, as well as the potential effects of technological interventions, can significantly influence the materials' quality and, subsequently, their suitability for reuse or recycling.

However, the study of communication interventions with repair and maintenance services warrants careful consideration. The focus should be on developing practices that do not cause harm to the materials and ensuring the control of impurities which involves a broader understanding and redefining "waste treatment" to "material treatment" by stakeholders and employees. Sustaining high quality throughout the product's lifespan is crucial, not just for the immediate functionality of the product but also for its potential to be recycled and integrated back into the production cycle. By optimizing these aspects, the efficiency and sustainability of practices in the aquaculture industry, can contribute to a more circular economy.

2. End-phase & systemic pressure

Initial design strategies in various industries frequently rely on the technology and capacity available during the end-phase of the product lifecycle. However, the practical scalability of these resources can often be limited, posing challenges for the effective implementation of these strategies. For example, while chemical recycling is frequently highlighted as a promising future solution to close the loop in waste management, this technology is not yet accessible on a practical scale with a low emissions factor. This discrepancy between theoretical potential and practical application can create gaps in the system.

Recognizing these limitations is the first step toward effective intervention. By acknowledging the constraints inherent in current practices, strategies can be adjusted and refined to better align with the realities of available technology and capacity. Further, fostering a stronger connection to the end phase from the outset of the design process can serve as a proactive intervention. This forwardthinking approach can guide the design strategy to consider end-phase resources and limitations from the beginning, rather than attempting to adapt the product or process retrospectively.

This intervention could promote a more balanced resource management within the system. By integrating end-phase considerations into initial design strategies, resources can be allocated more effectively, potential waste can be minimized, and the system can move closer to achieving a circular model. This aligns with the principles of sustainable development, advocating for a system that meets present needs without compromising the ability of future generations to meet their own needs. The application of such interventions, therefore, has the potential to significantly advance sustainable practices in aquaculture.

The recycling industry appears to be significantly underestimated during both the planning and practical phases. This leads to high pressures on the end phase, with little predictability about the incoming materials and potential market. A progressive development approach could balance the system's resource input and output and improve management capacity. Changes in extended producer responsibility are shifting the roles of producers towards taking full responsibility for their equipment and recycling processes. These shifts might increase ambiguity around the role of recyclers, potentially leading to more specialized roles or diminished roles.

4.7 Systemic Perspective

This study examines the shift towards circularity enabled by new rules initiated by policy and law changes in the EU. The shift towards CE changes communication dynamics and fosters collaboration of embedding new paradigms not only in the one organization but rather across firms. Drawing however from the feature or systems simultaneousness and leverage points, circularity could benefit from being further analyzed as information flow and paradigm shifts as leverage points that can be further explored based on SOD methodology.

5. Discussions and conclusion

This doctoral research embraces two major perspectives of CE and its application in the aquaculture sector. The first perspective focuses on the transition toward a circular economy within the aquaculture sector. This part of the research is dedicated to the exploration of the ongoing shift from a traditional linear model to a circular one in aquaculture. By studying the practices in the case and principles being adopted, as well as the challenges encountered during this transition, the research aims to highlight the strategies that can be helpful.

The second perspective involves the application of SOD and Research by Design methodologies to manage the complexity of the circular economy. Given the intricate and systemic nature of CE, which involves a wide array of interconnected elements and dynamics, this research will utilize the SOD approach to assist in understanding and managing these complexities.

5.1 Circularity transition in the aquaculture context

The aquaculture industry has a strong level of control over the materials and from that perspective, it has a great area of development CE shift. The aquaculture touches as well on multiple globally valid resource and sustainability issues that has itself a great potential translate the knowledge between industries, fields and disciplines.

The analysis identified several critical areas for intervention in the transition towards CE. The dynamics of systemic shift but also micro, meso, and macro levels are interesting from their role of transitions that Kirchherr et al. (2023) discuss. As in many other areas, recycling stands still strongly as a major focus of projects requiring more attention from the perspective of strong pressures toward circular understanding at scale and interconnected processes that face challenges due to unpredictability in the supply and end markets (Ghisellini et al., 2016). The research found that the pressure on the end phase of the recycling process could be reduced with a stronger connection to service companies and a more pragmatic approach to design ambitions. Recognizing the limitations of the current situation and ensuring a stronger connection to the end phase from the outset could lead to more balanced resource management within the systemic understanding.

Systemic changes in regulations of material handling have been necessitated, where technological advancements and interventions have introduced new dynamics to the value chain. However, technology is still not compatible with higher demands for recycling, application, and market expectations. Some materials are still not compatible with recycling technology and the end-phase is disconnected from the early design phase and material choice. Such a disconnection may suggest the root cause problem within the function of CE itself. This may not be seen as an independent system but a paradigm as a leverage point that needs more attention beyond organizational structure, signaling a complete paradigm shift within the systemic shift.

5.2 Use of methodology

The use of SOD as a methodology for addressing complexity and the dynamics between the systems are easier recognizable to address tensions (Tosi et al., 2024). Adopting a systemic design perspective can open up new possibilities in the CE transitions especially since a higher level of communication is required to handle a large scope of resource problems. The application of experimental frameworks can catalyze cross-disciplinary discussions among stakeholders involved in the value chain and connected to the Norwegian economy, moving beyond the field-specific terminology. GIGAmapping can be particularly effective in this regard. As a tool for transdisciplinary communication, the study shows that invited participants from a range of backgrounds

are able to contribute to the dialogue and therefore reduce the epistemological gap (Giraldo Nohra et al., 2020). The diverse perspectives brought to the table illuminate the complexity of the subject, rather than reducing it. In this way, GIGAmapping enables participants to embrace the multifaceted nature of their discussions fully. It serves as a platform for an in-depth understanding of field-specific challenges and for fostering collaboration among diverse stakeholders. By facilitating a comprehensive discussion, GIGAmapping has a potential to lead to more innovative and effective discussions on the large scale systemic circularity shift.

SOD can be further studied and hence has the potential to be embraced as a methodology in discussing real-life complexity in the field of aquaculture, plastic pollution or similar.

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STRANGE STRANGERS IN STRANGE LANDS : A COLLABORATIVE STORYTELLING GAME FOR COMMUNITY BIODIVERSITY ACTIVISM

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ABSTRACT | This workshop explores collaborative storytelling games for speculative fabulation in Community Bioiversity Activism, aimed at: researchers and practitioners in design; those interested in Speculative Design, Queer, More-Than-Human and Decolonial perspectives on design and society; and biodiversity and community activism.

