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Selection and categorization of materials to support design education

Seleção e categorização de materiais como apoio ao ensino em design

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ABSTRACT

The complexity of the projects and the diversity of possibilities regarding the use of materials, processing methods and social, economic, environmental and cultural implications broaden the designer's scope of activity and highlight the multidisciplinary character of the area. In order to relate these contexts to the teaching and learning opportunities in order to shorten the distance between the professional and the materiality of the object, this paper seeks to reflect on the designer's professional practice and understand how his academic training is built, which serves as a foundation for the training of creative thinkers, capable of analyzing and proposing solutions to complex problems. To retrieve an empirical contact with the materials, we analyze the application of Project-Based Learning (ABP) in the discipline of Materials and Processes V at the State University of Minas Gerais, within a teaching internship experience. ABP was selected to engage students in the resolution of real challenges in order to develop a catalog of materials, reversing the traditional dynamics and positioning them as the curators and active producers of knowledge. The results demonstrate the effectiveness of this approach in connecting the curriculum to the interests of students, and this can be seen in the curatorship of 31 different subjects. The requirement of technical research, rigorous categorization, and indication of creative potential reinforced autonomy and critical thinking, despite initial difficulties in coordinating these elements by the students. It is concluded that the experience can be seen as a creativity motivator, and the consolidated catalog is established as a collective, authentic and valuable resource for the educational process.

Keywords: Project-based learning. Material library. Active methodologies. Curation. Creativity.

RESUMO

A complexidade dos projetos e a diversidade de possibilidades quanto ao uso de materiais, formas de processamento e implicações sociais, econômicas, ambientais e culturais ampliam a área de atuação do designer e evidenciam o caráter multidisciplinar da área. Ao atrelar esse contexto às oportunidades de ensino e aprendizagem para mitigar o distanciamento entre o profissional e a materialidade do objeto, o presente artigo busca refletir sobre a atuação profissional do designer e compreender como se constrói sua formação acadêmica, servindo de alicerce para a formação de pensadores criativos, capazes de analisar e propor soluções para problemas complexos. Para resgatar o contato empírico com os materiais, analisa-se a aplicação da Aprendizagem Baseada em Projetos (ABP) na disciplina de Materiais e Processos V, na Universidade do Estado de Minas Gerais, em uma experiência de estágio docência. A ABP foi selecionada para engajar os alunos na resolução de desafios reais ao desenvolverem um catálogo de materiais, invertendo a dinâmica tradicional e posicionando o estudante como curador e gerador ativo de conhecimento. Os resultados demonstram a eficácia da abordagem em conectar o currículo aos interesses dos alunos, revelada na curadoria de 31 materiais diversos. A exigência de pesquisa técnica, categorização rigorosa e indicação de potencial criativo reforçou a autonomia e o pensamento crítico, apesar das dificuldades iniciais de articulação por parte dos discentes. Conclui-se que a experiência atuou como um impulsionador da criatividade, e o catálogo consolidado estabeleceu-se como um recurso coletivo, autêntico e de valor perene para o processo educativo.

Palavras-chave: *Aprendizagem baseada em projetos. Materioteca. Metodologias ativas. Curadoria. Criatividade.*

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INTRODUCTION

The accelerated transformations of the XXI century will introduce new and complex demands for higher education, especially in the field of Design. In a world that is increasingly feared by technology and global desirability, such as sustainability and social responsibility, we hope future designers will not only be creators of form, but rather agents of innovation capable of conceiving solutions that consider the entire life cycle of the product (Samaniego, 2024).

Education must not be based on mere transmission of technical content, focusing on the formation of creative and flexible thinking, with a high capacity to resolve complex problems and collaborate in multidisciplinary environments. This training of creative and innovative skills is of great help to ensure that Design is one of the pillars of Creative Economy.

Historically, the product designer, frequently linked to the environment of ateliers or smaller-scale factories, maintains an intimate and empirical contact with the materials and the transformation processes. This tactile and visceral understanding of the raw material (its resistance, texture and malleability) was a direct catalyst for innovation (Nimkulrat, 2022). However, the era of mass production and industrial globalization, combined with the complexity and diversification of exposure of materials, such as new polymers and composites, resulted in a significant separation between the profession and materials (Held, 2025). The specification of the material is mainly mediated by technical documents and digital catalogues, resulting, many times, in the schools being more conservative and less sensorial or creative, making it difficult to fully integrate the technical and poetic dimensions of the materials in the production process (Bak-Andersen, 2021).

To mitigate this pedagogical gap and address the depth of understanding of the subject, material libraries emerge as an essential step forward in education and learning in Design. These organized repositories, which can be physical, digital or hybrid, can be seen as reconnecting or allowing learning with the sensorial and technical universe of materials (Cohen; Santos, 2024). By allowing direct contact and consultation of information structures that transcend the basic, materials function as laboratories of inspiration, fomenting intellectual curiosity and experimentation, which are crucial for the development of imagination and cognitive flexibility (Dantas *et al.*, 2017).

In this context, the use of an active learning methodology becomes imperative to transform a simple consultation of material into a process of construction of significant knowledge (Hawari; Noor, 2020). This article relates and analyzes the experience of applying Learning Based on Projects (Project-Based Learning — PBL) in the discipline of Materials and Processes for a degree course in Design. The methodological study is based on the ability to actively engage someone in the search and resolution of a problem for an authentic purpose, which is the creation of a real and useful path for an academic community (Miller; Krajcik, 2019).

The project encourages us to deeply investigate a raw material, inspired by the cataloging structure of material libraries, to develop a material catalogue. By requiring thorough technical research, rigorous categorization and, above all, indications of creative and innovative powers for the application of material, the experience gained as demonstrated by PBL can be implemented as a powerful creative impulse.

DESIGN EDUCATION

Design education, in the context of the complexity and accelerated innovations of the 21st century, demands that the educational process transcend the mere transmission of content (Samaniego, 2024). By adhering to a traditional teaching model, which Paulo Freire (2019) criticized as banking education, where the teacher "deposits" knowledge in passive and receptive students, there is a risk of producing adaptable but not transformative professionals. The pressing need is to develop creative skills, critical thinking, and autonomy for solving real and complex problems.

Historically, debates in the field have been excessively focused on the issue of teaching. Within the pedagogical scope, there is a need to integrate projects and research, professional practices, and cultural activities through the dynamics between students and teachers. It is important that this reflects the skills and competencies for working in the appropriate living conditions in Brazil (Cardoso, 2016). In recent years, it has been essential to rebuild the curriculum, bringing in new methodologies and learning strategies, as an opportunity for the development of skills related to investigations (Wang, 2024).

