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HAPTIC JOURNEY THROUGH CIRCULAR TEXTILES DESIGN PRACTICES

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Abstract

This paper presents an analytical framework designed to explore the educational barriers hindering the transition towards sustainability in the textile and fashion industry. The approach is based on the analysis of the ongoing Sustentare Project, which focuses on circular design methodologies and adopts the Textile Strategy Approach. Through the analysis and discussion of this project, we argue that textiles play a significant role in shaping cultural, economic, and ecological regeneration.

Moreover, the established framework offers a more refined understanding of how design can drive sustainability transitions. It introduces additional analytical tools to circular design thinking, allowing for a deeper exploration of its methods and potential impact on change processes. By advancing the discourse on education and competence development, we aim to enhance the visibility and tangibility of both the challenges and opportunities in the transition to sustainability, making them more actionable at individual and organizational levels.

Keywords*: Sustainable education; Textile strategy approach; Circular design; Analytical framework; Competences*

Introduction and context

For decades, and even today, the design discipline has been observed and analyzed from adversarial perspectives, generating unnecessary dualisms that are certainly not beneficial to the ultimate goal: achieving sustainable development. It is common to find battles and oppositions between art and science, craftsmanship and technology, or analysis versus creativity. Perhaps due to the empirical roots from which we descend and our cultural predisposition to favor closed numerical data, sustainability studies, and strategies have focused on quantifiable figures encapsulated in exclusively and restrictively measurable strategies. The fashion industry requires systems that reduce the impacts of overproduction, as highlighted by Fletcher (2008), and promote a circular economy to redesign the future of fashion, as proposed by the Ellen MacArthur Foundation (2017). It is essential to foster collaboration and knowledge transfer through global networks to achieve these objectives, following circular economy and sustainability principles. It is evident in everyday classroom settings that, disconnected from the material reality of these figures, there is little commitment to the actions needed to change patterns of use, consumption, and production of textile goods.

Regarding sustainability, we refer to a network of interdependent relationships involving different agents, processes, times, and spaces. The complexity of the social system in general, and the fashion sector in particular (due to the many interconnected links that configure it), makes the battle between academia and practice, or in other words, the struggle between thinking, measuring, and analyzing versus doing, creating, and transforming, no longer relevant in the context of education for sustainability. An integrated model is needed to address sustainability in fashion design, one that transcends traditional linear models and can generate circular strategies. Through strong partnerships and global networks, it is possible to exchange knowledge and foster collaborations that promote a new form of participatory design within the system (Mattelmäki & Visser, 2011; Von Busch, 2008). Adopting a sustainable approach involves carefully considering the processes without focusing exclusively on the final product.

These approaches take into account multiple levels of interdependent complexity situated at the intersections of the "self," culture, and nature. These are, in turn, analyzed and studied from diverse knowledge perspectives.

Beyond the fashion product: circular design approach

Circular Design focuses on creating products that integrate within a closed-loop system, where resources are continuously utilized through reuse, recycling, and regeneration processes. This approach goes beyond a purely technical or quantitative perspective of environmental impact, incorporating qualitative elements that foster greater emotional and social satisfaction (Vezzoli and Manzini, 2008) while promoting a more responsible and ethical consumption model. Due to its cyclical nature, circular design requires the development of new methods, skills, tools, and indicators that enable practical evaluation and monitoring of the various impact dimensions, thereby facilitating the creation of divergent and disruptive solutions.

More than ever, it is recognized that circular design has the potential to act as a catalyst for the transformation of the fashion industry, promoting greater responsibility and a more ethical model of consumption (Fletcher & Grose, 2012), capable of building bridges of convergence between emerging research practices, educational methodologies, and the real needs of the industry. It is not merely an option but an imperative necessity, where all stakeholders must find effective ways to collaborate and work together, allowing the design to move beyond being an isolated practice

and become a unifying force that connects and enhances different areas of knowledge and production. As Williams (2015) argues, fashion design education must adopt a holistic approach that considers sustainability and design ethics, ensuring that future designers are equipped to tackle the environmental and social challenges of the industry.

In this context, reflecting on its role in this new paradigm is crucial. This is a time for collective introspection and reconfiguration of the purpose of design, not only as a tool for problem-solving but as a means to construct a more conscious, equitable, and collaborative future. Circular design can be a transformative tool, capable of generating systemic change and acting as a powerful force to realign current values, ethics, and practices.