The Strange Strangers Playset (see Figure 1) is based on a Biodiverse Futures Design Framework, in which futuring practices framed by Queer Ecology1 are articulated; and which is designed to support Community Biodiversity Activism2 through Speculative Design (Jeffcott & Ferreira, 2021). It draws on the Conceptual Character3 of the Strange Stranger, who decentralises the human by framing all beings as "uncanny, familiar and strange simultaneously." (Morton, 2010). The playset is designed around a collaborative storytelling game, Strange Strangers in Strange Lands (See Figure 2). Collaborative storytelling games create a space which permits the making together of futures, such that they are materialised in the present2. The design of such games is a scaffold to shapes a space for the creation of fictional worlds and influences the sorts of futures that emerge. (Acharya & Wardrip-Fruin, 2019; Begy, 2013; Coulton et al., 2016). Strange Strangers in Strange Lands is designed to allow collaborative creation of biodiverse futures based on the principles of Sympoesis, where we make better futures together with others (Haraway, 2016); of prioritising transitional states over fixed categories; of storytelling to engender care; of playfulness as a speculative strategy; and of Pluriversality: embracing multiple worlds. The Playset is designed to support Community Biodiversity Activism, through making such speculative practices tangible to community members. The hope is that the sensitivity to possible futures engendered by collaborative and biodiverse speculative practices can help communities to oppose mono-cultural futures in the shadow of a narrow, human-oriented present. Workshop participants will explore the emergence of possible biodiverse futures from the perspective of

More-Than-Human3 beings. The objectives of the workshop are to: explore how collaborative storytelling games can support speculative practices in Community Biodiversity Activism; frame the world from a Strange Stranger's perspective; identify environmental challenges; create biodiverse futures in response through collaborative storytelling gameplay; debate the feasibility and value of emergent futures; and explore how futures can become materialised through design. The three hour workshop draws on the methods of speculative fabulation and making, collaborative game play, storytelling, concept mapping. The workshop (50 minutes) opens with an introduction (10-15 minutes) and an icebreaker guessing game (10 minutes). Following this, participants will work as a group identifying a local environmental challenge (10 minutes). After a break (10 minutes), the group will play the Strange Strangers in Strange Lands collaborative storytelling game (45 minutes), in which the group will co-create a pluriverse of fabulated futures or elseworlds. This is followed by a discussion of the feasibility and desirability of these futures, through a mapping exercise (15 minutes), ultimately choosing one particular future to focus on. Following a short break (10 minutes), the last part of the workshop will involve working in smaller groups to materialising that future in the here and now through speculative design activity prompts (40 minutes); afterwards, we will share and discuss the outcomes collectively (20 minutes). During the workshop, participants will make use of laptops and projectors, flip charts, craft materials (scissors, coloured pens, glue sticks, stickers etc) and lo-fi physical prototyping materials (Modelling Clay, LEGO Bricks, Sandboxes etc). Through these activities, the Strange Strangers in Strange Lands will result in the tangible outcomes of nascent speculative elseworlds that represent possible futures, speculative design artefacts that materialise those worlds, the gain of expertise in critically assessing pluriversal futures, and an understanding of how speculative gaming and a design framework situated in queer ecology can support community biodiversity activism through speculative design.

KEYWORDS | SPECULATIVE DESIGN, COMMUNITY ACTIVISM, QUEER ECOLOGY, FABULATION, BIODIVERSITY

[1] a lens that rejects arbitrary binaries between beings blurs the false dichotomy between nature and humanity.

[2] The myriad ways in which communities take action towards protecting their ecosystem, whether within or in opposition to existing systems of environmental management and legislation.

[3] An archetype personifying a philosophical concept (Deleuze & Guattari, 1994)

[4] Such a space for the emergence of fictional worlds has been referred to alternatively as a Diegetic Void, in which an empty space is provided that imposes some character on the world that emerges (Jara, 2023), and as a Simulation Gap, where the suspension of disbelief is required to breach the boundary condition between the fictional and the real. (Begy, 2013)

[5] A name for "post humanist constituencies" that encompasses "non-humans and other than humans such as things, objects, other animals, living beings, organisms, physical forces, spiritual entities, and humans." (Bellacasa, 2017)

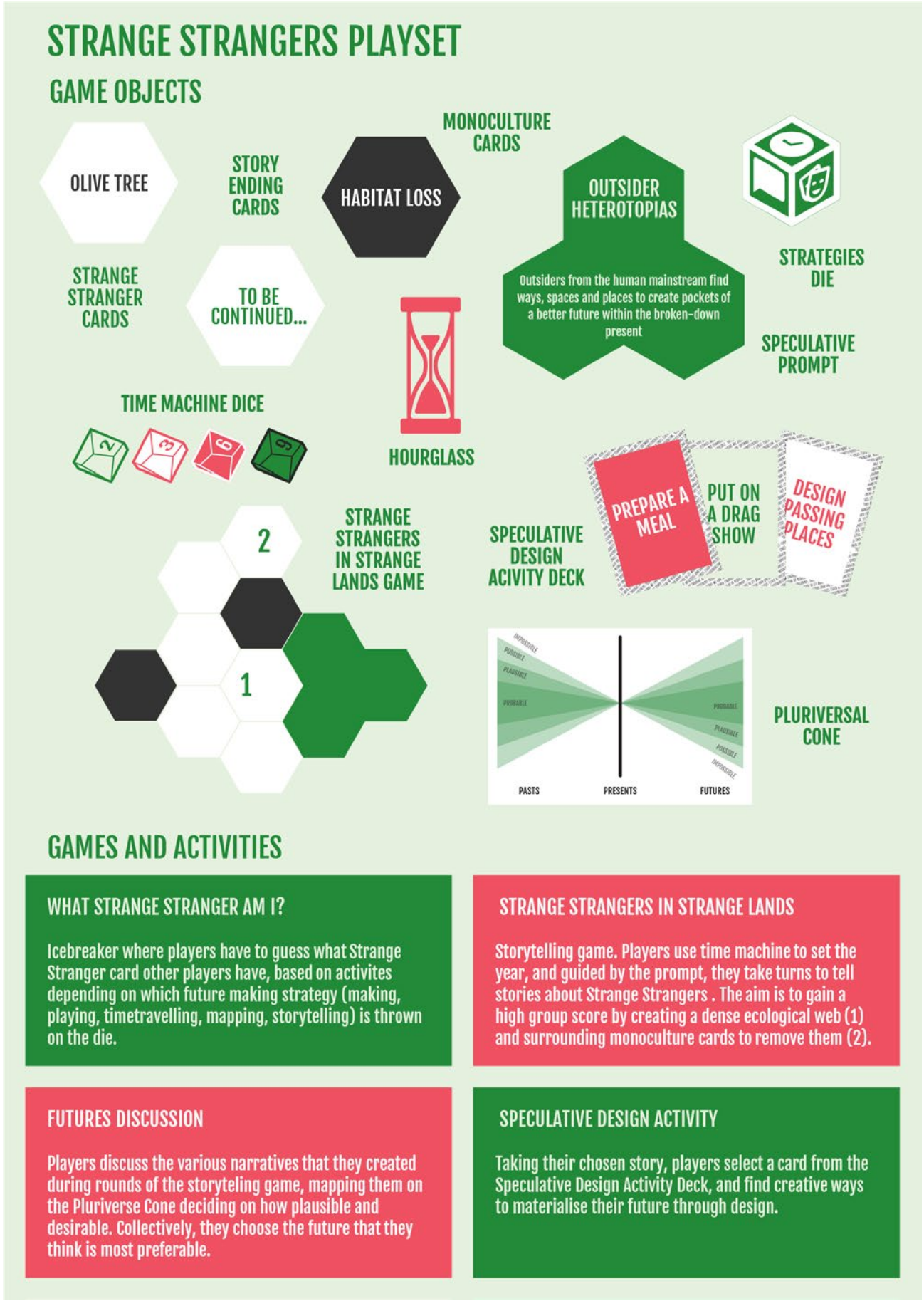

Figure 1. Overview Diagram of the Strange Strangers Playset, showing its game objects and games and activities

