CREATIVE AND COLLABORATIVE THINKING THROUGH RECYCLING IN DESIGN EDUCATION

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THE ADVANCEMENT OF ENVIRONMENTAL CHALLENGES AND THE NEED FOR CREATIVE SOLUTIONS MAKE EDUCATION A FUNDAMENTAL ELEMENT IN THE DEVELOPMENT OF INNOVATIVE MINDS AND CREATIVE THINKERS CAPABLE OF ANALYZING AND PROPOSING SOLUTIONS TO COMPLEX PROBLEMS. THIS ARTICLE EXPLORES MANUAL PAPER RECYCLING AS AN INITIATIVE THAT COMBINES ENVIRONMENTAL AWARENESS AND ARTISANAL PROCESSES AS TOOLS FOR DEVELOPING CREATIVE SKILLS AND ADAPTIVE THINKING. THROUGH ACTION RESEARCH METHODOLOGY AND A CASE STUDY IN THREE COLLABORATIVE WORKSHOPS, WE SEEK TO UNDERSTAND HOW PRACTICAL EXPERIMENTATION WITH RECYCLED PAPER FOSTERS INNOVATION AND ADAPTIVE AND FLEXIBLE THINKING IN DIFFERENT TRAINING CONTEXTS. DURING THE ACTIVITIES, PARTICIPANTS EXPERIMENT WITH TECHNIQUES FOR HANDLING PULP, MOLDS, AND PIGMENTS, GAINING CLOSE CONTACT WITH TRADITIONAL MATERIALS AND TECHNIQUES. THE RESULTS SHOW THAT MANUAL EXPERIMENTATION FOSTERED CREATIVE SOLUTIONS, INCLUDING THE REINTERPRETATION OF COLONIAL ICONS AND TEXTURAL EXPLORATION. PRELIMINARY FINDINGS POSITION WORKSHOPS AS HIGHLY EFFECTIVE SPACES FOR DEVELOPING THE COGNITIVE FLEXIBILITY AND COLLABORATIVE SKILLS ESSENTIAL FOR TRAINING PROFESSIONALS AND CITIZENS ADAPTABLE TO CONTEMPORARY CHALLENGES, THUS CONFIRMING THE INITIATIVE'S PEDAGOGICAL IMPACT.

KEYWORDS: EXPERIENCE IN MATERIALS, ARTISANAL PROCESSES, PRODUCT DESIGN, SUSTAINABILITY

INTRODUCTION

Today's world demands that design transcend the mere creation of artifacts, positioning itself as a discipline of critical reflection in the face of global challenges (Petre, 2020). In this context, education is crucial for shaping a new generation of professionals with a circular and ethical mindset. Integrating hands-on projects—such as those involving materials like recycled paper—fosters essential, practice-based skills that move beyond theory (Manfredi et al., 2021).

Collaborative workshops, in particular, are distinguished by their practical and interactive nature, promoting the co-creation of knowledge and autonomy, where the student becomes an active agent in the learning process, and the instructor assumes the role of facilitator (Bak-Andersen, 2021). This active approach seeks to prepare future designers to solve complex problems and operate in uncertain environments. In this context, experimentation with materials plays a fundamental role, driving the search for alternative raw materials in innovative projects (Karana et al., 2015) and, in particular, the use of post-consumer materials in product development.

In this sense, this research seeks to understand how practical experimentation, through collaborative workshops on manual paper recycling, fosters innovation and the development of adaptive and flexible thinking in different design training contexts. To address this issue in a verifiable manner, the article describes the pedagogical process of workshops to foster creativity and collaboration among participants. As a documentary method, the quality and uniqueness of the creative solutions generated by the participants were analyzed, in addition to identifying evidence of the development of cognitive flexibility and adaptive thinking during the activities. This record facilitates future co-creation dynamics and collaborations observed in different learning environments.