The training of designers in contemporary Brazil transcends technical software skills and purely aesthetic notions, demanding the development of a robust set of systemic competencies and critical attitudes to intervene in a complex social and productive scenario (Mazzarotto Filho *et al.*, 2023). Thus, the professional must be an agent of transformation, mobilizing creativity and critical thinking to propose innovative solutions that consider not only market viability, but also ethical and socioeconomic implications, reflecting a commitment to sustainable development and improving quality of life in the Brazilian context (Nobre; Martins-Fernandes, 2021).

Active learning methodologies emerge as an essential counterpoint to traditional pedagogy in design education. These approaches, which place the student at the center of the process, stimulate engagement, collaboration, reflection, and experimentation, vital elements for the maturation of creativity (Li *et al.*, 2024). In this way, they provide learning environments that simulate professional reality, where knowledge is not absorbed in isolation, but rather actively mobilized and constructed to face concrete challenges (Ferreira; Santos, 2025).

MATERIALS EXPERIENCE

Among the factors that foster innovation in products, one is certainly the application of a specific material for the configuration of these objects. The selection of materials and production processes to compose a product is a crucial part of the design project (Freire de Oliveira, 2022). During the process, not only the technical properties and the final cost are determined, but also the aesthetic, sensory and symbolic qualities of the artifact (Ashby; Johnson, 2013).

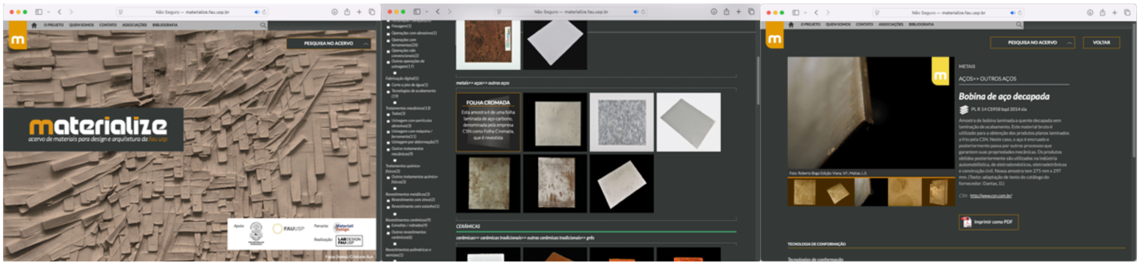
For the development of innovative products that are consistent with their purposes, the designer needs a broad spectrum of information about materials that goes far beyond purely functional and mechanical data. It is crucial to master the technical characteristics, such as strength, density and durability, the manufacturing processes and the environmental implications, such as life cycle and recyclability (Ferroli; Librelotto, 2024). Equally important are the intangible qualities of the material, including its sensory attributes, such as texture, temperature, sound, and odor, associative values, and expressive potential, which directly influence user experience and perception of product value (Held, 2025). The integration of these diverse informational dimensions allows the designer to make strategic decisions, transforming materiality into an element of innovation (Bak-Andersen, 2021).

In this scenario, material libraries fill the gap between theoretical knowledge and practical experience, offering students the opportunity for physical and multisensory contact with a vast and organized diversity of materials (Cohen; Santos, 2024). By providing tangible samples and detailed information about their origins, processes, and innovative applications, material libraries act as laboratories of inspiration (Dantas *et al.*, 2017).

Initiatives to create material libraries in Brazilian universities demonstrate a diversity of focuses, ranging from technology to cultural appreciation. The State University of Pará (UEPA) Material Library, show in Figure 1, for example, focuses on offering tactile and visual interaction with samples, with the clear objective of connecting academics and the general community to technical information and production processes existing in the Northern Region (Cohen; Santos, 2024). In contrast, the Materioteca adopts a more social and cultural approach, creating a virtual collection focused on materials and artisanal processes from Maranhão, recognizing and making tangible traditional knowledge and local narratives (Farias *et al.*, 2020).

Source: Cohen and Santos (2025).
Figure 1. Universidade Estadual do Pará Material Library Space and Information Organization.

At the level of collaboration and national scope, the Materialize project stands out as a network of material libraries connecting institutions such as the Universidade de São Paulo (USP), the Universidade Federal do Rio Grande do Norte (UFRN), and the Universidade Federal do Espírito Santo (UFES), focusing on the development and sharing of digital and physical collections. Materialize, show in Figure 2, aims to catalog regional materials and new materials resulting from academic research, reinforcing the university's role as a generator of applied material knowledge. The detailed organization of these materials into groups and types is based on a wide range of properties, from resistance and durability to recyclability and cost, offering a robust and standardized database (Dantas *et al.*, 2023).



Source: available at: http://materialize.fau.usp.br/. Accessed on: Feb 23, 2026.
Figure 2. "Materialize" platform interface.

The Ornamental Stones collection of the Academic Center of Agreste — CAA/UFPE serves a dual function, serving both the academic aspect, by providing practical contact to students, and the commercial aspect, assisting Design, Architecture and Engineering professionals in their project specifications (Pedrosa; Silva, 2024). The Materioteca of the Universidade Federal de Santa Catarina (UFSC), linked to the Department of Architecture and Urbanism, is divided into a traditional physical collection and a virtual platform, where access to technical analysis and links on sustainability are facilitated (Ferroli; Librelotto, 2024).

To maximize the pedagogical/project value, the categorization and organization of information about the materials in detailed technical data sheets is crucial, as these sheets report the experience with the raw materials. The data sheets go beyond the manufacturer's raw data, structuring the essential attributes for decisions regarding the development of product projects (Mendonça *et al.*, 2023). The information layout should be clear, direct, hierarchical, and highly visual, integrating high-quality photographs of the materials and their applications in context (Pedrosa; Silva, 2024).

METHODOLOGY

This article adopts the format of an Experience Report, with a predominantly qualitative approach, aiming to describe and analyze the effectiveness of PBL as an active methodology applied in the Materials and Processes discipline (Hawari; Noor, 2020). The project was divided into stages that mirror the PBL cycle, as shown in Figure 3, beginning with the Initiation and Definition phase, where theoretical concepts about materials, production processes, and the functioning of Material Libraries were introduced, establishing the criteria for excellence and the final delivery of the discipline. In total, 48 students participated in the activity, divided into 31 groups.

Next, in the Research and Cataloging stage, the students, organized into groups, carried out an in-depth investigation of a specific raw material. This research required the structuring and completion of a detailed technical sheet, inspired by material library models, which went beyond the physical-chemical properties, demanding the inclusion of transformation processes, sustainability analysis and, essentially, the exploration and indication of potential creative applications and unconventional uses of the material. The final phase consisted of organizing the technical sheets to compose a Materials Catalog.