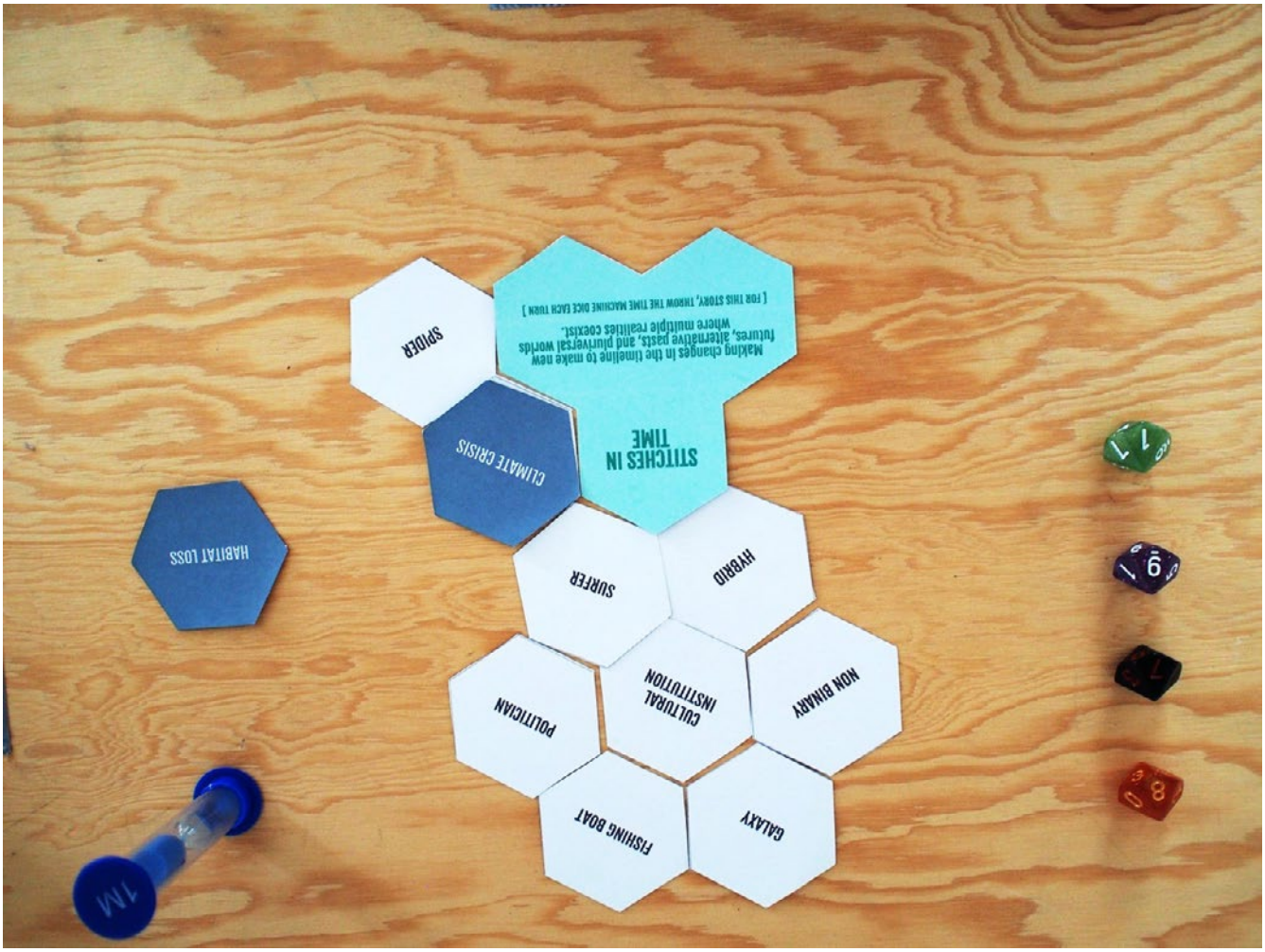

Figure 2 : Illustration of a game of Strange Strangers in Strange Lands in progress : players take turns to build up an ecosystem map by telling a story based on speculative prompts, aiming to maximise the biodiversity while eliminating monoculture cards (in grey).

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SLIDE DECKS ABSTRACTS

ART AND DESIGN ACTIVITIES AS DATA

Dávid Farkas and Ádám Radványi

ABSTRACT | Generalizing tendencies and creating comparable analytics for art and design have long been challenging due to the diversity of activities in these fields. No single database has been designed to serve as a comprehensive basis for such research.

To address this, we have developed a dynamic, form-based web application to administer and manage activities ranging from publications and events (including exhibitions and media appearances) to awards, artworks, and other creations. This web application integrates with the university's other systems, enabling the conclusive identification of students, teachers, researchers, and their collaborations.

With this data, we can generate detailed reports for our staff and their leaders on their achievements. Additionally, we created a collaboration map that visualizes the internal and external collaborations of our university in a network, highlighting highly collaborative individuals and allowing us to monitor the evolution of these networks over time. Furthermore, we built a Natural Language Processing-based competency finder to identify faculty and students proficient in specific skills, even if those skills are not explicitly listed in any of the input texts.

Leveraging our experience with these tools, we are now developing a more generalizable, user-friendly, and AI-based version of the platform and database. This enhanced system aims to benefit not only our institution but also other art and design institutions globally.

KEYWORDS | DATA SCIENCE, NETWORK, COLLABORATIONS, AI, DIGITAL TRANSFORMATION

CULTIVATING COMMUNITY COLLABORATIONS TO FOSTER SOCIETAL CHANGE

Claire Campion

ABSTRACT | Within the context of the third level Design education, the student is appropriately insulated within the classroom environment as they are guided through the structured collegiate experience. However, as educators, it is increasingly evident that, through our pedagogical methodologies, we must work to cultivate collaborations between students and external communities. Responsive teaching that asks students to answer live project briefs with associated real world design problems encourages a proactive way of learning rather than the traditional reactive style of study. 'Real world' briefs demand that students engage and collaborate with individuals and communities that sit outside of the expected academic populace. In this way we encourage young designers to solve design problems that work towards societal change – they are asked to confront the realistic demands on the contemporary designer in a changing world.

At the National College of Art and Design (Dublin, Ireland) Communication Design students join the Design Bureau as part of their third year of study. A teaching space is cultivated that encourages exploration, experimentation and both internal and external collaboration. Internally, students are taught to progress their skills with a cross-disciplinary approach as Graphic Design, Illustration and Moving Image Design students work together. Additionally, live project briefs are set that demand students collaborate externally with various communities, breaking down the barrier between the academic setting and real world societal design problems.