To verify the effectiveness of this pedagogical approach, this study used action research as its methodology, a cyclical process that integrates practical intervention with theoretical research. The case study focused on analyzing three educational and collaborative workshops on manual paper recycling in different contexts in Brazil. The results indicate that manual experimentation with recycled paper generated unique creative solutions. The activities proved to be spaces with great potential for developing cognitive flexibility and fostering collaboration. Therefore, this article seeks to report on how this teaching-learning initiative drives innovation and adaptive thinking, describing the impact of the workshops in different training environments.

COLLABORATIVE AND EDUCATIONAL WORKSHOPS

Workshops are powerful and versatile teaching tools, distinguished by their practical and interactive approach, transcending the traditional classroom model. They enable the exploration of complex topics in an accessible and engaging way, and are applicable in various contexts, such as formal education, corporate training, and community activities (Saroyan & Amundsen, 2023). By promoting collaboration and active learning, these workshops become a space for exchange, where theory is immediately applied to practice, consolidating knowledge and developing new skills in a dynamic and participatory way (Sabbaghian & Mir Moiny, 2023).

In the field of design education, this methodology has deep historical roots. The Bauhaus, for example, revolutionized teaching by prioritizing the workshop as the primary learning environment, bringing students closer to the production process and experimentation with materials. Today, this approach is making a strong comeback in universities, not only to teach techniques but also to promote a more democratic and horizontal teaching model (Cruchinho & Neves, 2025).

The idea of collaborative workshops goes beyond a simple teaching methodology. It represents a fundamental change in the dynamics between teacher and student. By abolishing the traditional hierarchy, this model creates a co-learning environment, where both parties are considered partners in the construction of knowledge (Brosens et al., 2023). The teacher is no longer the sole source of information but becomes a facilitator, a mentor who guides the exploration of ideas. In turn, students abandon a passive stance and become active agents, contributing their own experiences and perspectives to problem solving (Watkins et al., 2021).

Active participation in the creative process promotes autonomy and a sense of belonging, encouraging the exchange of knowledge. A practical example is the workshop on handling coffee waste to create objects. In an educational context, this activity goes beyond a simple manual task; it teaches about the life cycle of materials, the circular economy, and the importance of reusing waste, transforming what would otherwise be trash into valuable raw materials (Costa et al., 2021). A further notable example is the clay workshop, which educates participants on archaeology, heritage, and cultural preservation. Here, learning the technique is coupled with reflection on history, culture, and identity (Zuse, 2021).

EXPERIENCE IN MATERIALS

Historically, designers have maintained a close relationship with raw materials and the production process, with artisans mastering manufacturing techniques. Since the Industrial Revolution, this connection has become increasingly distant from mass production and labor specialization (McDonough & Braungart, 2017). However, the Arts and Crafts movement and, later, the Bauhaus sought to reestablish this connection, arguing that designers must understand materials and processes to create honest and efficient products (Cruchinho & Neves, 2025).

In the context of design education, by manipulating different raw materials, such as wood, metal, plastic, and especially recycled materials, students learn to identify their properties, limitations, and potential (Karana et al., 2015). This practice goes beyond theoretical knowledge, stimulating creativity, problem-solving, and critical thinking (Bak-Andersen, 2021). The tactile experience and prototyping with real materials (Figure 1) allow future designers to understand the materialization of their ideas, refine their solutions, and ensure that the final product is functional and well executed (Zi, 2021).

Sustainability is a fundamental pillar in the experience with materials, requiring a conscious and ethical approach on the part of designers. The choice of materials, their origin, and the method of disposal of a product are decisions that directly impact the environment. This need has driven the exploration of alternative and, above all, recycled materials (Mengistu et al., 2024). In this scenario, designers become agents of change, seeking to reduce the ecological footprint of products and contributing to a circular economy. Experimenting with recycled materials challenges us to create from what already exists, transforming discarded materials into new and valuable raw materials and redefining the concept of waste (Gözene & Metlioğlu, 2025).