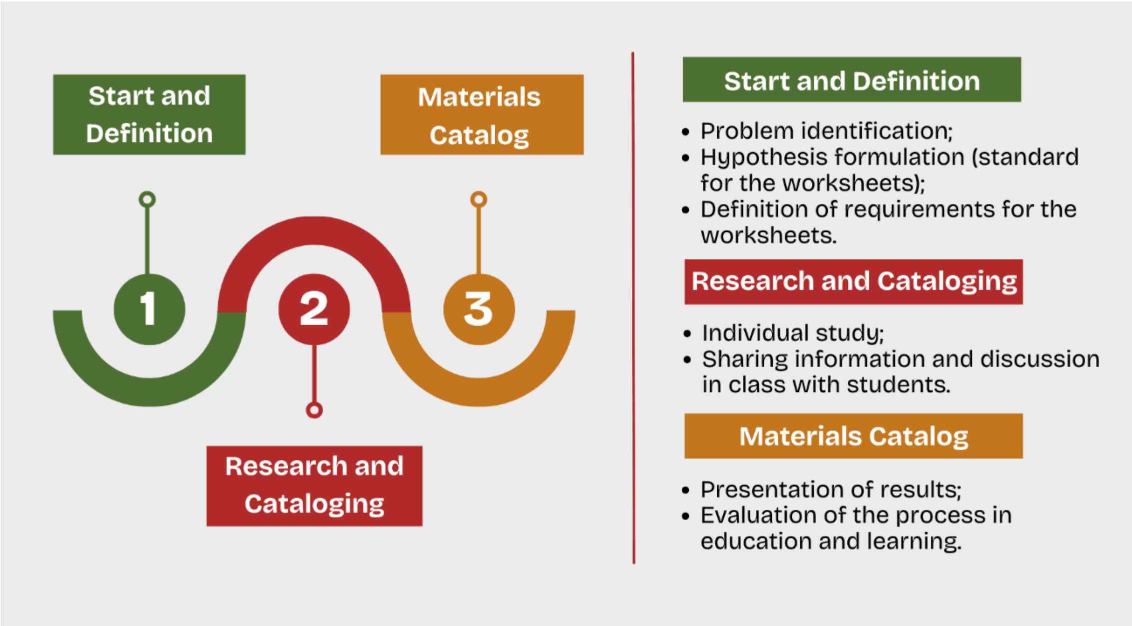


Figure 3. Activity steps based on the Project-Based Learning (PBL) method.

The catalog, a tangible product of the project, was implemented as a digital consultation resource, conferring authenticity and responsibility to the work of the designers in training. For the elaboration of the article, the data analysis was based on the students' reports of the journey until delivery of the final product.

RESULTS AND DISCUSSION

The analysis of the results and the discussion about the implementation of PBL in the Materials and Processes discipline revealed a significant change in the students' role in relation to the traditional interaction with information sources about materials. In a standard context, such as a physical or digital materials library, the designer is expected to act primarily in the material selection and product development stage, seeking pre-existing information (Cohen; Santos, 2025).

However, the structure of this activity reversed this dynamic; students were placed in a position that was actively responsible for the generation, research, and curation of knowledge. This transition required the groups to go beyond mere cataloging, requiring rigorous guidance from the teacher.

The teacher assumed a strategic role, providing essential methodological support on how to conduct searches and research efficiently, encompassing prospection in scientific databases, critical analysis of supplier websites, and interpretation of detailed technical materials related to the samples studied, establishing the basis for the construction of the technical data sheets that make up the catalog. In contrast to an uncritical reception of content, the activity promoted a problem-posing and dialogical educational experience, transforming the student from a receptacle of technical information into an active subject, aware of their own learning process (Freire, 2019).

The transition to this autonomous model did not occur without conflict, as there was some resistance to abandoning academic passivity. Some students showed disinterest in the new dynamic, expressing insecurity and the perception of being 'lost' when given such freedom of research.

This phenomenon can be understood as a reflection of the conditioning generated by the traditional teaching methods experienced in previous Materials and Processes courses, where the delivery of pre-digested content and technical memorization were the norm (Bak-Andersen, 2021). Overcoming this state of inertia required considerable adaptive effort, demonstrating that intellectual autonomy is a gradual process that directly confronts the culture of pedagogical dependence, demanding time for the student to understand their new role as the protagonist of their own education (Nimkulrat, 2022).

The next step was the selection of materials to be investigated and cataloged, a process carried out by the student groups themselves. The result of this phase was the structuring of a table that consolidated 31 distinct materials, categorized into classes, demonstrating the wide range of interests and the diversity of thematic scopes.

In order to organize these in a didactic way, as illustrated in Table 1, the first step was to understand the classification found in classic literature on the subject, especially that which is indicated as basic bibliography for undergraduate courses, such as the book *Ciência e engenharia de materiais: uma introdução* (Callister, 2018).

Table 1. Selected materials divided by classes.

Material Class	Selected and categorized raw material
Natural	Paricá plywood; Banana fiber; Cork; Amber; Bamboo; Gourd; Shellac; Sheep's wool; Freijó wood; Parchment paper; Samaúma; Pine.
Textile	Neoprene; Pineapple Leather.
Polymeric	Silicone; PLA+; Kevlar; ABS; Inner Tube Rubber; Polyester Film; HDPE; Epoxy Resin.
Metallic	Silver; Gold; Tin; Magnesium Alloy (AZ31B); Steel; Aluminum; Nitinol.
Composite	Bacterial Cellulose Paper and Eggshell; Epoxy Fiberglass Composite.

The choice reflected motivations that went beyond the technical scope, ranging from an interest in cataloging cultural aspects of local raw materials, such as gourds, to categorizing the results of research experiments from the university itself, such as bacterial cellulose paper and recycled eggshells. This variety of choices attests to the potential of PBL to connect curricular content to real-world problems and the personal interests of designers in training.

The students' choices demonstrate a remarkable concern with different aspects of design and innovation. There were groups that actively sought to discover technological solutions with advanced materials, envisioning their application in the context of design, as exemplified by a study of magnesium alloy. Others, in turn, used the activity as an opportunity for creative exploration, choosing materials they had never worked with before, such as porcelain, with the aim of developing an innovative concept project.

This diversity of focuses, from sustainability and local research to high technology and experimentation, not only enriched the catalog with multidisciplinary information, but also prepared students for the complexity of decision-making in Design projects, where the selection of materials is influenced by technical, cultural and market factors (Ashby; Johnson, 2013; Ferroli; Librelotto, 2024).

When analyzing the sustainability profile of the 31 selected items, a balance is observed between the appreciation of biogenic alternatives and the persistence of conventional high-impact materials. Approximately 40% of the sample was concentrated in the class of natural materials; however, the predominance of virgin or difficult-to-recycle materials is still noticeable in the polymeric and metallic categories.

This duality reveals that, although there is a conscious awakening of students to circular materials, the vision of the designer in training is still strongly anchored in market availability and the superior technical properties of polluting materials, highlighting the challenge of fully transitioning to a selection of materials entirely based on sustainability (Bak-Andersen, 2021).