During the 2024 Spring Trimester the Design Bureau was presented with the opportunity for students to contribute to the conversation around future development opportunities for a local vacant textile mill. Property, land ownership and the accommodation crisis are hugely current societal issues in Dublin and so this invitation to set a project brief that would include the young creative voice in this discussion was a unique and important opportunity. With the guidance of tutors, multi-disciplinary student groups responded to the vacant mill as a catalyst for creativity. Once a building's intended purpose has been fulfilled or is no longer required, its role transitions

and presents new opportunities. Its components can be salvaged or recycled, contributing to sustainable practices. The end of its primary use doesn't signify the end of its story; rather, it marks the beginning of a potential transformation or a journey toward its next phase.

Throughout the project, students engaged in collaborations with local community groups and the Dublin City Council. In this way students stepped outside of the insulated classroom setting and into the real world space of design for positive societal change.

Concurrently, during the spring trimester, students took part in the Creative Boardroom project. This unique initiative asked Communication Design students to collaborate with directors of businesses from the Institute of Directors, Ireland; to develop innovative and effective solutions that address the complex environmental challenges we face in Ireland today. This government supported project is the first of its kind with a series of workshops hosted to facilitate intergenerational conversations and design sprints on the topic of climate change. The initiative offers a further example of collaborations that expand the academic experience while simultaneously allowing students to address global challenges.

KEYWORDS | CULTIVATING COMMUNITY COLLABORATIONS, FOSTERING SOCIETAL CHANGE, RADICAL PEDAGOGY, EDUCATIONAL INNOVATION

GOTA AND GULSHAN: POETIC ADORNMENT

Nida Abdullah

ABSTRACT | This talk will discuss an ongoing research investigation and ongoing development of a body of work. This is a research inquiry that explores making practices surrounding a textile adornment material “gota”, which traces its roots to the pre-colonial Indian sub-continent. This project focuses on the practice of embodied making as a form of witnessing. It engages with a inherited lineage of practices, materials, presences, histories, bodies, temporals and false borders. In this way the research examines gota’s (also known as gota patti, gota kinari, zari work or lappe ka kaam) socio-cultural significance as a communication object.

Gota is an ornamental embroidery technique which originates in pre-colonial India. It traces its lineage through a cross cultural fascination between the Mughals and the Persians. This shared interest in embellishment created a fertile ground for the development of gota in pre-colonial India, where materials and labor were easily exploitable.

Gota developed into an appliqué and embroidery technique using gold and silver tinsel thread (known as zari) onto fabrics such as cotton, chiffon and silk. It has distinct pleating, twisting or folding style markers which make up its visual language. Gota adorned objects are forms of knowledge transfer across many generations, typically handed down from mother to daughter. The use of precious metal and intricate hand work made it accessible historically only to the royalty, wealthy class, where the technique was used on elaborate dresses for occasions, especially weddings. For those of less wealth, these dresses would cost a lifetime’s savings and possibly even debt to its owners. In this way, gota becomes an object that transfers with it a kind of soft power as it is typically handed from woman to woman.[1]

The research inquiry asks how can gota adorned objects be a form of cross-generational and cross-border knowledge transfer? How can they embody ways of making? These forms of visual inquiry incorporate the poetic concept of “gulshan,” an Urdu and Persian word for garden. This is the closest translation, though it falls short in capturing the full social, cultural and spiritual meaning of the word. Gulshan is a poetic symbol for [the] beloved, a symbolic place of immense beauty or happiness. Here this concept may reference a land or time now lost. These textile

compositions as inquiry include multilingual typography, traditional gota patterns and motifs (elements such as peacocks, paisleys, and floral features), embroidered with gold zari; exploring the shared cultural meaning and memory of gulshan.

How does the poetic concept of gulshan intersect with the adornment practice of gota? How might multilingual typography (in Urdu, Farsi, Arabic and English) intersect with floral gota and zari kaam (textile adornment practices) calling up a brightness that we (diaspora) hold in our collective memory and collective imagination? How will these compositions sit within a long and inherited practice of poetic adornment? How does gulshan intersect with bare-e-saghir (subcontinental) diasporic adornment practices of gota and zari across time, bodies, borders and space?

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KEYWORDS | GOTA, INDIAN-SUBCONTINENT, FIBERS, DECOLONIZATION

TRANSFORMATION TO A CIRCULAR CAMPUS

Kwok Yiu Chan, Chi Yeung Choi and Chun Ting Leung

ABSTRACT | Circular Campus Initiative

The Hong Kong Design Institute (HKDI) stands as a design education institution in Hong Kong. Deeply rooted in experiential learning, the institute allows students to engage in hands-on activities that necessitate a variety of materials, ranging from textiles to construction elements. However, upon the end of these educational activities, a significant amount of these materials is often wasted.

This situation presents an imperative to reassess and incorporate resource management strategies in teaching and learning activities, design and research projects both inside the institute and with the community.

The institute is embarking on a transformation into a “Circular Campus”, a new initiative that aims to agglomerate design education, applied research and campus operations. This initiative is driven by the Butterfly Diagram of Circular Economy Systems, identifying the “Technical Cycle” and “Biological Cycle” to bring circular economy theory into practice with on-site recycling, redistributing, and redesigning of valuable resources for educational and communal use.

II Go-Greenovate Campaign

A campus-based campaign, Go-Greenovate, is established that emphasizes and promotes the importance of innovation and creativity in driving sustainability practices forward. The term combines Green – representing sustainability; and Innovate – representing creativity and innovation, encourage institute staff, students, and the surrounding community to achieve a shared goal of reducing waste across different platforms, demonstrating how creativity and resourcefulness can be applied to creating greener solutions for learning, teaching and design commercialization.

After surveying on campus operations and material consumptions in learning and teaching activities, tracking systems are set up to monitor the amount of materials that are used and can be redistributed, reused, or recycled through the internal cycles of the circular campus and external cycles with partnering communities and non-profits organizations.

Multi-disciplinary projects are identified from working group discussions among design programmes and campus administrations. The common goal of sustainability has enabled a wide spectrum of design specialists within the institution to work together for more impactful and holistic solutions that are relevant to societal needs. By integrating circularity principles and sustainable practices with design innovation, design projects with real-life challenges are introduced to educate future designers to enhance their vocational and professional skills.

III Significance

The Go-Greenovate campaign aims to become a knowledge hub for applied design research on sustainable design and craftsmanship that can bridge the connection among academia, industry and community.

KEYWORDS | HONG KONG DESIGN EDUCATION, CIRCULAR DESIGN, CIRCULAR ECONOMY, DESIGN PEDAGOGY

TECHNOLOGY AND MĀORI NARRATIVES IN DESIGN EDUCATION AND RESEARCH

David Hakaraia

ABSTRACT | Aligned with New Zealand's commitment to enhancing Māori student participation and achievement in higher education, my research and teaching philosophy is rooted in the Tertiary Education Strategy. This strategy recognises Māori as tāngata whenua (indigenous people of N.Z) and Crown partners under Te Tiriti o Waitangi, mandating that Tertiary Education Organisations facilitate Māori educational success by respecting and integrating Māori language, culture, and values.