The use of recycled materials in product and process design creates value that transcends functionality (Dumée, 2022). A product made from recycled plastic or paper, for example, is not only functional but also carries with it a narrative of environmental responsibility. This approach elevates design to a level of cultural and social influence, demonstrating that beauty and innovation can co-exist with responsibility.

Projects that prioritize the experience with materials demonstrate that innovation can be achieved through simplicity and creativity. By understanding and addressing the production process and raw materials, designers create solutions that not only solve problems but also inspire behavioral changes (Bak-Andersen, 2021). The beauty of an object lies in its history, in the materials it is made of, and in the impact it has. Experimenting with materials, therefore, is not just a step in the design process but a guiding principle that shapes the future of products, processes, and our relationship with the material world (Mengistu et al., 2024).

FIGURE 1. Tactile experience with materials.

PAPER RECYCLING

Paper is a widely used solid waste with significant recycling potential. Recovering the paper production cycle through recycling is valued for its dual benefits: generating economic value (as income for stakeholders and through recycled products) and preserving the environment. This is particularly relevant for Brazil, a major producer and consumer of paper, where recycling serves as an efficient tool for this process (Carvalho & Silva, 2020).

Recent data from the pulp and paper sector in Brazil show a growth trend in production and investment. In 2024, paper production in the country reached 11.3 million tons, an increase of 4.6% over the previous year. Pulp production reached 25.5 million tons, an increase of 5.2% (Indústria Brasileira de Árvores, 2024). However, municipal solid waste management in Brazil still faces challenges. According to the Solid Waste Overview, the country produced 80.96 million tons of waste, a volume slightly higher than the previous year (Brazilian Association of Public Cleaning and Special Waste Companies, 2024).

Post-consumer paper recycling (Figure 2) is a fundamental pillar of contemporary design, offering a sustainable approach that merges aesthetics with environmental responsibility (Sudheshwar et al., 2023). Designers increasingly harness this material's versatility to create innovative products—from minimalist packaging to furniture and decorative objects. By repurposing discarded paper, they demonstrate design's transformative power to redefine product life cycles (Liu et al., 2025).

Integrating post-consumer paper recycling into the design process goes beyond simply choosing the material. It requires a circular mindset, in which designers must consider ease of disassembly and the possibility of recyclability at the end of the product's lifespan (Dumée, 2022). This proactive and conscious approach drives innovation, resulting in solutions that are not only aesthetic and functional but also efficient and environmentally friendly. By adopting this principle, product design becomes a driver of the circular economy.

The relationship between post-consumer paper recycling and design education for university students is crucial for the development of a new generation of conscious and innovative professionals (Manfredi et al., 2021). Projects that use recycled materials, such as paper, challenge aspiring designers to solve complex problems, considering material constraints, sustainable production processes, and the value chain (Bak-Andersen, 2021).

FIGURE 2. Manual paper recycling process.

METHODOLOGY

This study employed action research as its methodology, a cyclical and iterative process that integrates practical intervention with theoretical research. This approach allows research to be conducted simultaneously with the intervention itself, where the authors actively participate in the process, and the action is intentionally planned to generate results and learning (Silva & Castilho, 2022). The objective of this study was to analyze the effectiveness of practical experimentation with recycled materials in promoting creativity and adaptive thinking.

The objects of analysis were three educational and collaborative workshops on manual paper recycling, held in different contexts in Brazil. The workshops were facilitated by design students (who acted as researcher-facilitators), and the target audience included 55 participants in total, including design students seeking to deepen their technical and conceptual knowledge, and creative industry professionals interested in new approaches to sustainability in their processes. Before the workshops began, participants were informed about the ongoing research and agreed to participate voluntarily in the study. In addition, anonymous use of their data and authorization for photographic recording, audio recordings, and use of the artifacts produced were permitted.