Research methodology

This research adopts an integrated and multidisciplinary approach to exploring and implementing circular strategies to understand how circularity can transform the production processes and underlying mindsets in textile design practices. To capture and evaluate the effectiveness of circular design education, the research combines empirical data collection gathered through fieldwork with reflective practice based on the analytical framework.

A key element of this methodology involves integrating ethnographic research techniques, which are essential for examining the behaviors, practices, experiences, and cultural factors that influence sustainable textile practices. By observing and analyzing the interactions between individuals and materials, this ethnographic perspective provides a comprehensive understanding of the socio-cultural dynamics at play. Applied to craft research and circular design education, it offers a holistic view of how circular principles are perceived, adopted, and implemented (Goldsworthy & Politowicz,2014).

At the heart of the methodology lies material exploration and the construction of textile pieces. These processes are critical for bridging the gap between conceptual ideas and tangible outcomes, allowing creative practice to take center stage. In this research, innovative practice serves not only as a method of production but as a means of generating knowledge, wherein the relationship between the designer, materials, and reflections on the process is fundamental. The research emphasizes the role of tacit knowledge — the intuitive understanding that emerges from hands-on engagement with materials (Almevik and Hallnäs,2021; Niedderer,2007). This knowledge and self-conscious reflection allow for deep insights into textile materials' potential, limitations, and sustainable properties. The manipulation of textiles helps to develop new design ideas, pushing the boundaries of material use while remaining rooted in circular principles such as recyclability, biodegradability, waste production, and regeneration. As Goldsworthy and Earley

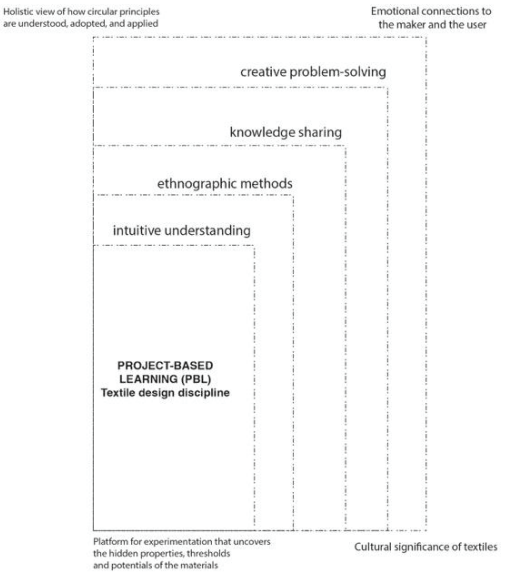

Fig. 1 Overview of primary research methodologies. Souce: Own elaboration

(2018) describe, the transition to a circular textile design model requires innovative approaches that allow for closing material loops, ensuring these materials are continuously reused and recycled.

The researchers utilized an analytical framework to gather quantitative and qualitative data from fieldwork, focusing on participants' experiences, outcomes, and perceptions of circularity. This was coupled with a collaborative, project-based learning (PBL) methodology, where multidisciplinary teams, including students from diverse educational backgrounds connected to fashion and design, worked together on a practice-based textile design project. This collaborative process was further enriched by dissemination events featuring presentations, panel discussions, interviews, and workshops. These sessions fostered knowledge exchange, skill development, and creative problem-solving, as each participant contributed their unique perspectives and expertise to the shared goal.

The insights and innovations emerging from these collaborations culminated in a physical exhibition, showcasing the project outcomes and highlighting the potential of circular design strategies in textile practices. This exhibition displayed tangible results and served as a platform for ongoing dialogue and reflection on its potential contribution to driving transformative change.

Framework proposal

The analytical framework for this research is built on thematic analysis, which allows the identification of key themes related to sustainable material use, circular thinking processes, and cultural significance. The data gathered through fieldwork and material exploration is analyzed to identify common patterns, challenges, and opportunities within circular textile design.

Furthermore, the framework incorporates feedback loops that capture reflections and responses to project outcomes, providing deeper insights into refining and adapting circular strategies for broader applications within the textile industry. This iterative process ensures the research remains flexible and responsive to the evolving challenges and opportunities of circularity in textiles.

The framework ***es***tablishes a comprehensive system of strategies to achieve total circularity. This system operates through a flow of interactions among four pillars: academia, a retail-focused company, a measurement-focused company, and a cultural institution. These agents' collaborative and synergistic work makes comprehensive sustainability in the industry viable through various approaches.

The retail company provides material resources to academia, which, through tacit knowledge, process, and co-creation—also based on the student's emotional and physical connections—enables the reduction of industrial waste through creativity and practical ingenuity. These actions are measured and evaluated, producing measurable and traceable results that make the value chain more transparent.