At the heart of my teaching philosophy is the belief that students are creative and responsible arbiters of design and mātauranga Māori (Māori knowledge). I strive to cultivate an inclusive and culturally responsive learning environment where Māori perspectives are central. Integrating Māori knowledge, values, and perspectives into the curriculum ensures that Māori students see their identities reflected in their studies. This includes the use of Māori language and the incorporation of tikanga Māori (Māori customs). Additionally, I encourage students to be critical thinkers who can engage with emerging technologies and understand their impact on diverse people and the planet. This fosters the creation of innovative students who appreciate the unique whakapapa (genealogy) and relationships we have with our surroundings. Promoting an educational approach where students work across disciplines and embrace inclusivity, we envision a world where designers are empowered to create with profound and practical impact. My research philosophy is centred on exploring how modern fabrication techniques and Māori narratives can combine to create contemporary Māori design. This approach aims to take Māori creativity in a new direction while drawing on a rich legacy of history and cultural development. By expanding traditional Māori conceptual thinking into modern design, new avenues of learning and understanding are exposed. Key aspects of this research include the integration of digital technologies. Experimentation with digital technologies such as laser cutters, CNC machines, and 3D printers offers an opportunity for Māori knowledge to be communicated and shared using modern mediums. These tools of expression can offer a level of integrity comparable to traditional arts and crafts.

Addressing the debate within the Māori community about the merit of contemporary Māori art and design versus customary practices, as discussed by Damian Skinner in “The Carver and the Artist,” is another crucial aspect of my research. There is a tension between maintaining traditional narratives and embracing contemporary innovation. My research seeks to bridge this gap by showing that modern techniques can enhance rather than diminish the cultural significance of Māori design. Enhancing understanding through storytelling is also vital. Storytelling is crucial for the intergenerational transmission of knowledge. By incorporating narratives into design, we can convey important cultural values, history, and societal norms. This includes using traditional art forms like Whakairo (carving), Raranga (weaving), and Tā moko (tattoo), alongside modern technology to create tangible cultural expressions.

My work contributes to the survival and well-being of Māori as a people. It aims to foster greater knowledge and use of Māori language and tikanga Māori, as well as the development of mātauranga Māori. By combining traditional Māori knowledge with modern technological capabilities, this research enhances Māori cultural expression and creates broader applications in the field of contemporary Māori design. Through this integration, we aim to empower a diverse community of students and faculty to make significant contributions to society and culture both nationally and internationally.

KEYWORDS | INDIGENOUS, MĀORI, DESIGN, EDUCATION, STORYTELLING

CO-DESIGNING HEALTH COMMUNICATION FOR NEURODEVELOPMENTAL DISORDERS IN SOUTH ASIA

Alifiya Mutaher and Reema Deshpande (online)

ABSTRACT | The Project is a collaborative initiative between an India-based non-profit mental health organisation, a UK-based University, a Nepal-based parent-led non-profit for Autism, and a Sri Lanka-based government medical college, supported by three funders. It endeavours to establish an evidence-based pathway for the early detection and intervention of neurodevelopmental disorders (NDDs), focusing on Autism and Intellectual Disability (ID) among young children in districts in India, Sri Lanka, and Nepal.

Our team worked alongside the project's Community Engagement Team to co-design and develop a communication strategy and tools for caregivers, facilitated by frontline workers (FLWs) to engage with the project care pathway. The co-design process highlighted several critical insights in community engagement in low-income settings for a complex and stigmatised health condition in South Asia.

The objectives of the communication tools were twofold: firstly, to increase awareness regarding child development delays and care pathways for ASD and IDs and secondly, to foster acceptance and engagement with project interventions led by FLWs. Community engagement builds trust, mobilises resources, fosters sustainable collaborations crucial for better health outcomes (WHO 2020), and strengthens local knowledge and capacities, promoting involvement in health programs (O'Mara-Eves 2015).

To design comprehensive communication tools, Quicksand led a year-long co-design process with various stakeholders, including

- Audience of the Communication Tools: Caregivers and parents of children with ASD and IDs and typically developing children.
- Health System Cadres: System Level Health workers and Health Specialists

- Program Teams: Community Advisory Boards including Autistic Individuals, Country Site Program Teams including NDD specialists and Global Program Leads

We applied a framework of co-learn, co-decide, and co-design (McKercher 2020). We engaged with each stakeholder to different degrees, using various approaches across project stages. This process led to outputs co-created by multiple stakeholders, centering the voices of parents and caregivers of children with ASD.

Given that the project had a limited budget and a fixed time frame, it required us to design communications tools that were applicable across the four project sites while accommodating local nuances. Co-designing with stakeholders from each site was essential in informing a communication strategy that reflected the unique contexts and negotiated the needs of each site, instead of imposing communication tools that sought to enforce behaviours that didn't meet the population where they were. Sustained engagement with stakeholders instead of a one-time interaction for ongoing decision-making, buy-in, stakeholder ownership and long-term sustainability of a communication strategy was critical.

The process demonstrated the need for thoughtful community engagement and how project plans needed to reflect this in resource and time allocation.It was also evident that all stakeholder touchpoints needed clear objectives that would respect community involvement, particularly in contexts where time poverty is a genuine challenge.

We aim to share insights at the intersection of design and global health, contributing to a deeper understanding of the complexities in co-design and community engagement in South Asia. We emphasise the critical role of community-centred approaches in achieving sustainable health outcomes.

KEYWORDS | COMMUNITY ENGAGEMENT; CO-DESIGN; PARTICIPATIVE DESIGN; INCLUSION; NEURODEVELOPMENTAL DISABILITIES; COMMUNICATION TOOLS; SOUTH ASIA; UNIVERSAL HEALTH COVERAGE

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REPRESENTING RISK: RADICAL COLLABORATION IN A DESIGN CLASSROOM

Angela Norwood and Yaqing Helen Han

ABSTRACT | A collaboration between an undergraduate design course and an international, multi-modal research project collecting data on perceptions of risk in LGBTQ2S+ young women in three cities: Melbourne; New York; and Toronto yielded novel opportunities for interdisciplinary knowledge exchange. The course was delivered as a vertical studio — comprising second through fourth-year undergraduate Design students. The international research team functioned as clients by introducing the research project to the class, providing access to the data, and visiting at key points throughout the term to ensure project progress and success. The students, many of whom identify as members of the population targeted in the research, worked to organize, amplify, and honour the data shared by participants in the form of web-based data visualizations and a physical pop-up gallery.

In an effort to reach broader audiences, social science researchers have been grappling with different modes for data translation and knowledge mobilization. Design education has been exploring ways to integrate social science research methodologies to inform applied outputs. While design is increasingly well-versed in various modes of co-creation and participatory processes, collaborations between designers and research teams remain relatively rare. However, such partnerships recognize the value of interdisciplinary cooperation and provide co-learning opportunities for both the research team and design students. Recent findings highlight the substantial impact of creative artifacts on public discourse, education, and policy-making, (Leahy, 2022) as they provide an opportunity to foster awareness by means of creation, sharing, and exhibiting data translations.