Qualitative data were collected using three main techniques: facilitator notes during the workshop, which contained detailed observations on group dynamics, interactions, creative decisions, participant discourse, and challenges encountered. The main points recorded included: participant profile, proposal objective, organizational and preparatory activities, and considerations regarding dynamics. The accounts described in the article were transcribed from these recordings, ensuring their accuracy and anonymity. The recycled paper cards, created at the end of the activity, served as direct evidence of the creative solutions generated. The data analysis process was structured in three phases: (1) pre-analysis; (2) organization and dynamic reading of all material; and (3) exploration of the material, which applied an open coding process. The data was segmented into record units and then grouped into emerging categories of analysis.

The generation of emerging analytical categories for data analysis is based on a technique of constant comparison, in which units of record extracted from facilitators' notes and transcripts are systematically compared to identify recurring patterns of behavior and discourse. The grouping criterion is based on the thematic and functional affinity of the observations, linking the participants' practical activities with the objectives of creativity and adaptive thinking for the purposes of the study. To ensure consistency and comparability across the three educational workshops, a degree of standardization was used as a transversal guideline, allowing the data to be subjected to the same interpretative rigor despite variations in context and audience.

RESULTS AND DISCUSSIONS

The workshop, held during the R Magnético Event, focused on the presentation and application of the technique of manufacturing tiles from post-consumer paper pulp, promoting practical reflection on sustainable materiality in design. The main audience was design students, which ensured immediate participation and deep critical thinking regarding the creative processes and materials used. The workshop took place at São Luís's historic Convento das Mercês (Figure 3), using social media as the primary online channel for dissemination and participation.

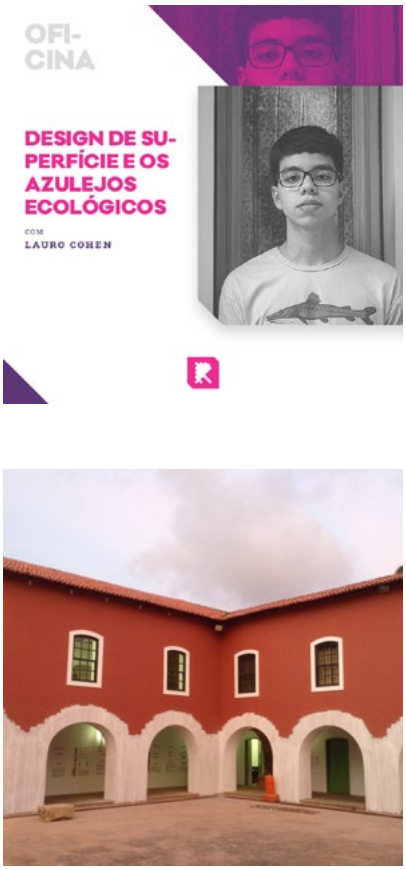

FIGURE 3. Promotion of the workshop, the venue where it was held, and creation of the pieces.

The preparation phase of the activities was crucial for the development of essential skills and abilities in design training. In the university laboratory, the student facilitators had to manage the entire material production process, including the selection of post-consumer paper, the production of recycled paper pulp, its application to molds, demolding, and the final preparation of the pieces for painting (Figure 4). This process involves the practical application of skills such as project management, mastery of prototyping techniques, and awareness of material sustainability (Manfredi et al., 2021).

According to the facilitator's observations, participants showed genuine interest in the subject of tiles and the opportunity to apply their creativity to the graphic composition of the pieces. The creative process revealed a rich cultural repertoire, as shown in Figure 5. While some brought representations of popular figures, such as cartoon characters, many local participants from São Luís used references from everyday life and the city's Brazilian colonial architecture: its shapes, colors, and textures. This direct connection to local modern heritage was remarkable, as participants sought to reproduce views of restored buildings or, more fondly, sought inspiration from pieces in their grandparents' homes, emphasizing the relative value of tile memory.