The combination of creativity, practical knowledge, and measurable and evaluable data enables the dissemination of quality content on the future of circularity in the fashion industry within cultural institutions. This content reaches a broader audience, fostering critical thinking and expanding knowledge around sustainability through contemporary textile art pieces.

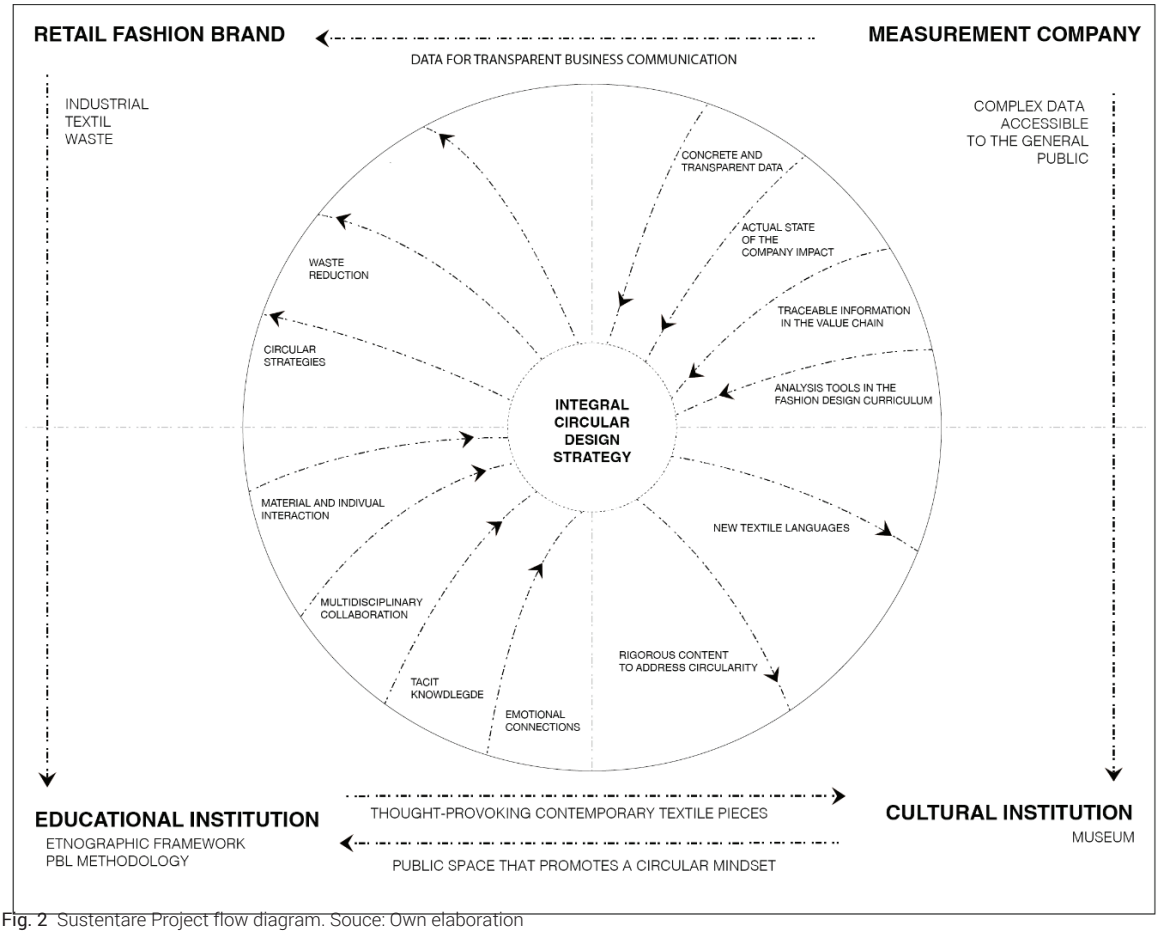

Fig. 2 Sustentare Project flow diagram. Souce: Own elaboration

Case study: sustentare project

Through collaborative loom construction, participants engage in hands-on learning, applying circular design principles to their projects. This process enhances their technical skills and deepens their understanding of sustainable textile production. The project's collaborative nature mirrors the broader need for cross-disciplinary collaboration in addressing sustainability challenges within the textile industry.

Sustentare has provided an optimal environment to conduct a case study on reducing textile waste in the fashion industry, with the indispensable participation of a retail company, a measurement company, and a design university. The dialogue has been established transversally and simultaneously among the different actors, processes, and materials, generating an integral methodological work within the university context. Capturing, in textile art pieces, the dynamic and integrative essence of our actions and thoughts through our hands.