After the introduction of theoretical concepts, students were guided to internalize this knowledge by developing templates for the technical data sheets. This process was not limited to graphic aspects; the teams, in consensus sessions in the classroom, debated and defined which information they considered most relevant for the designer, culminating in the choice of the final model to be applied.

This active discussion reinforced the concept that the final product should go beyond the physical-chemical properties, as advocated in the methodology. Figure 4 illustrates the diversity of technical data sheet models proposed by the groups.

The design of these fact sheets was directly influenced by the study of the landscape of material libraries in Brazil, presented in this article and discussed in class with the students by the professor. The students' comments revealed a critical appropriation of this knowledge, expressing what they considered most interesting to incorporate into the proposal. While some valued the technical focus and the presentation of information in a direct and objective way, others highlighted the importance of sustainability indicators, labels and consumption standards, or even local approaches to raw materials. Figure 5 illustrates, through a graph, the information that the students considered most relevant to the final product.

Stage 2 began with an individual study by the students, who based their work on previously established references and research sources, such as databases and technical materials. Later, the dynamics moved to the classroom, where the groups could actively share the information collected and discuss their results, transforming individual knowledge into a collective construction (Li *et al.*, 2024).

To meet the depth required in the technical data sheet, the students had to scrutinize the material's life cycle, investigating the origin of the raw material, its transformation processes, its most important characteristics, and its potential applications. In this context, two active learning strategies were crucial: the critical analysis of technical materials and supplier websites to extract raw data, as well as the intergroup comparison of findings in the classroom.

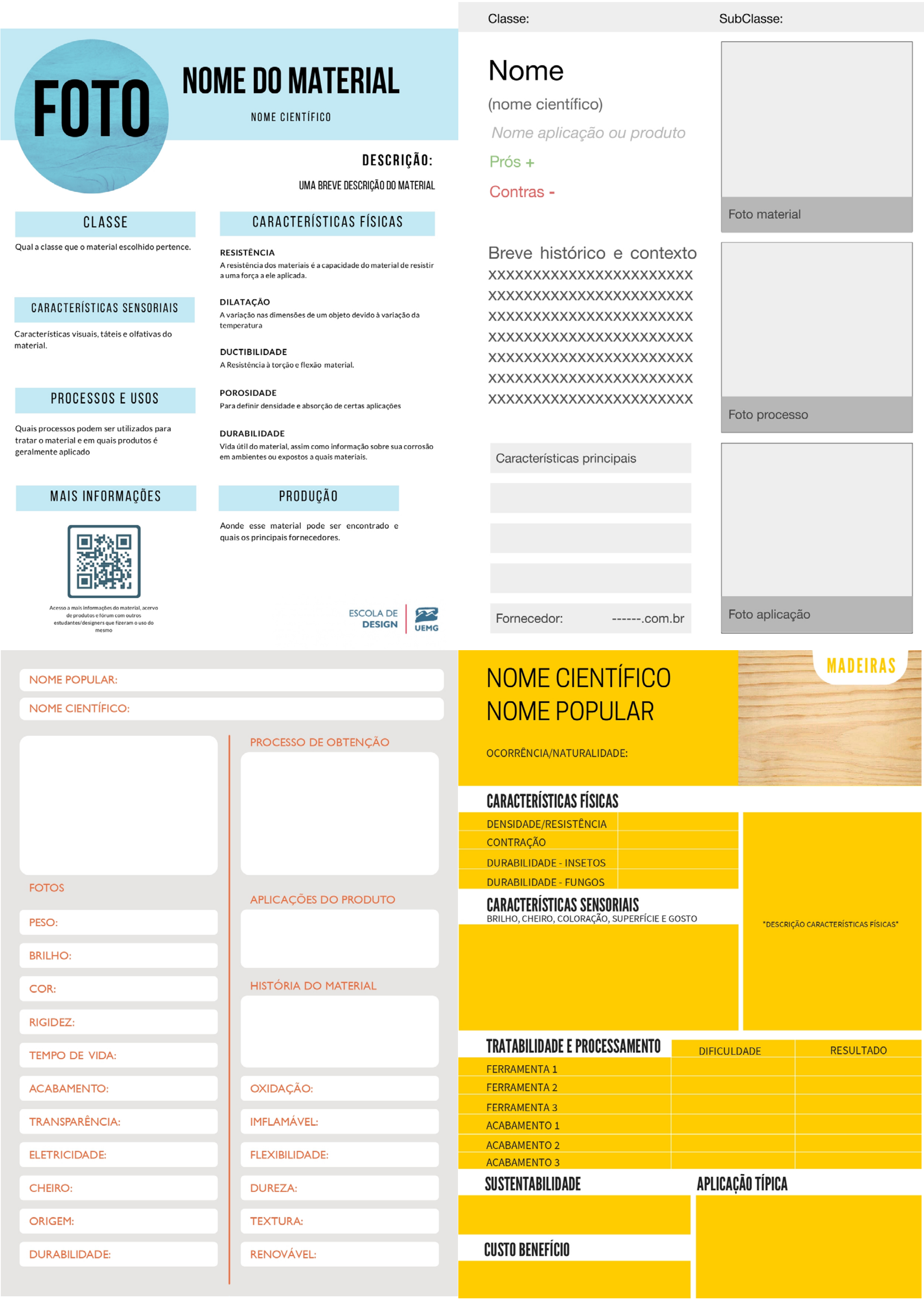


Figure 4. Layout proposals developed by the students.

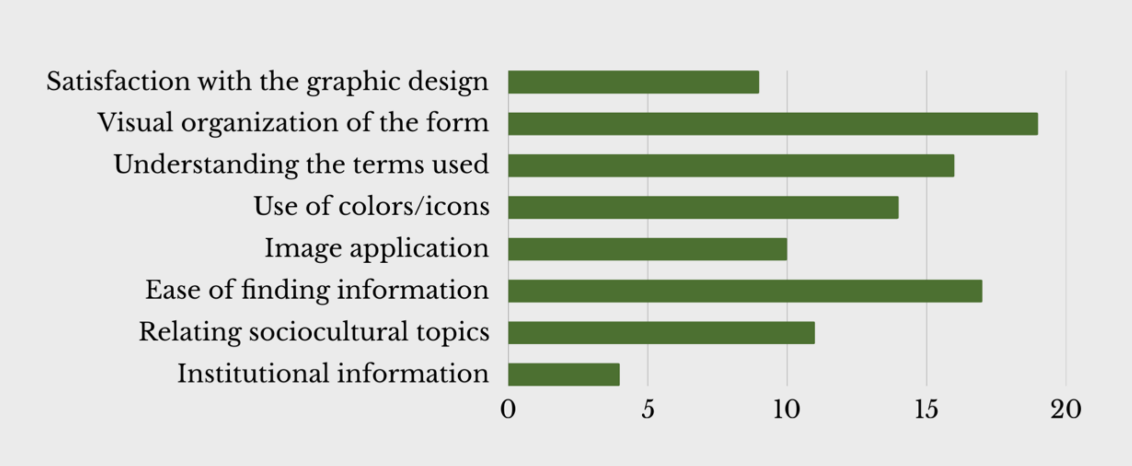


Figure 5. Graph showing students' choices regarding the most relevant information.