As a result, the pieces were exhibited and demonstrated, and the participants explained the concept, technique, and final form of their productions. A common point of debate arises around the contrast between the firm's results and contemporary Brazilian architectural production, marked by mass production and the standardization of synthetic and homogeneous textures and patterns (Anagnost, 2022). Participants emphasized that the revival of manual work in the workshop provided a joyful, vibrant, and colorful experience, full of stories and meaning. They also argued that this hands-on experience would be a positive aspect to consider in their future authorial projects, as a way to avoid standardization and ensure an authentic narrative in design.

Conducted at the Solar Colaborativo cultural space in Belém, Brazil, the second initiative described here broadened the scope of the preceding work. The main objective was to replicate the process of painting tiles with post-consumer paper pulp, but fundamentally, to involve participants in the production process from the start. To this end, pieces with a smooth texture were produced, encouraging free creation. The participants came from diverse backgrounds, including architecture students, architects, and artisans, all interested in deepening their knowledge of craftsmanship and the use of recycled paper in product creation.

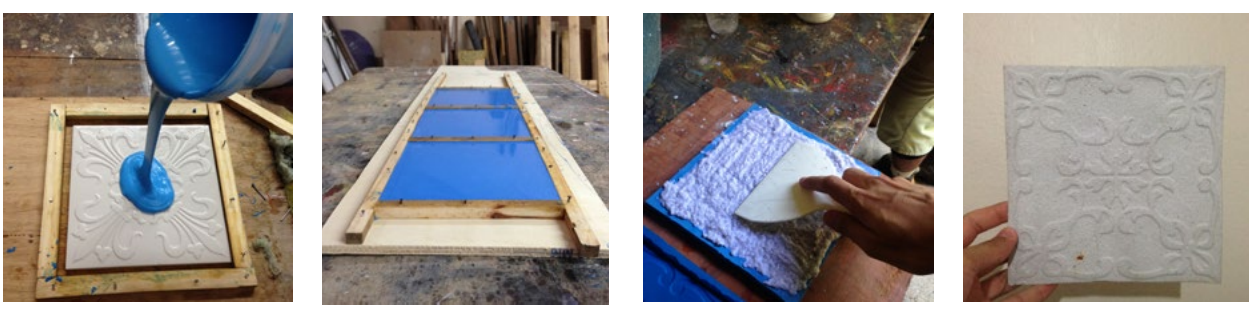

FIGURE 4. Stages of paper recycling and raw material production.

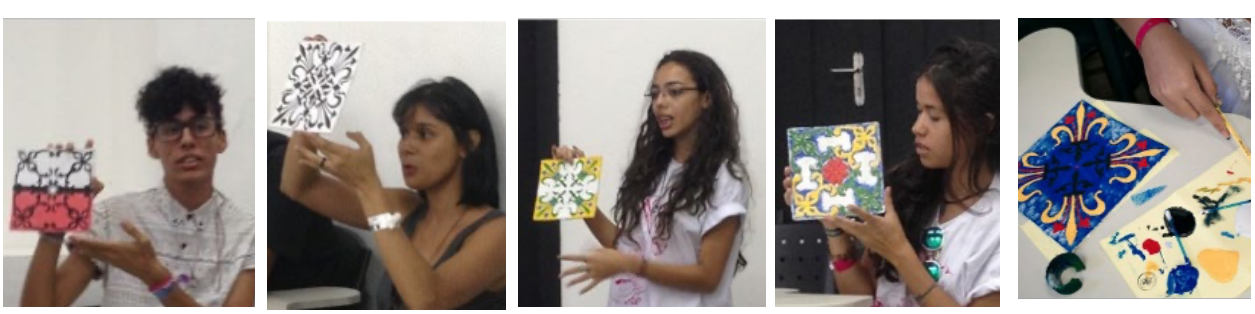

FIGURE 5. Final results of the workshop.

The organizational and preparatory activities for this second workshop were more complex and required the student facilitators to deepen their pedagogical and technical skills. The preparation involved more than material separation; it included creating comprehensive educational materials. These materials conveyed both technical information and the theoretical context of sustainability, manual production, paper processing, and material development.