The manual research made by fashion design students focuses on three different phases. During the first phase, conceptualization and design of a collaborative tapestry through the symbol of the hand, students were tasked with reinterpreting the meaning of the hand through textiles. They were provided with bibliographic references and contributed additional resources to achieve this. In this conceptualization phase, students could think of a concept, translate it into words through brainstorming, and then into images by creating various mood boards, ultimately arriving at a sketch for their textile art piece.

In the second phase, exploration of materials, the university facilitated collaboration between the company and the students, providing the latter with textile waste from the retail sector. The students analyzed these materials, primarily defective garments or unsellable prototypes, to identify their properties and evaluate their potential for reuse.

Finally, during the third phase of collaborative tapestry production, students translated their textile art concepts into physical forms, as depicted in Fig. 5. Before assembling the final tapestry, students conducted experimental trials utilizing different textile techniques on smaller-scale frames to refine their skills and optimize design execution.

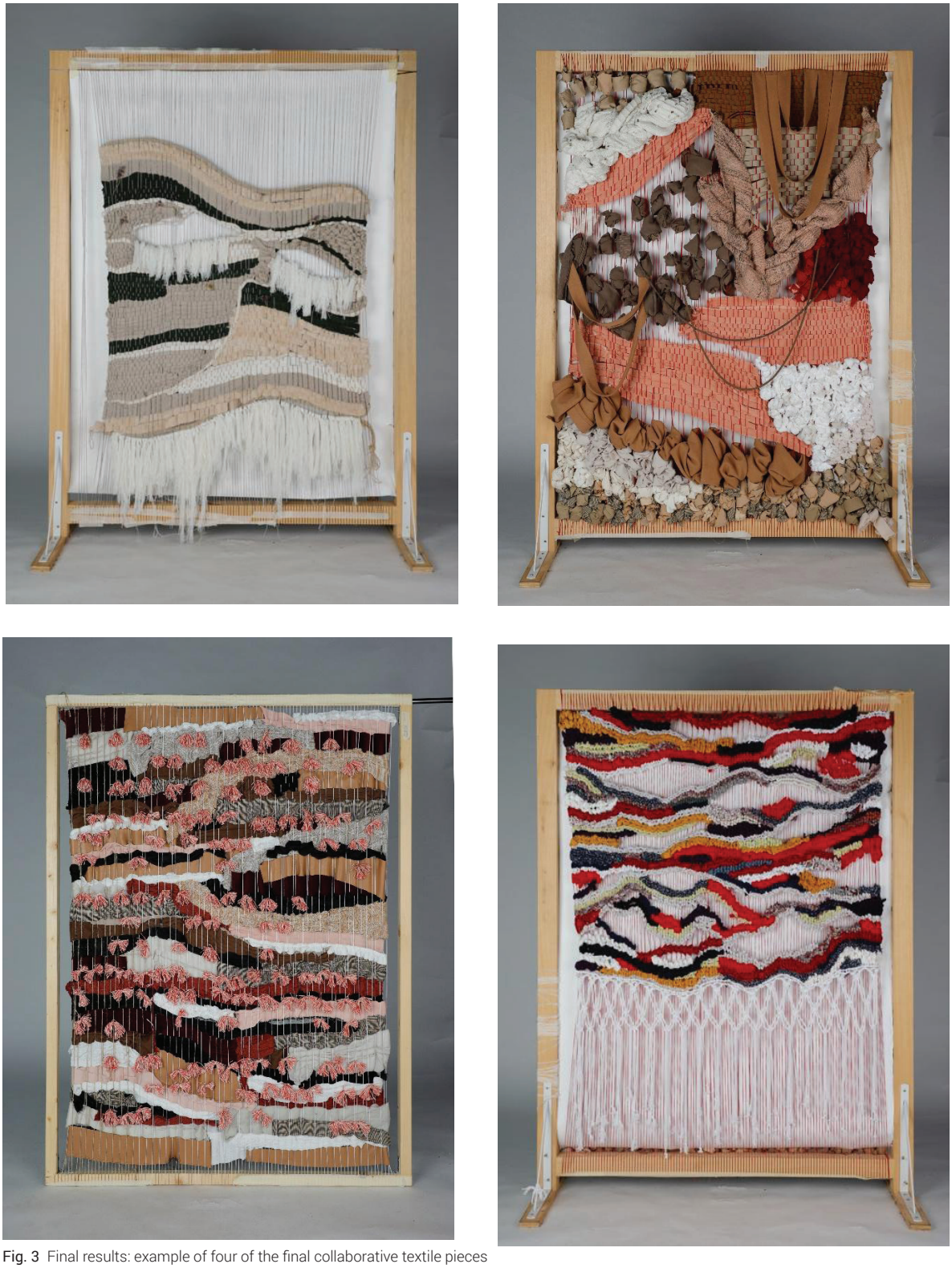

Fig. 3 Final results: example of four of the final collaborative textile pieces

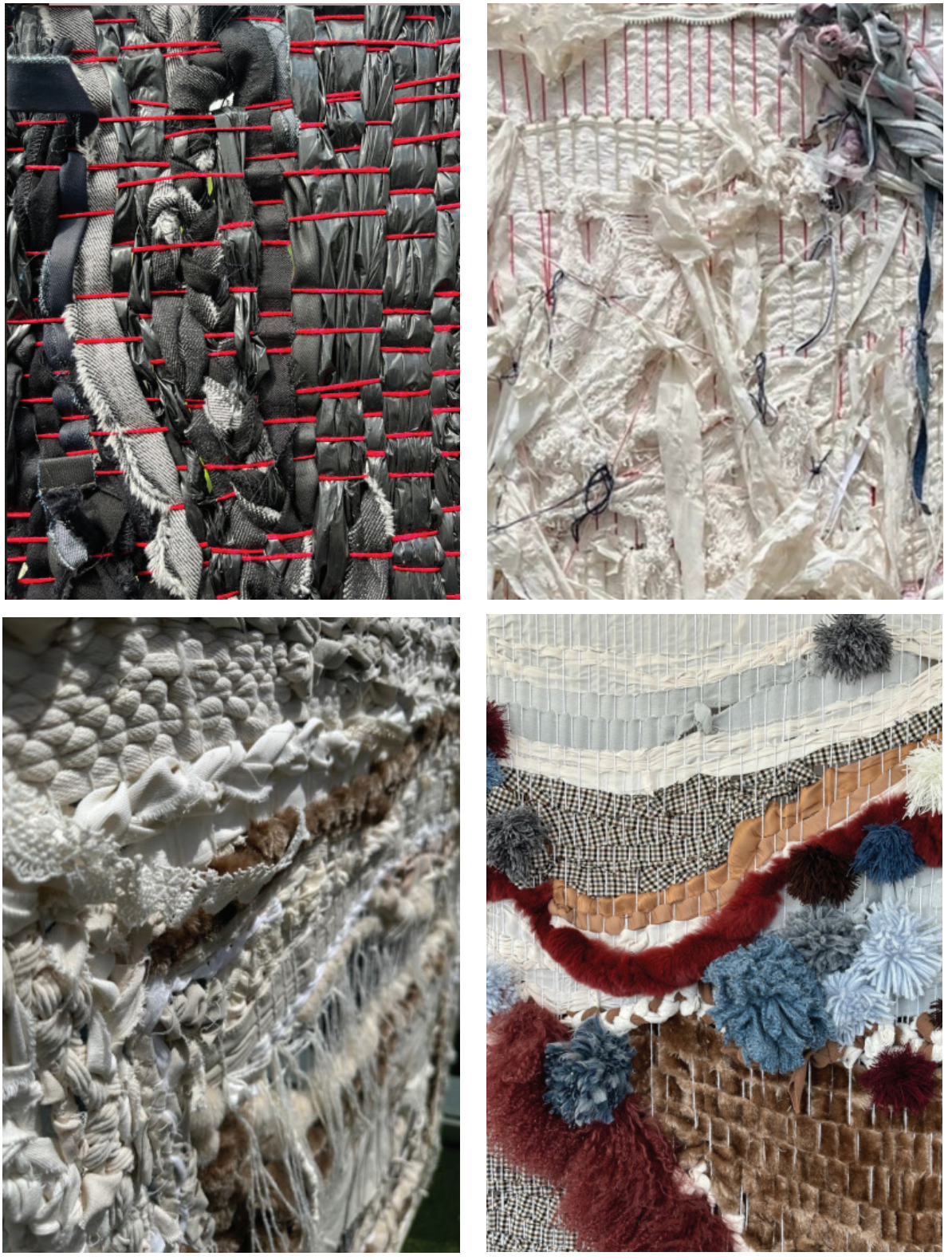

Fig. 4 Final results: example of some textile pieces textures

In the subsequent images (Fig. 4), the textures created by the students are displayed, showcasing the outcomes of their experimentation with various textile weaving techniques.