Based on the information collected and structured, the students were challenged to explore innovative possibilities for using the chosen raw material. As a source of inspiration and validation, they could base their work on existing Design projects that used similar materials, but which were not necessarily previously known. This link between technical research and creative design closes the active learning cycle, ensuring that the knowledge acquired is not merely theoretical, but immediately related to the designer's professional practice, reinforcing the authenticity of the project according to the PBL method (Miller; Krajcik, 2019).

Stage 3 represented the crucial moment of sharing and socializing knowledge, materializing the tangible product of the project. In the context of the discipline, students not only organized the technical data sheets to compose the catalog, but also presented the results of their research. The presentation and subsequent organization of the catalog reinforced the pillars of PBL, especially by transforming individual knowledge into a collective resource (Hawari; Noor, 2020; Brigato, 2025).

This presentation served as a forum for discussion and validation of information, allowing designers in training to share their findings on the origin, process, and potential creative applications of materials. It conferred authenticity to the work and promoted the exchange of views in Design with peers. The technical data sheet for the Calabash (*Lagenaria siceraria*) exemplifies the research depth, which integrated technical, sensory, and sociocultural aspects. The study covered essential technical information but was enriched by the analysis of perceptual aspects such as texture, touch, color, and shine. In line with the search for relevant attributes, the product's status as a renewable resource, its environmental responsibility, and non-toxicity were highlighted.

The greatest difference, however, lay in the exploration of its cultural applications, citing, for example, its use as a percussion instrument in carnival groups in Minas Gerais and in religious cults of African origin. This approach demonstrated the students' ability to integrate Brazilian identity and anthropological context in the cataloging of materials. Figure 6 illustrates the technical data sheet and the applications of this raw material.

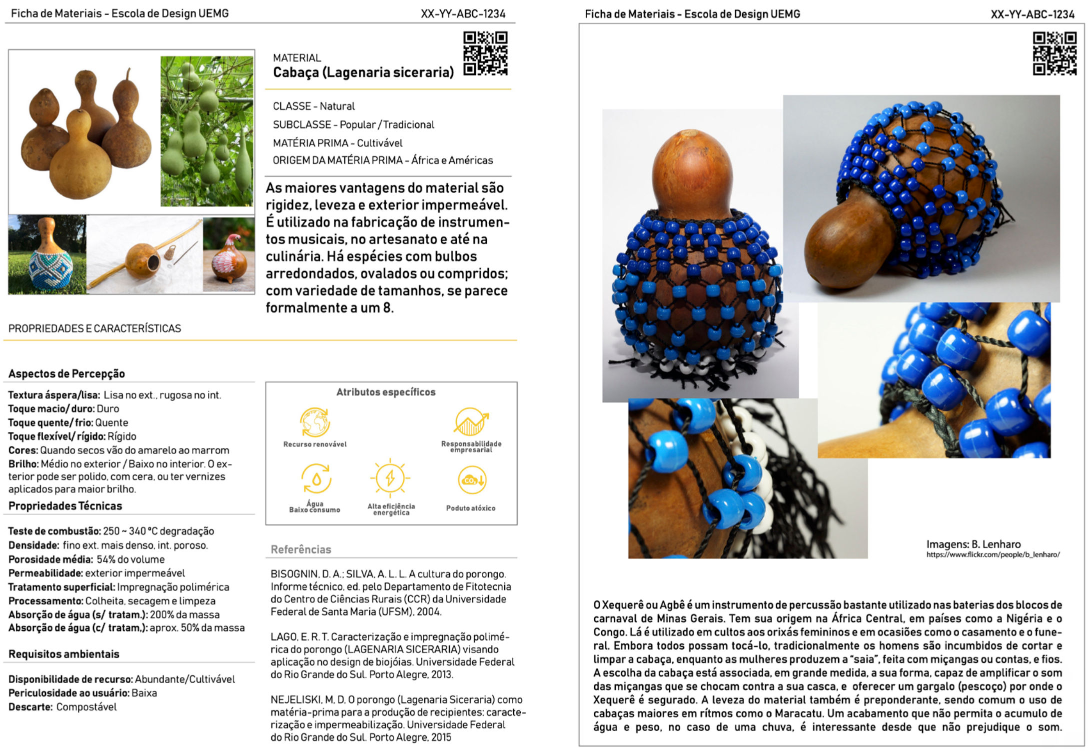


Figure 6. Completed form and image of the raw material.

The research on banana fiber focused on its application in contemporary product design projects and sustainability demands. The technical data sheet detailed technical information and perception attributes (texture, touch, colors, and shine), emphasizing its qualities as a renewable resource, potential for upcycling, and environmental responsibility.

The highlight of the analysis was the proposal for its use as a sustainable substitute for polyester in upholstered furniture, aiming to combine the languages of national design with the new perspectives of the decade. The material (Figure 7) was valued for its properties as a breathable, flexible, soft, and smooth fabric, which improve the user experience in different climatic conditions, in addition to its chemical characteristics of resistance to grease, heat, and water, essential for durability. This analysis demonstrated how the students exercised the designer's vision to solve current problems, honoring Brazilian identity and innovation.

The integration between knowledge of the subject matter and design practice positions Design as the central axis of Creative Economy. This model is based on intellectual capital and creativity as main inputs (Dantas *et al.*, 2017). When the students select gourd or banana fiber, they are not just choosing a raw material, they are approaching it as a strategic resource for generating immaterial value.

This strategic approach, which positions Design as the engine of Creative Economy, is clearly manifested in the analysis conducted by the students on amber, Figure 8. By investigating this material, it was possible to describe its superficial physical properties and explore the intellectual capital contained in its history and bioactivity. The transition from matter to strategic resource occurs when the research identifies the immaterial value of the raw material, not only as an ornamental resin, but as an agent of well-being. Understanding analgesic properties exemplifies how the designer, by mastering technical and scientific knowledge, adds layers of therapeutic and cultural value to the final product.

Ficha de Materiais - Escola de Design UEMG XX-YY-ABC-1234

MATERIAL
Fibra de Bananeira

CLASSE - Naturais
SUBCLASSE - Fibras
MATÉRIA PRIMA - Bananeira
ORIGEM DA MATÉRIA PRIMA - Natural

As fibras de bananeira podem ser extraídas do pseudocaule ou das folhas da planta. Estas têm sido utilizadas em produtos artesanais e em compósitos, sendo reforço de alguns materiais como resina epóxi, éster vinílico, poliéster, polipropileno e polietileno. Sua boa capacidade de finura e rotação vem colocando a fibra de bananeira como uma melhor escolha frente a outras fibras.