Unlike the first experience, in which the facilitator limited himself to applying technical knowledge, the challenge now was to transfer this knowledge to an audience unfamiliar with design, involving teaching materials, production processes, and guidance on the creative process. Although the initiative benefited from the technical guidance of a teacher, the student's autonomy in leading the process was essential. This scenario allowed them to develop leadership skills, didactic communication, and a deep mastery of the content, since it was not enough to apply the techniques; it was necessary to teach them (Petre, 2020). Due to the predominance of participants from the field of architecture (students and professionals), interest focused mainly on the production process and how manual skills can be applied in the context of the project. Participants, accustomed to working with already processed raw materials, showed greater curiosity about the process and the potential for applying artisanal and sustainable techniques in their professional fields. The steps involved were: producing the paper pulp, applying it to the molds, removing it from the molds, and preparing the pieces for painting (Figure 6).

Like the previous city, Belém also has a strong historical and aesthetic appeal due to its colonial-era buildings and the presence of tiles. Thus, local architectural references were expressed by participants through collections and copies that evoke the culture of the city. There was intense debate about the importance of these representations as a way of raising awareness about the historical value of these pieces as part of Brazil's cultural heritage. In fact, it was suggested that the activity should serve not only to share design processes, but also to promote the restoration and preservation of heritage. In terms of free creation, participants followed two main paths: creating original prints with abstract or non-figurative shapes or using the stencil technique (which involves applying paint or pigment to a hollow surface, creating repeatable shapes) to print the pieces (Figure 7).

The presence of tiles in historic buildings plays an important role in the transfer of cultural identity. When tiles on historic buildings deteriorate, become damaged or physically destroyed, cease to function properly, or require new design components, careful conservation is essential to ensure the preservation of the original history (Zhang & Dong, 2021). One point highlighted by the student facilitator was the predominance of women in the workshop, a topic that was discussed internally. This scenario, as recalled in academic references, reflects the context of craftsmanship and manual practices in Brazil, where female participation is historically and socially predominant (Soares dos Santos et al., 2024).

The third initiative was a workshop aimed at first-year Design students (Belém, Brazil). The participants were emerging designers experiencing the world of design for the first time, which provided them with an introduction to the creative context of production, materials, and processes. The aim of the project was twofold: to promote practical experience with manual paper recycling, demonstrating the importance of handling raw materials in design, and, at the same time, to introduce a context of creative production that involves breaking square pieces into geometric shapes for painting and creating. The practical activities in this workshop covered a complete cycle: participants experimented with paper pulp production, fragmenting pieces with a table saw, preparing for painting, and, fundamentally, discussing collective construction (Figure 8).

This workshop, in particular, reinforced the importance of an adapted didactic and pedagogical approach. The student facilitator must develop audience analysis skills, understanding the maturity level and repertoire of new students to provide an appropriate learning experience (Bak-Andersen, 2021). Therefore, organizational and preparatory activities, which involve the use of laboratory tools and the management of the production process, directly help the student facilitator to develop knowledge mediation skills, pedagogical empathy, and management of a creative production environment (Manfredi et al., 2021).

According to the facilitator, one of the main challenges and, at the same time, one of the greatest successes of the experience was the introduction to the laboratory context. For the enthusiastic students, everything was new: their first contact with the laboratory, the molds, and the production context. As a result, many participants discovered the possibility of working with artisanal practices, realizing that design is not limited to industrial processes, but that it is possible to adapt processes using everyday tools and materials (Luckman & Andrew, 2020).

In addition, the context of the activity served as practical reinforcement of the theoretical knowledge presented at the beginning of the design course, such as color theory and practice, shape analysis, and creative techniques (Figure 9). The main difference between this office and previous ones, where the form and context of predefined pieces dominated the narrative of the creations, was the possibility of deconstruction. The fragmentation of the original pieces into geometric shapes gave participants significantly greater autonomy to create collectively.