These three areas link work or learning, reflection, and action. Skills, experience, and knowledge development arise from the tangible manipulation of materials (Sennett, 2008), a constant interplay between tacit knowledge and reflective awareness. These tapestries aim to encourage expressive experimentation in the classroom and create meaning through textile techniques.

Fig. 5 Students working on collaborative textile pieces

Fig. 6 (Top left) time management workshop organized by students; (top right) discussion forum: Design methodology applied to the act of dressing with Gonzalo Álvarez; (bottom left) upcycling workshop, with Marta Maté, co-founder and creative director of Santamarta; (bottom right) swap party

Students from different disciplines organized lectures, panel discussions, and various activities featuring professionals from diverse sectors to complement these events. These engagements aimed to promote reflection on how to integrate sustainable values effectively into contemporary design practices (Fig. 6). By actively involving students, the goal was to enhance their professional development while inspiring their peers and fostering a sense of commitment to sustainability.

These conferences, spanning over four days, addressed several pivotal themes related to sustainability and innovation within the fashion industry. Discussions emphasized the importance of precise measurement to drive the circular transformation of textile production, ensuring resource efficiency and transparency. The role of diverse physical and cultural environments was also analyzed, highlighting their influence on fostering varied lifestyles that contribute to sustainable community development. Emerging business models were discussed to identify effective strategies for reducing overproduction and promoting responsible consumption patterns within the fashion sector. Cognitive design was addressed, focusing on redefining functionality and materiality in objects and spaces to enhance user interaction and

experience. Furthermore, innovative methodologies related to dressing were examined, underlining the need for novel approaches in garment design that align with contemporary sustainability challenges. The conference also positioned social impact as a central tenet of business strategy, with an emphasis on addressing poverty, fostering social entrepreneurship, and creating inclusive business models, thereby embedding ethical values at the core of sustainable fashion practices.

In addition to the conference discussions, practical activities were conducted concurrently with creating textile art pieces. These activities enabled students to take direct actions that have a meaningful impact on their environment and daily lives while fostering reflection on the importance of their contributions to sustainability and community well-being.

Data collection and analysis methodology

The methodology implemented for data collection and analysis integrates a combination of monitoring, traceability, and textile waste classification techniques. It adopts principles from the circular economy and the European Parliament's Waste Directive (2008), which emphasizes the Waste Management Hierarchy (Fig. 7) to optimize the recovery and valorization of textiles. This methodology enriches the practical/creative exercise by contextualizing the value of reusing discarded textiles through upcycling, a highly

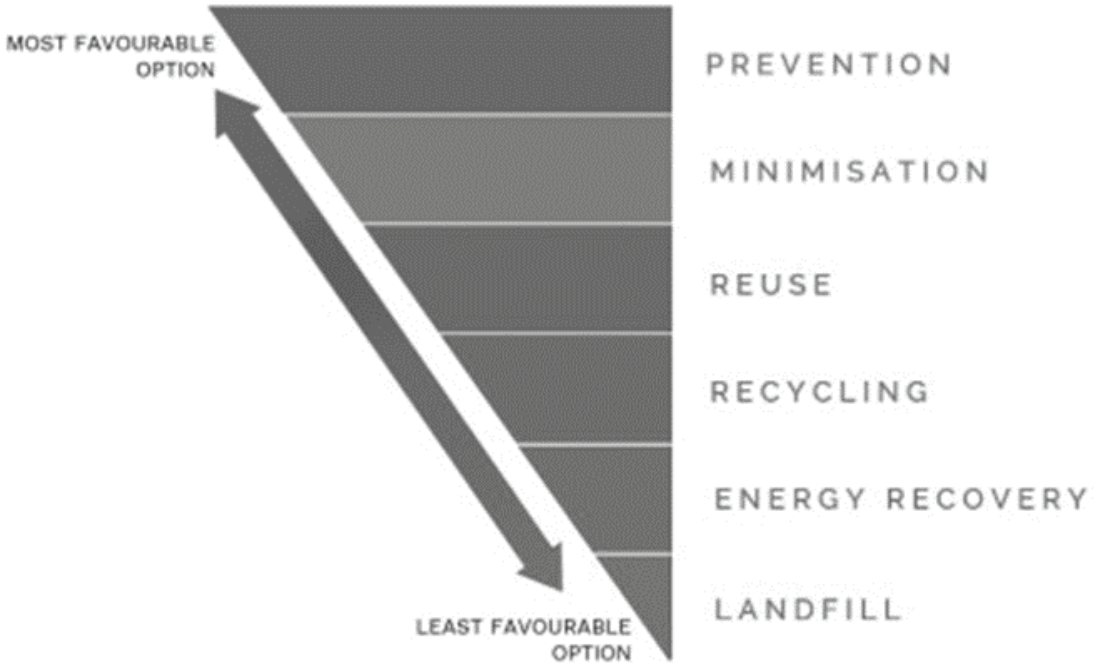

Fig. 7 Waste Management Hierarchy. Souce: Own elaboration

preferred technique within the circular economy framework, as it promotes conserving and enhancing the value of discarded materials.