PROPRIEDADES E CARACTERÍSTICAS

Aspectos de Percepção

Textura áspera/lisa: Áspera (porosidade)
Toque macio/ duro: Macio
Toque quente/ frio: Quente
Toque flexível/ rígido: Flexível
Pureza: Sujeito aos processos submetidos
Brilho: Sujeito aos processos submetidos

Propriedades Técnicas

Densidade (g/cm3): 1,6 ± 0,2 (D'água)
1,7 ± 0,1 (Prata)
Teor de umidade (%): 22,0 ± 4,0 (D'água)
19,8 ± 0,5 (Prata)
Tingibilidade: Grande potencial na absorção de pigmentos naturais ou artificiais
Resistência: Água, calor, alta capacidade de tração e rotação

Requisitos ambientais

Disponibilidade de recurso: Matéria-prima abundante em países tropicais
Periculosidade ao usuário: Não há perigos
Descarte: Biodegradáveis, atóxicas e facilmente modificadas por agentes químicos

Atributos específicos

Recurso renovável
Upcycling
Responsabilidade empresarial
Água Baixo consumo
Alta eficiência energética
Poduto atóxico

Referências

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ALBINANTE, Sandra R.; PACHECO, Élen B.A.V.; L.Y.VISCONTE, Leila; BATISTA, Luciano do N.. CARACTERIZAÇÃO QUÍMICA E FÍSICA DAS FIBRAS DE BANANEIRA DOS TIPOS D'ÁGUA (Musa sepientum) E PRATA (Musa balbisiana). **Anais do 11° Congresso Brasileiro de Polímeros**, Campos do Jordão, Sp, v. 11, n. 1, p. 1-6, 16 out. 2011.

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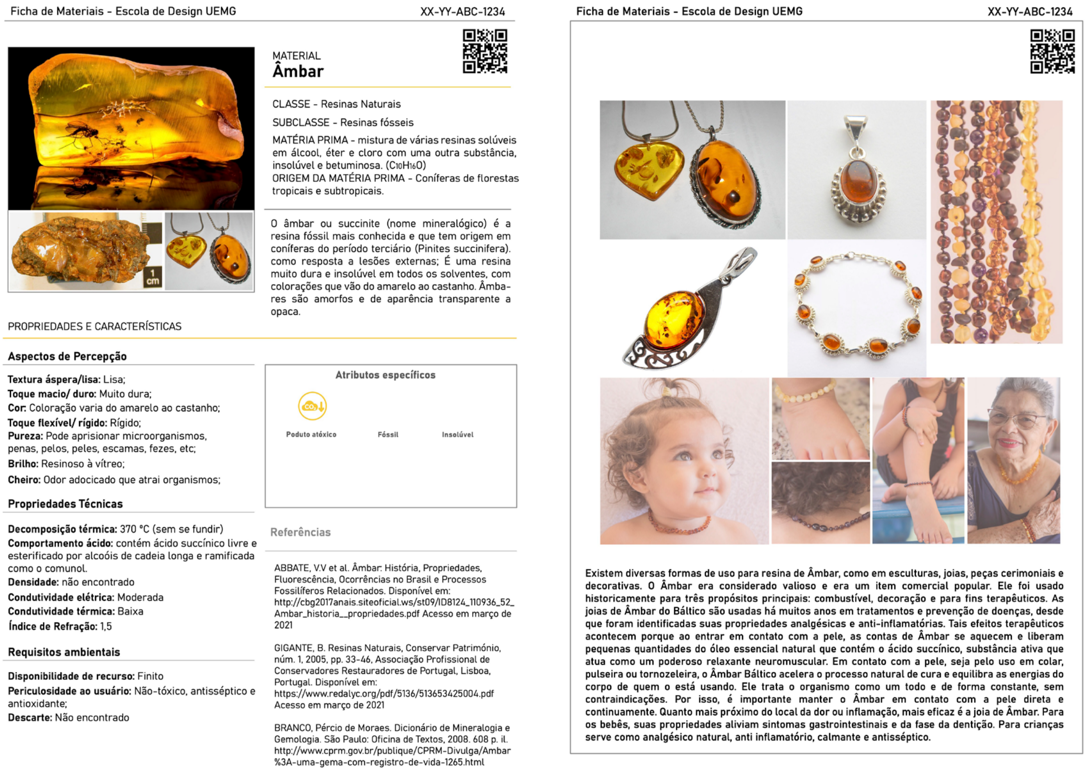
O intuito desse projeto visa aliar as linguagens do design brasileiro com as atuais demandas do mercado, com as novas perspectivas sustentáveis da década em que vivemos e mantendo e valorizando a brasilidade da peça feita por Zanine Caldas. O uso da fibra de bananeira vem com o propósito de um tecido mais sustentável possível como substituto do poliéster que é mais comumente usado na produção de estofados mobiliários. Ela traz o benefício de ser um tecido respirável - devido sua alta umidade- o que permite que o usuário consiga de forma confortável transpirar durante o uso do móvel em dias quentes ou frios, além de ser também um material flexível, suave e macio o que torna a experiência, do toque da pele com o tecido, agradável além de suas características químicas como resistência a gordura, calor e ser à prova d'água ajudarem na durabilidade do tecido.

Figure 7. Completed form and image of the raw material.

The final stage of consolidating the catalog involved a review and refinement process under faculty supervision. After the initial delivery, the materials underwent a detailed correction, which included the validation of bibliographic references and technical textual review. To ensure visual uniformity and clarity of information, students made final adjustments strictly linked to the established standard for technical data sheets, ensuring that the diversity of materials was presented in a cohesive and professional manner in the final document.

The primary expectation is that the generated material will serve as a foundation of practical support for students throughout their training and, above all, in their professional work in the field of Design. In parallel, it is expected that the result, illustrated in Figure 9, will be a rich source of consultation for other students, researchers in the field, and professionals, fostering the dissemination of the educational process.

After the course, a survey conducted by the teacher regarding the feedback and effectiveness of the actions, revealed that the students perceived a real gain in their autonomy, valuing the freedom to direct the focus of their studies to topics of personal interest. As a suggestion for improvement, the students indicated that the activity would be even more beneficial if the research of materials were directly linked to the development of an original product, strengthening the link between design theory and practice.



Ficha de Materiais - Escola de Design UEMG XX-YY-ABC-1234

MATERIAL
Âmbar

CLASSE - Resinas Naturais

SUBCLASSE - Resinas fósseis

MATÉRIA PRIMA - mistura de várias resinas solúveis em álcool, éter e cloro com uma outra substância, insolúvel e betuminosa. ($C_{10}H_{16}O$)
ORIGEM DA MATÉRIA PRIMA - Coníferas de florestas tropicais e subtropicais.