These novel collaborations between designers and researchers provide numerous opportunities for graphic design to transform research findings. UX/UI design can facilitate the accessibility of research findings through digital interfaces, such as websites and mobile applications. Information design can systematically visualize and organize both quantitative and qualitative data, enabling more effective translation of research results to diverse audiences. Communication design can employ visual systems to represent complex information, and convey

in-depth knowledge. Thus, graphic design emerges as an exceptional means of knowledge mobilization, serving to present and represent research data, while simultaneously creating accessible platforms for knowledge dissemination.

The vertical studio format provided a space that enabled knowledge from both fields to flow, clash, intersect or fuse. That knowledge exchange coupled with the diversity of the students' skill sets and interests in relation to the data, was leveraged as interdisciplinary, instructional material." (Peterson & Tober, 2014) Our reflections reveal that the topic of risk not only defined the research, it also permeated the vertical studio and creative making. The sense of community in the classroom, fostered by affiliation through gender identity with each other and the research participants, allowed for freer exploration of visual forms, deeper compassion for the experiences recounted in the dataset, and easier collaboration through organic team restructuring.

We will share selections from the exuberant visual output of the course and subsequent pop-up exhibit. The semester-long experience with the design students inspired the researchers to reconsider their approach to their own research.

KEYWORDS | DESIGN EDUCATION AND RESEARCH TRANSLATION, INTERDISCIPLINARY COLLABORATION IN DESIGN EDUCATION, PERCEPTIONS OF RISK AMONG LGBTQ2S+ YOUTH, INFORMATION DESIGN AND DATA VISUALIZATION VERTICAL STUDIO, SELF-SELECTING TEAMS

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KINESTHETICS AND INTEROCEPTION: FUTURE DESIGNS FOR MORE THAN FIVE SENSES.

Eugenia Bertulis

ABSTRACT | Designers are often described to be translators, developing and iterating specifications across analytic, written, visual, and experiential languages such as sound and touch. Especially when partnering with technology-centric teams, written and analytic languages can be more highly valued, resulting in largely neo-liberal utilitarian measures for design success. On the other hand, ethical design practitioners champion further human (and more-than-human) modes of sense-cognition. For example, moving beyond Visual Design and considering all five "classic" or "Aristotelian" senses can synesthetically extend design touchpoints into experiential channels. This presentation shares a progression of design moments, starting with analytic design briefs and collaborative visual design criteria development, and concluding with audience-engaged interactive experiments and sensory design examples, investigating future opportunities in design considering kinesthetic and interoceptive senses.

The examples critique the current modernist-colonial default visual design languages that result from "usability" studies and simplistic form-follows-function hierarchies. Furthermore, the design explorations shared interrogate the role of "Artificial Intelligence" and other tools enabled by Big Data and Surveillance Capitalism, comparing supporting, hybrid, and Centaur models in Design for all the senses.

KEYWORDS | USER-EXPERIENCE DESIGN, DESIGN AND TECHNOLOGY, HUMAN-CENTERED METHODS, SENSE-COGNITION, DESIGN FUTURES

DECOLONIZING DESIGN: EQUITY IN PARTICIPATION

Juliana Edith Rojas Reyes, Jordana Baron and Isabel Sandoval

ABSTRACT | Circular Campus Initiative

The initial objective of our project was to co-design a comprehensive package that promotes a supportive and gender-equitable environment for young adolescents in Indonesia, enabling them to grow and thrive. This objective necessitated a holistic approach, considering not only the adolescents themselves but also their key influencers, including parents, family members, and religious leaders. To achieve this, a powerhouse team was formed, comprising the GEAS Youth Advisory Board, Johns Hopkins Center for Communication Programs, PKBI Bali, and ThinkPlace US.

Process:

Our process began with a thorough review of existing literature to synthesize information that would frame the design process. This involved generating insights and identifying opportunity areas that could serve as focal points for intervention. Subsequently, we conducted co-design workshops to transform these insights into actionable ideas. The ideas generated were then prioritized and further developed into concrete design concepts.
These design concepts were translated into prototypes, allowing us to visualize potential interventions. These prototypes ranged from medium to high fidelity and were rigorously tested and iterated upon to refine their effectiveness and feasibility.
Establishing Equitable Relationships:

A central question throughout our project was, “How might we establish equitable relationships with the communities with which we are designing?” As a global north-founded, based, and funded organization conducting a project in the global south, we recognized the importance of leveraging our diversity. Our team consisted of designers from both the global south and north, which enriched our perspectives and approaches.

To ensure equitable relationships, we made our local partners integral members of the team, providing them with the necessary support to build ownership of their roles. This approach was crucial in fostering an environment of mutual respect and collaboration, where local insights and expertise were valued and incorporated at every stage.

Community-Centered Design:

As designers, we adhere to the principle of placing users and the community at the center of the design process, engaging them in every step. While this user-centric approach is not new to our discipline, what is innovative in our project is the commitment to ensuring that for every stakeholder we involve, we strive to give more than we take. This philosophy is part of our broader effort to decolonize our practice, ensuring that our interventions do not perpetuate existing power imbalances but instead empower and uplift the communities we serve.

In conclusion, our project represents a concerted effort to create a gender-equitable environment for young adolescents in Indonesia through a collaborative and community-centered design process. By integrating diverse perspectives and fostering equitable partnerships, we aim to develop interventions that are not only effective but also sustainable and empowering for the local communities. This approach highlights the importance of decolonizing design practices and prioritizing the needs and voices of those we seek to support.

KEYWORDS | EQUITY, PARTICIPATORY, DECOLONIZATION, SOCIAL IMPACT

STRATEGIC FORESIGHT FOR SOCIAL IMPACT: UTILIZING DESIGN TO PROMOTE EMPATHY AND INTERCULTURAL UNDERSTANDING

Ellen Hlozan and Alex Lobos

ABSTRACT | Strategic foresight is a pivotal tool for navigating future uncertainties by systematically envisioning potential outcomes. Bridging the gap between science fiction and strategic planning enables a proactive engagement with unforeseen forces that significantly influence today and tomorrow.1 This presentation explores how strategic foresight promotes empathy and intercultural understanding, which are crucial in today's globally interconnected society.

At a recent industrial design graduate studio, students were introduced to strategic foresight tools, including weak signal scanning and scenario building,2 which help to identify fragmented indicators of future trends and explore potential futures based on these signals. They used these tools to create speculative scenarios across social, technological, environmental, economic, and political (STEEP) categories.3 Students presented their scenarios via imaginative short videos. This format stimulates discussions on uncertainty and the dynamics of change, thereby fostering a deeper understanding of the potential societal impacts.4 Student's scenarios ranged from envisioning economies devoid of money—where AI provides necessities and human motivation shifts from materialistic to intrinsic values—to nations collaborating extensively to mitigate resource scarcities and balance population demographics, and even presenting a decayed city of Venice where material pollution has taken over natural resources and urban infrastructure, making waste one of the only resources available. As a second part of the assignment, students developed speculative solutions for issues identified in the scenarios. These solutions included novel systems for indoor farming, modular housing made out of corals, minimally invasive medical scanning devices, and many more.