The focus shifted from individual pieces to a collective, integrated result. Students were encouraged to think about creating panels, combining shapes, and building unique structures, working together like a puzzle until they achieved a common final shape (Figure 10). This process highlighted the importance of collaboration and a systemic perspective in creating designs (Mengistu et al., 2024).

FIGURE 6. *Stages of paper recycling and raw material production.*

FIGURE 7. *Customization of pieces and final results of the workshop.*

FIGURE 8. *Stages of paper recycling and raw material production.*

FIGURE 9. *Customization of parts and composition tests.*

FIGURE 10. *Final composition tests and workshop results.*

To ensure the integrity of the sustainability dimension and the coherence of the process, the materials used in the three workshops were carefully selected. The paper, the main raw material, came from internal administrative waste at the university (zero-waste life cycle). The water used in pulp production was treated and reused in the production cycle. As for the painting of the parts, which is crucial for the prototype's life cycle, only natural pigments and water-based paints (acrylic latex paint) were chosen, which are biodegradable and free of heavy metals and solvents. This choice is vital because it prevents contamination of the material, allowing the final products to be reprocessed in the paper recycling cycle once their educational function has ended, mitigating the environmental impact and reinforcing the circular nature of the activity.

Despite the similarities in the basic technique (post-consumer paper pulp) and the differences in the scope of each workshop, the tangible result was unique, original, and authentic pieces. The creations directly reflected the creative expression and cultural repertoire of the participants, whether through references to local architecture or fluid abstractions. The manipulation of recycled materials and the artisanal process restored the value of memory, authentic narrative, and antistandardization in contemporary design, counteracting mass production (Cruchinho & Neves, 2025).

The pieces produced are not intended for structural or outdoor use, but are primarily educational prototypes and reflective artifacts. Their recycled paper composition makes them suitable for indoor use. Due to the emotional value and cultural references incorporated by the participants, many pieces acquire great sentimental appeal for display in places protected from rain and humidity. Their final destination, after the exhibition cycle or internal use, is reuse within the laboratory itself or reinsertion into the recycling chain, closing the product's life cycle and ensuring that the entire process, from raw material to disposal, remains aligned with the principles of sustainability and ecological responsibility.

The activities developed and led by the students went beyond mere curricular activities, as they allowed future designers to take on leadership roles and exchange knowledge. Through planning, organizing, and executing workshops, facilitators explored and consolidated essential skills and competencies for design training. These include project management, mastery of prototyping techniques, didactic communication, pedagogical empathy, and the ability to mediate technical knowledge in diverse contexts, exemplifying the practical application of active teaching and learning approaches (Petre, 2020; Manfredi et al., 2021). The autonomy in conducting these initiatives demonstrates the ability to go beyond formal requirements, applying learning in a context of service and dissemination of sustainable and authorial practices. Some of these aspects are illustrated in Table 1.

To provide a synthesized overview and facilitate comparative analysis of the experiences reported, Table 2 presents a cross-sectional summary of the three workshops. It highlights the different contexts, audience profiles, and pedagogical objectives, as well as the results achieved in terms of creative, collaborative, and sustainability skills.

The intense debates and reflections that arose during the workshops, both on the heritage and cultural value of the tiles and on the implications of manual and sustainable production versus industrialization, reflect the urgent need for solid theoretical and methodological approaches to guide design teaching practices. The critical engagement of participants with issues such as heritage, sustainability, the design process, and the role of authorship suggests that laboratory practice and practical work should always be based on conceptual frameworks that provide the context and depth necessary for the development of critical and conscious designers. The success of the workshops in generating debate and self-awareness about the relevance of manual work and materiality reinforces the importance of teaching methodologies that transcend technique and integrate debates about the cultural and environmental impact of design (Bak-Andersen, 2021; Zhang & Dong, 2021).