O âmbar ou succinite (nome mineralógico) é a resina fóssil mais conhecida e que tem origem em coníferas do período terciário (Pinites succinifera). como resposta a lesões externas; É uma resina muito dura e insolúvel em todos os solventes, com colorações que vão do amarelo ao castanho. Âmbares são amorfos e de aparência transparente a opaca.

PROPRIEDADES E CARACTERÍSTICAS

Aspectos de Percepção

Textura áspera/lisa: Lisa;
Toque macio/ duro: Muito dura;
Cor: Coloração varia do amarelo ao castanho;
Toque flexível/ rígido: Rígido;
Pureza: Pode aprisionar microorganismos, penas, pelos, peles, escamas, fezes, etc;
Brilho: Resinoso à vítreo;
Cheiro: Odor adocicado que atrai organismos;

Atributos específicos

Poduto atóxico Fóssil Insolúvel

Propriedades Técnicas

Decomposição térmica: 370 °C (sem se fundir)
Comportamento ácido: contém ácido succínico livre e esterificado por alcoóis de cadeia longa e ramificada como o comunol.
Densidade: não encontrado
Condutividade elétrica: Moderada
Condutividade térmica: Baixa
Índice de Refração: 1,5

Requisitos ambientais

Disponibilidade de recurso: Finito
Periculosidade ao usuário: Não-tóxico, antisséptico e antioxidante;
Descarte: Não encontrado

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Existem diversas formas de uso para resina de Âmbar, como em esculturas, joias, peças cerimoniais e decorativas. O Âmbar era considerado valioso e era um item comercial popular. Ele foi usado historicamente para três propósitos principais: combustível, decoração e para fins terapêuticos. As joias de Âmbar do Báltico são usadas há muitos anos em tratamentos e prevenção de doenças, desde que foram identificadas suas propriedades analgésicas e anti-inflamatórias. Tais efeitos terapêuticos acontecem porque ao entrar em contato com a pele, as contas de Âmbar se aquecem e liberam pequenas quantidades do óleo essencial natural que contém o ácido succínico, substância ativa que atua como um poderoso relaxante neuromuscular. Em contato com a pele, seja pelo uso em colar, pulseira ou tornozeleira, o Âmbar Báltico acelera o processo natural de cura e equilibra as energias do corpo de quem o está usando. Ele trata o organismo como um todo e de forma constante, sem contraindicações. Por isso, é importante manter o Âmbar em contato com a pele direta e continuamente. Quanto mais próximo do local da dor ou inflamação, mais eficaz é a joia de Âmbar. Para os bebês, suas propriedades aliviam sintomas gastrointestinais e da fase da dentição. Para crianças serve como analgésico natural, anti inflamatório, calmante e antisséptico.

Figure 8. Completed form and image of the raw material.

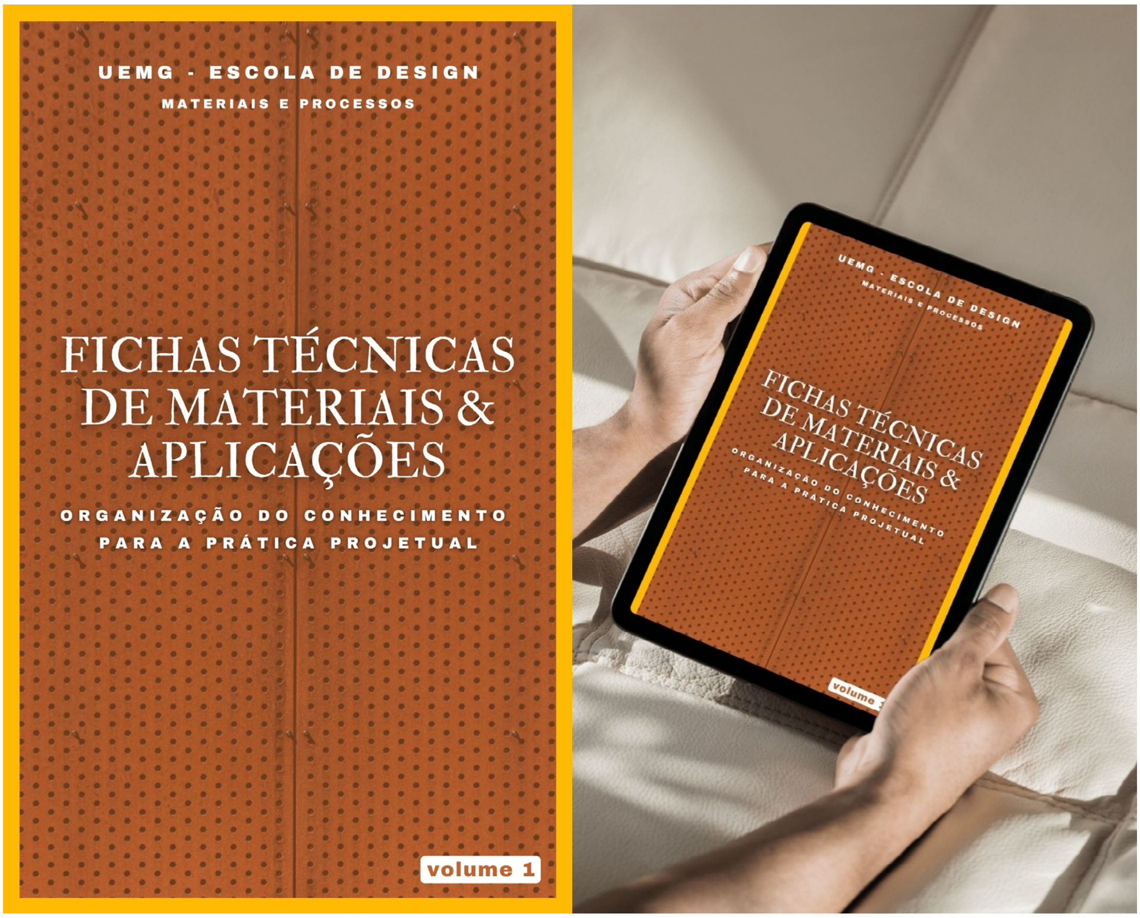

Figure 9. Images from the catalog cover, a result of the course.

Despite the positive results, the experience revealed challenges inherent in the implementation of active methodologies, such as a disparity in the pace of learning and a difficulty of some groups in filtering excess information in digital databases. The main limitation observed was the time barrier — the density of research required to fill out the detailed technical sheets competed with the schedule of other courses, which may explain the students' desire to combine this investigation with the development of an original product.

To provide greater transparency and security to the process, the evaluation criteria went beyond the final result. The evaluation considered the rigor in prospecting sources, the ability to critically synthesize information in technical data sheets, and the collaborative engagement in discussion sessions, ensuring that individual progress and investigative effort were valued as much as the delivery of the catalog.