These scenarios and speculative designs help students to understand potential large-scale changes in a structured manner, enabling them to visualize a sequence of cause and effect that could result from certain developments. This visualization also helps to understand how different futures might coexist, encouraging students to think critically about the broader implications of design decisions.5 Integrating strategic foresight in the design process provides several key benefits, including:

1. Mitigating Risk: Foresight methods help designers think beyond the immediate, consider the long-term consequences of design decisions, and work towards a more desirable future.

2. Bridging Across Boundaries: Foresight encourages designers to consider diverse perspectives and anticipate challenges related to cultural, geographical, and economic differences. This fosters empathy and promotes the creation of solutions that cater to a wider range of users.

3. Designing Towards Autonomy: Through scenario building, designers can envision futures where users have greater agency and control over their lives. This empowers designers to create solutions that support user autonomy and promote a proactive approach to shaping the future, instead of simply reacting to challenges.

Strategic foresight is not about predicting the future; it helps to prepare for it in a way that incorporates empathy, ethics, and a broadened understanding of cultural dynamics into the design process. Teaching future designers to employ foresight in their work allows them to create more thoughtful, inclusive, and culturally aware designs that improve human interactions and societal cohesion on a global scale. This approach ultimately helps to cultivate a design philosophy that values change and actively contributes to a preferable, empathically connected future.

KEYWORDS | STRATEGIC FORESIGHT, SPECULATIVE DESIGN, SOCIAL CHANGE, INDUSTRIAL DESIGN, FUTURES SCENARIOS, DESIGN RESEARCH, DESIGN PROCESS

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THE EVOLUTION OF COLLABORATION: TRACKING BENEFITS OF ALTERNATIVE INSTRUCTION METHODS

Deidra Arrington and Hawa Stwodah

ABSTRACT | Universities offering degrees in fashion design and fashion merchandising/ marketing silo the program tracks with little interaction or collaboration between the two, which is counterintuitive in the preparation of students in an industry where designers and merchandisers work together to bring creative ideas to fruition through saleable, desirable fashion products. The lack of collaboration and basic understanding of the function of design and merchandising in fashion education led two professors (1 from design and the other from merchandising) to the creation of a new course combining fashion design and merchandising students in a studio environment where they spend a semester creating a line of apparel.

The course and research explore the incorporation of action learning and simulation teaching methods in fashion education prepares students seeking fashion careers. It contributes to the field of fashion education by introducing a method of cooperative teaching, which includes peer teaching, experiential learning, critiques, and critical thinking resulting in the cross-pollination of parallel and intersecting, but disparate disciplines. The instruction is made possible through teachers from analogous, but differing backgrounds, who bring insight into the classroom demonstrating to students the team work and flexibility required to fuel an inspired result. Students learn to adapt to different work environments and creative problem solving through the simulation of a 'real world' workplace. The studio course created to address the void in the curriculum has been monitored and documented since August 2019. The course has transitioned through several disruptive semesters where modalities have pivoted and counter-pivoted and has mirrored the changes occurring in the fashion industry.

The course is process oriented, meaning it is organized to lead students, who work in teams, through the entire line development process as it generally occurs. Students are given a prompt for the semester, which have included denim, adaptive apparel, inclusive sizing, and activewear.

Based on the prompt, students research the consumer, marketplace, and industry. They identify the inspiration and the ethos of the brand they will create. Sketches of proposed looks are presented, from which the line is selected. The final selections become flats and are rendered in CLO3D. Technical aspects of line development such as, cost sheets, specifications, and line sheets are required. Lastly, marketing and advertising plans are created. To enhance the learning of each process step, guest speakers address topics in their areas of expertise including, team building, textiles and fibers, forecasting, sustainability, and marketing. An industry critic, with expertise in the particular topic, takes on the role of creative director and visits the class (in person and on zoom) throughout the semester to evaluate the progress of the teams. They are present in the studio for the final presentations, where a 'critic's choice' winner is selected.

The teaching methods of the course have resulted in a greater appreciation of design and merchandising from their respective counterparts, an increase in student engagement in the studio, and an elevation in work quality.

KEYWORDS | FASHION DESIGN AND FASHION MERCHANDISING, COLLABORATION, COOPERATIVE TEACHING, EXPERIENTIAL LEARNING, CRITICAL THINKING, CROSS-POLLINATION, SIMULATION OF A 'REAL WORLD' WORKPLACE, PROCESS ORIENTED

WE ALL NEED A HOME: CO-CREATING SUSTAINABLE SHELTER

Tibor Danyi

ABSTRACT | The Research Group for Solidarity in Architecture Lakni Kell (We All Need a Home) initiative in Hungary is based on a solidarity framework for design thinking practices. We assert there is no acceptable architecture and design without solidarity with other citizens/communities/the public. Unhoused populations are our core concern with homelessness resulting from a housing crisis one of the greatest challenges facing many so-called “developed” societies, particularly in North America and Europe.

We learn with community partners as we collaborate to contest complex socio-economic conditions. Resulting interventions in public and private spaces are small scale with increasingly complex programmatic ambition. These efforts expand the conception of designers as citizens while improving the lives of people we serve.

This design-build project learns from from cross-disciplinary architecture and social psychology research insights. Ultimately a team of researchers, students, citizen allies and unhoused residents created a durable, protected living space that minimizes the ecological footprint while addressing more equitable social possibilities.

The research phase employed qualitative methods to document survival strategies and creative techniques by which this community finds shelter despite a forbidding housing policy context. Those findings illustrated how participants creatively used local materials and simple techniques to realize functional homes with minimal ecological impact compared to more advanced housing technologies. Adaptive insights from these individuals in marginalized communities evidence resistance to systemic obstacles within the homeless care system, allowing otherwise unhoused people to keep relationships intact in “homes”.

With these ecological and social findings as a basis, the student-led collaborative design established sustainable materials, a means of co-construction that included students and the resident family and neighbors, and definition of the housing program through the lens of the family’s needs. Construction with donated, up-cycled materials ensured a circular economy and minimal

ecological impact. This included timber from demolished houses, leftover thermal insulation, festival tent membranes, and door panels. A couple who had established a highly vulnerable shelter in the gardens (leaking and subject to flooding) participated across the entirety of these processes and informed many decisions about how to achieve a viable house and home reflective of their sense of belonging.

As an example of socially engaged architecture the prototype has catalyzed ongoing dialogue with political leaders about the potential for transformations of public parcels in Pecs, a municipality of 140,000. This shelter for an unhoused couple can be a model for more systematic use of the gardens for permanent housing, particularly considering that local homeless organizations do not provide long-term housing for married couples, partners, and families.

The project demonstrates how environmental sustainability goals might also serve economic and ultimately social sustainability outcomes: minimizing waste produced in the consumer society model can contribute to the alleviation of social inequalities through the framework of solidarity. Finally this project provides an expanded sense of the possibilities of co-creation to engage with solidarity and in an equitable way with the lived expertise of unhoused communities to address serious social problems.