CONCLUSIONS

The experience offers important contributions to research methodologies and the training of researchers at the undergraduate level. The role of facilitator assumed by the students served as a laboratory for developing leadership, teaching communication, and autonomy skills, which are essential for consolidating a culture of research from the early years of training. The structure of the workshops, from the management of raw materials to the mediation of the creative process for different audiences, illustrates pedagogical models that activate research and critical reflection through practice, going beyond the vision of design as a purely applied activity. These results provide valuable information for the formulation of curricular strategies aimed at strengthening the academic legitimacy of design research in comparison with other disciplines.

For future work, it is imperative to expand research to analyze knowledge transfer and the social impact of waste-based projects. Longitudinal studies are suggested to evaluate the development of research and leadership skills in student facilitators, measuring how this practical experience influences their future professional and academic trajectories. Replicating this methodology in other regional contexts and with different waste sources could consolidate a framework for interdisciplinary and transdisciplinary design, promoting solutions that are innovative, sustainable, and deeply rooted in local culture.

TABLE 1. RELATIONSHIPS BETWEEN ACTIVITIES AND COMPETENCIES FOR DESIGN TRAINING

TASKS AND DEMANDS OF THE WORKSHOPS	SKILLS AND COMPETENCIES FOR DESIGN TRAINING
Raw material preparation: Selection of post-consumer paper, paper pulp production, application in molds, demolding, and preparation of parts for painting.	Mastery of prototyping and artisanal manufacturing techniques: Practical knowledge of the material value chain and control of production processes (Manfredi et al., 2021).
Creation of Educational Materials: Develop comprehensive educational content on sustainability, manual production, and paper processing.	Teaching and Knowledge Mediation: Transforming technical knowledge into accessible materials, preparing designers for their role as educators/ multipliers.
Workshop management and leadership: leading the process, guiding creation, and transferring technical knowledge to diverse audiences.	Didactic Communication and Leadership: Ability to guide groups, convey information clearly, and develop autonomy in the teaching process (Petre, 2020).
Audience Analysis and Pedagogical Adaptation: Adjusting the teaching approach to the level of maturity and repertoire.	Pedagogical Empathy and Context Analysis: Ability to understand the needs of the target audience to provide an appropriate learning experience (Bak-Andersen, 2021).
Discussion and reflection: Debates on the contrast between artisanal results and mass production, heritage value, and the importance of authorship/ narrative.	Critical thinking and material/cultural awareness: the ability to contextualize design practice within social, cultural, and environmental issues (Anagnost, 2022).

TABLE 2. SUMMARY OF THE MAIN RESULTS OF THE WORKSHOPS ANALYZED

	MAGNETIC R EVENT	SOLAR COLABORATIVO CULTURAL SPACE	WORKSHOP AIMED AT DESIGN STUDENTS
Context	Design event	Cultural and collaborative space	University Design Laboratory
Participant profile	Design students (focus on critical thinking)	Diverse audience: Architects, students, and artisans	First-year students (emerging designers)
Educational objective	Reflection on sustainable materials and tile techniques	Replication of the technique with a focus on complete production (from the beginning)	Introduction to the laboratory environment and collaborative construction
Materials and techniques	Post-consumer paper pulp, hand-painted finished bales	Pulp production, molding, and stencil/ free painting technique	Complete cycle: pulping, molding, mechanical fragmentation, and painting
Key learning outcomes	Project management and mastery of prototyping techniques	Teaching skills (teaching technique) and leadership	Mediation through knowledge, empathy, and audience analysis
Evidence of creativity and collaboration	References to the tile heritage of São Luís (Brazil) and treasured memories	Debate on heritage restoration; use of abstract forms	Geometric deconstruction and creation of collective panels
Sustainability dimension (environmental)	Reflection on zero life cycle; eco-friendly pigments and water-based paints	Focus on processing local raw materials and circularity	Reuse of administrative waste; reprocessable items in the paper cycle

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