Classification process

The classification methodology is divided into two phases, starting with segmenting textiles according to their condition and continuing with the type of item, material composition, and color to extract key information from each garment (Fig. 6). This approach emphasizes the importance of qualifying textile flows and ensuring the traceability of the materials that make up the garments to maximize their value and apply appropriate criteria for reuse or recycling.

1. The first classification phase focuses on a detailed assessment of the physical condition of each garment. This analysis determines whether the garments are suitable for direct reuse or need to undergo transformation processes. In this exercise, this classification point was also used to identify the possible origin of the garment within the supply chain, which helps understand the sources of textile waste outputs in the industry and identify potential leakage points. For example, finished clothes in good condition typically come from stock surpluses, returns that have not been reintroduced into the sales flow, or unused commercial samples. On the other hand, textiles in poor condition usually derive from product development processes (offcuts, incomplete garments, pieces used for internal testing) or quality control rejects.
2. Once the textiles have been classified by condition, the next phase focuses on a detailed materials analysis. At this stage, the fabrics' fiber composition and technical characteristics are identified, which is essential in selecting the most appropriate circular solutions, thereby maximizing their potential for reuse or recycling.

Baseline data

- The study received a total of 120.1 kg (369 garments) of textile waste, of which 54% was in optimal condition for direct reuse.
- The classified material was subjected to creative transformation processes. For this purpose, the 369 garments were divided into 17 groups, producing 17 final tapestries. 49% of the received material was successfully reused, and the remaining 51% was also recycled. Offcuts and reusable pieces were sent to the university's reuse system, with accessible bins for students to collect and deposit textiles. Non-reusable material was placed in municipal containers specialized in textile collection for recycling.

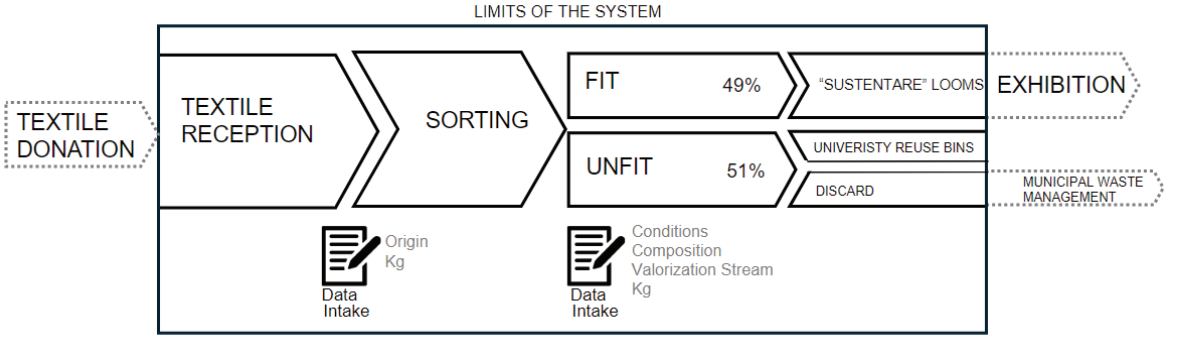

Fig. 8 – Textile Classification Process. Souce: Own elaboration

The museum: a cultural institution that promotes a circular mindset

To facilitate the diffusion phase, the aim was to exhibit the final textile art pieces. The institution that hosted this exhibition was the Real Fábrica de Tapices in Madrid. This institution is dedicated to the preservation of Spanish textile heritage, actively participating in the development of procedures and technologies for the restoration of historical textiles. Moreover, it is firmly committed to developing applied textile I+D methodologies, promoting research into new techniques, analysis, and diagnosis applied to the restoration and study of textiles. Therefore, the pieces were well-suited to this context as they generated interaction and dialogue between tapestries and traditional and contemporary textile techniques.

Moreover, this exhibition provided a unique opportunity for students. It allowed them to generate knowledge through their unique perspectives, explaining their design process and inspiration for the final textile pieces. By being immersed in a space dedicated to preserving and studying historical textiles, students gained firsthand knowledge of the structural elements of past fabrics. This experience enabled them to apply traditional techniques with a contemporary vision.