KEYWORDS | CIRCULAR ECONOMY, HOMELESSNESS, SOCIAL SUSTAINABILITY, PARTICIPATION

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OFF ROAD, TRY OUT & THE CHOREOGRAPHY OF MAKING

Nelleke Karst

ABSTRACT | Every conference we attend, exchanging information with global colleagues, we notice that how we do things is not so common. Perhaps even unique. We'd love to share what we do during Cumulus Monterrey, and start a dialogue.

Minerva Art Academy

Minerva Art Academy is an international learning community with four bachelor and four master programmes, spanning art, design, art education and popular culture.

Ten years ago, the Design bachelor built a programme that transformed compartmentalized majors into a broader, more open playing field, stimulating the crossing of boundaries between disciplines.

A set or a flexible playing field

Besides offering set courses, our students can also, to a high degree, influence their educational path, with the goal of allowing them to create their imagined future professional practice. Our program offers structural as well as one-off opportunities for students to flexibly plan their desired study route.

Major Cross overs: Off Road

In the propaedeutic year students go through a program of 5x7 weeks in which they get acquainted with our different design disciplines. Many incoming students haven't developed a strong preference for a specialism yet. Before year 2, they pick one of the five specific majors, ór the 6th: Off Road Design. On this transdisciplinary route, they can combine up to three majors during the rest of their study-journey.

This allows students to decide how they wish to describe themselves on their future business card. From 'installation building graphic designer' and an 'illustrating product maker' to a font focused storyteller'.

For whom?

After the first academic year, about 20% of our students choose the Off Road major, amounting to roughly 30 students. This shows that the majority of our students prefer a set major route, leading up to a specific specialty. In the Off Road group, about half consciously choose in the spirit of our intentions. To critically approach and shape their future profession. The other half are students who, generally speaking, have difficulty choosing direction and fear missing out.

Mapping out your own study journey

Off Road; the lesser trodden path. Carving out your own route. Like a jeep in an empty dessert. In his poem 'The road not taken", Robert Frost described a fine case of FOMO[1] avant la lettre, which resounds in determining one's study programme. Choosing this path asks of students to map out their own route. To critically ask themselves what they want to learn, in what order and through which medium. To trust in their own ability to create depth instead of fearing what they are missing out on.

Rooted in trust

Operating from a place of trust is essential to us, where also so much in education is about control, limiting the space for play and innovation. When starting this endeavor, crossovers were scarce and difficult to organize. When wanting to tear down the borders, we wanted to be progressive. Offer freedom, based on trust in the abilities of our students.

Why all his flexibility?

The future is now: create your own professional practice
Providing a clear definition of our profession is becoming more and more difficult. Pascal Gielen[2] stated that, as the future is racing towards us at an ever-increasing speed, this means that the preparing for 'employable graduates' is outdated. The future lies in the present and students must not be prepared for a future profession but should 'create' these professional practices themselves.

To offer educational support, the assignments in our course are described as Design Dilemmas. Not assignments with only one possible answer but issues in which students are challenged to consider possible 'solutions' while creating. Allowing for a specialty- as well as an off road- approach.

Try Out: a choreography of making

Along the way, Try Out became a motto for us.
The meaning of Try Out in theatre terms, offers the department the opportunity to have the audience (the user, those involved) be part of the development of education, and to experiment interactively with intended goals.

How else do we cross borders?

Besides the major routes, we offer a so-called “Switchboard semester” in which students can choose a wide variety of options outside of their regular program, allowing them to move closer towards their desired positioning. Ranging from taking courses in other specialty areas in our academy or doing an individual project, e.g. focusing on artistic research, or starting a business. The crossing of boundaries also happens in the theory components of our course. In theory, thinking through making is highly encouraged. Like critically editing a classic art history book, by (literally) cutting away, reshuffling, and adding new content or form to the book.

Additional slide deck input

In addition, we will present how our students try things out.
Like making a time-based installation for an interactive font.
Or work on theory by making.
We’ll conclude by circling back to the theme of the conference.
Through perspectives. Empathy. And creating the future in the now.

*1 Houghton, R. (2015). https://robinhoughtonpoetry.co.uk/2015/08/23/the-road-not-taken-fomo/

*2 Gielen, P. (2013). Kritisch Vitalisme. Culture + Education (37), 36 – 42.

KEYWORDS | OFF ROAD, TRY OUT, CHOREOGRAPHY OF MAKING, FLEXIBILITY, FUTURE IS NOW, EXPERIMENT, MAJOR CROSS-OVERS, DESIGN DILEMMA

THE FUTURE OF CRAFT

Elena Andreea Tron (online)

ABSTRACT | This research as part of an ongoing Master Thesis in Fashion Design entitled “The Future of Craft”addresses the challenge of keeping craft alive in a future where it is increasingly at risk of being replaced by new technologies. The thesis proposes a positive view of an uncertain future, following in the footsteps of Ursula K. Le Guin’s “Carrier Bag Theory of Fiction”. The essay posits that stories, and by extension cultural practices, should collect and hold diverse experiences rather than follow a singular, heroic trajectory. Le Guin’s metaphor challenges the dominant narrative of the lone hero overcoming obstacles, advocating instead a more inclusive, collaborative approach.

Similarly, the integration of digital tools with traditional craft techniques fosters a holistic design process, creating synergies that embody both the precision and innovation of technology and the tactile, experiential wisdom of craft. This blend can lead to innovative practices, combining the efficiency and replicability of digital methods with the ingenuity and longevity inherent in craft traditions.

Through a series of speculative scenarios, the research envisions futures where craft evolves into an innovative design tool, where traditional craftsmanship and modern technology coexist harmoniously, and where sustainable practices become integral to fashion. The study aims to inspire a sustainable and creative future rooted in the timeless principles of traditional craftsmanship.

As a research methodology, I chose practice-based research, based on my dual role as a practitioner and my strong belief that craft can only be studied holistically through practice. This approach posits that the most profound understanding of craft emerges through direct practice, where embodied knowledge is acquired through the act of creation and experiential engagement.

The themes I have chosen to research include

- Traditional weaving: Chosen for its familial significance and its role in preserving embodied knowledge.
- Zero Waste Pattern Making: Based on traditional folk clothing patterns, speculating on their evolution.
- 3D Weaving: Selected as the most advanced form of weaving to date.
- Bioplastics: Experimenting with kitchen-made fabrics as a form of grassroots innovation.
- AI: Embraced as a design assistant.

While most of the current discussion around craft focuses on its preservation, this thesis proposes to liberate it from the constraints of the past and, through speculative scenarios, allow it to evolve organically into an optimistic future.

KEYWORDS | THE FUTURE OF CRAFT, PRACTICE BASED RESEARCH, SPECULATIVE SCENARIOS, WEAVING, ZERO-WASTE PATTERN MAKING, BIOPLASTICS, CO-CREATION, FASHION DESIGN, MATERIAL INNOVATION

Cumulus conference: Design Across Borders - United in Creativity
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