This analysis of student perception, combined with the practical challenges reported, shows that the construction of autonomy is directly linked to the methodological structuring of the discipline. By mirroring the initiatives of real material libraries, the activity not only taught "what materials are," but also "how to investigate and decide" about them, preparing the student for the complexity of professional decision-making. To summarize how this teaching experience is anchored in the contemporary landscape of material libraries and in the systemic training of the designer, Table 2 relates the initiatives consolidated in the literature with the practical actions developed.

Table 2. Relationship between the practices of material libraries and pedagogical activity.

Initiatives in Material Libraries	Application in practical activity	Contribution to Education
Cultural and regional appreciation (Farias *et al*., 2020)	Selection of materials such as gourd (used in carnival floats) and banana fiber (national design)	Development of perspectives on Brazilian resources and a strategic view of raw materials
Cataloging and standardization of information (Dantas *et al*., 2023)	Creation of unified templates and organization of 31 materials into classes (natural, metals, polymers, and others)	Stimulation of scientific rigor and the systematic organization of technical information
Multisensory approach (Cohen; Santos, 2025)	Inclusion of perception attributes in the data sheets (touch, shine, texture, and odor) for designer evaluation	Raising awareness of intangible qualities and the user experience with the object
Focus on environmental sustainability (Ferroli; Librelotto, 2024)	Life cycle analysis, toxicity, and upcycling potential of the selected samples	Development of a critical and ethical awareness of the project's environmental impacts
Innovation and technology (Pedrosa; Silva, 2024)	Research on advanced materials such as magnesium alloy, pineapple leather, and composites	Connection between technical-scientific knowledge and the prospecting of innovative solutions
Digital and collective access (Dantas *et al*., 2023; Ferroli; Librelotto, 2024)	Implementation of the digital catalog as a consultation resource	Transition of individual knowledge into a strategic resource of the Creative Economy

Furthermore, the application of PBL in the discipline proved to be an imperative tool for the construction of meaningful knowledge. By transforming individual effort into a collective and lasting resource, the project ensured the authenticity and professional relevance of the work, establishing a foundation of practical support in connecting materials theory to the complex and multidisciplinary demands of contemporary design. Figure 10 illustrates these relationships.

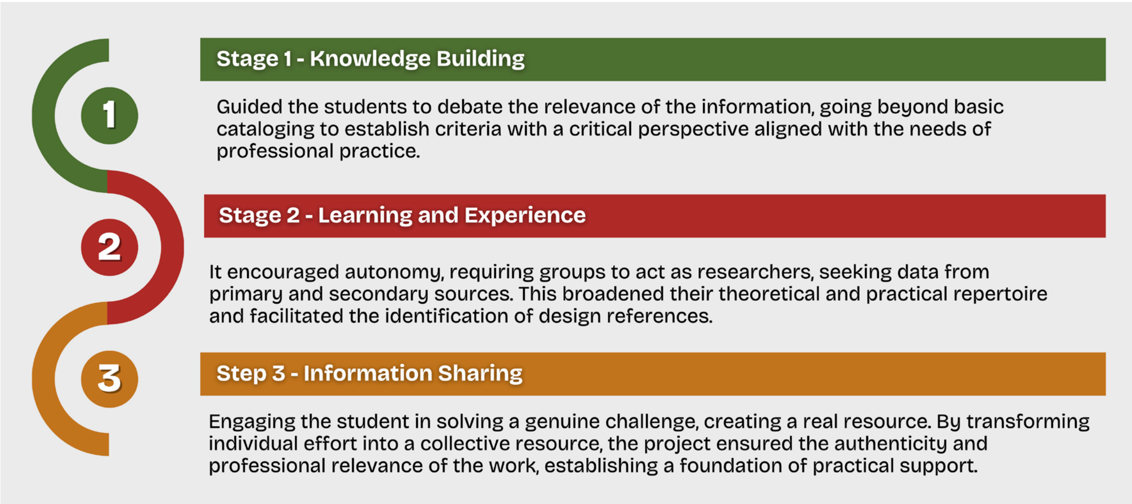

Figure 10. Contributions of the selection and categorization of materials through project--based learning.

Beyond its current function, the project paves the way for continuity and expansion initiatives. The material generated has high potential for integration with collections, projects, and studies under development in various research centers and different Design Schools, acting as a link between the academic production of the discipline and the broader ecosystem of research and innovation in Design.

The transition from a pedagogical artifact to a public consultation resource for other students, researchers, and designers poses the challenge of the technical reliability of the catalog and a possible database of the educational institution. Thus, while the classroom experience focused on the student's learning process in the discipline, it is understood that external availability requires rigorous data processing.

Therefore, this includes the need for final faculty curation to mitigate possible inconsistencies in the technical data sheets produced by students in training and the implementation of a metadata structure that allows the resource to be interoperable with other material databases. Some of the requirements include peer or expert review before publication; the data sheets must undergo a technical review to ensure that the described physicochemical properties are correct and referenced by standards such as ABNT, ASTM, or ISO.

As with the data sheets presented, each piece of technical data must be linked to a bibliographic source or original manufacturer's data sheet, allowing the researcher to deepen the consultation in external sources. Another relevant point raised after completion of the activity is the inclusion of the collection date, in which each sheet must contain the date of the last update. The opportunity to systematize the experience and publish its results will guarantee advances in the classroom and other environments.

FINAL CONSIDERATIONS

This experience report reiterates the relevance of the PBL methodology for contemporary Design education. PBL not only rescued intimate and empirical knowledge of raw materials, mitigating the pedagogical gap generated by industrial complexity, but also ensured that the final product was an authentic and useful resource for the community. The Materials Catalog, by integrating technical, sustainable, sensory, and cultural data, proves its effectiveness in developing systemic skills and critical attitudes that are essential for working in the complex Brazilian productive and social scenario.

The main contribution of this work lies in its applicability and potential for expansion in the area of teaching and research in Design. For future work, it is suggested that the catalog be continued and expanded, incorporating new raw materials and technologies, in order to guarantee its continuous updating and relevance.

Another suggestion is to carry out longitudinal case studies, monitoring the impact of this digital resource on the choice of materials in students' final course projects, measuring the correlation between active curation and innovation in products. The PBL method detailed here can serve as a pedagogical model for other disciplines of a technical-creative nature, replicable in different Design schools in the national and international context.

In this way, the project does not end in the classroom; it becomes an active link between local academic production and the broader ecosystem of research and innovation in Design, reinforcing the role of the university as a generator and curator of applied material knowledge. It is expected that this initiative will inspire and facilitate strategic decision-making regarding materials by future professionals, promoting more conscious, creative choices aligned with the global challenges of sustainability.

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