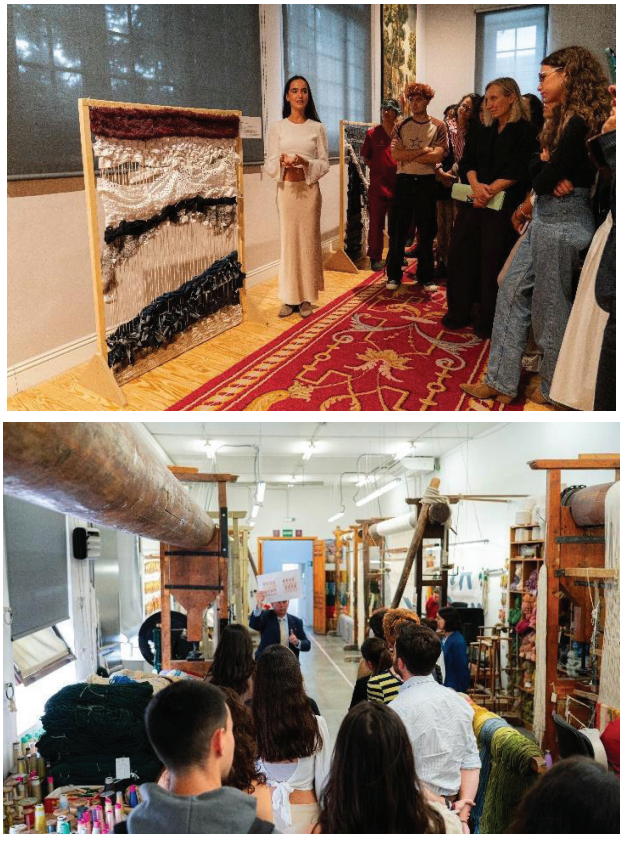

Fig. 9 Official visit and opening ceremony of the exhibition

Discussion

This educational initiative exemplifies how a collaboration between a major retail company, a fashion design university, and a measurement company can lead to a circular solution with a significant positive impact by redirecting discarded and undervalued textiles toward a renewed and valuable lifecycle. This study demonstrates the feasibility of circularity initiatives within the educational sector. It reinforces the potential of upcycling as a key component in the transition toward a sustainable and responsible economy. Furthermore, it highlights the crucial need for seamless connections between different actors in the textile ecosystem to ensure that each chain link contributes to the circular model's success.

The technical analysis underscores the importance of understanding the quantity of textile waste generated and discarded during various stages of the textile supply chain (collection development, production, distribution, quality control, etc.). It highlights the value of directing this type of material, which would otherwise be difficult to reuse without losing value, through academic programs focused on sustainability and circularity. The experience of creating collaborative tapestries with defective clothing has proven to be highly effective in developing key competencies in students, such as creativity, teamwork, and problem-solving. Beyond technical skills, students gain a deep understanding of the environmental impact of textile waste and the potential of circular design to transform the industry.

The results of the tapestries have been varied and surprising, ranging from textiles with unique and complex patterns to pieces that incorporate three-dimensional elements. This diversity in outcomes reflects the students' creativity and experimental approach and their ability to reinterpret materials deemed waste into new textile forms. It is also important to emphasize the work of students from other disciplines in interviewing and generating dialogue, both with industry professionals and with the students creating the textile art pieces, to document the intangible heritage of this practice.

Conclusions and perspectives

The success of the collaborative tapestry project highlights the importance of implementing practical educational experiences that allow students to interact directly with discarded materials and understand the value of circular design. This methodology can be replicated and adapted to other academic or community contexts, cultivating a culture of sustainability and collaboration within the textile design sector.

There are plans to expand the project by integrating digital technologies, such as computer-aided design and digital manufacturing, to explore new possibilities in material reuse and sustainable textile creation. The integration of these interdisciplinary practices will not only enrich the educational experience but also enhance the training of designers who are conscious and committed to a more sustainable future. Analyzing the results of teaching approaches centered on problem-based learning, collaborative learning, and a transdisciplinary approach is essential. In the long term, it is proposed to open new lines of research to manage the small, "non-useful" waste generated from this practice. For example, creating a non-woven fabric by shredding these waste materials.

Finally, the importance of involving professionals from different industries has been observed, and, above all, collaborating with a measurement company that can provide accurate and tangible data on these practices. It is also important to collaborate with cultural institutions to create a platform for disseminating information and work and to generate impact across a broader segment of society.

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