Fecha de recepción: abril 2025
Fecha de aceptación: mayo 2025

BeCircular: Innovating Ecodesign Training for the Textile and Clothing Industry

Raquel Santos[(*)a], Sofia Tavares[(*)a], Alexandra Cardoso[(**)], Tânia Espírito-Santo[(**)], Paulo Mendes[(**)] y Carla Silva[(*)]

Abstract: The textile and clothing industry faces a significant challenge in transitioning from a linear economic model to a circular one, which is reflected in the lack of knowledge among professionals regarding sustainability concepts. Although the Portuguese textile sector is already at the forefront of sustainability strategies, offering the market alternatives aimed at minimising the negative impacts inherent to this industry, it is essential to establish an adequate training framework to facilitate this transition. In particular, the choices made at the design stage of a product often overlook important concepts related to the impact of materials and processes, as well as the circularity and longevity of products. Therefore, it is imperative to promote circular design and ecodesign strategies.

Within the scope of be@t - bioeconomy at textiles project, one of the initiatives aims to promote education and training in the Textile and Clothing Industry (TCI) in areas such as sustainability, ecodesign and eco-engineering, by integrating digital learning platforms, innovative resources and inclusive methodologies into education and professional training. The deliberate creation of broad and specialised skills has led to the development of upskilling and reskilling programs for workers in the sector, which consequently meet the demands of a market that is increasingly geared towards a circular economy.

This paper explores the development of a computer application, BeCircular, a tool that designed to be used as a training resource in advanced level training. This tool takes an interdisciplinary approach to the issue of decision-making in the design phase of fashion products, linking these choices with the latest methodological and technological innovations in the field of education and training through gamification.

This project is based on design thinking and UX/UI design methodologies, which were reflected in the simulation of a customizable jacket with different options for materials, colours, and components such as pockets, collar, padding and lining. The process steps were structured with different weightings, the final score being based on concrete Life Cycle Assessment (LCA) data of the selected materials and processes.

Beta testing sessions were held to test the tool, resulting in a collaborative process that refined both the application and the approach to the problem.

BeCircular was designed to provide trainees with a practical opportunity to apply their knowledge, while supporting trainers in implementing more interactive practices. Additionally, it serves as an effective tool for communicating science and raising awareness among all professionals in the textile and clothing industry in Portugal.

Keywords: Training - Gamification - Fashion Design - Ecodesign - Circularity

[Resúmenes en español y portugués en la página 243]

(*) CITEVE – Technological Centre of Textiles and Clothing of Portugal (PORTUGAL)

(**) ACADEMIA CITEVE (PORTUGAL)

[a] This authors contributed equally for this work and should be considered as co-authors

Introduction

The textile and clothing industry has a profound impact on both the environment and the economy, characterized by a complex interplay of benefits and detriments. Over the years, clothing consumption has increased not only due to the population increase, but also due to improved living standards and the change in consumption patterns (Shirvanimoghaddam et al., 2019). The industry is more focused on quick turnovers with rapidly changing trends, leading to planned obsolescence and early disposal to maximize profit (Kozlowski et al., 2018), making this one of the most polluting industries globally (Abbate et al., 2024). Incorporating ecodesign practices is rapidly becoming a priority for companies not only because of consumers' demands, but also due to new legislation coming from the European Union. The EU Strategy for Sustainable and Circular Textiles, introduced in March 2022, aims to transform the textile industry by promoting durability, repairability, and recyclability of textile products (European Commission, 2024). This strategy is part of the broader Circular Economy Action Plan and the European Green Deal, which seek to reduce the environmental impact of textiles and other products European Commission, 2024; European Commission, 2024). Additionally, the Ecodesign for Sustainable Products Regulation (ESPR), which came into force on July 18, 2024, sets ecodesign requirements for products across various industries, including textiles, so that products placed on the EU market are designed with environmental considerations at their core, promoting longevity, reusability, and recyclability (European Commission, 2024). As sustainability becomes more important for companies in order to operate within the EU market, the need for qualified workers like designers increases. There is a growing trend among universities to integrate sustainability and ecodesign into their design curricula, but the extent and effectiveness at which this happens varies significantly, and ecodesign principles are still not regarded as an integral part of the design process (Delaney & Liu, 2023; Kafaridou, & Kazamia, 2023). Consequently, many graduates are not fully equipped with the necessary skills to apply these strategies that require technical knowledge. Additionally, professionals that have been in

the industry from some time must now seek external training to meet the new standards (Henninger et al., 2016). Additionally, recent regulations and standards are shaping new constraints in product design. While these restrictions may limit certain design options, they also foster the development of new competencies that empower designers. By requiring a deeper understanding of sustainability and compliance, these regulations enhance designers' influence in the creation process, positioning them as essential decision-makers in the shift toward more sustainable, responsible product development (Textile ETP, 2024). This need for better education in sustainability matters cannot be fulfilled solely by updating university curricula. It also requires the provision of external training programs. These programs, offered by industry organizations, professional bodies, and specialized training providers, can equip designers and other professionals working in product development with the necessary skills and knowledge in a shorter period of time, compatible with their workplace responsibilities.

In Portugal, over the past four years, there has been a significant increase in the total hours of training provided to workers in the Textile and Clothing Industry (TCI). This training includes various programs, workshops, courses, and other activities aimed at enhancing the skills and knowledge of professionals. Such initiatives are crucial for improving workforce quality and boosting the sector's competitiveness (CITEVE, 2023).

Effective methods are essential for quickly and effectively impart this new knowledge. One promising approach is gamification, which refers to the application of game design elements and principals in non-game contexts to enhance user engagement, motivation, and overall experience (Berni & Borgianni, 2021). This approach leverages elements such as points, badges, leaderboards, and challenges to create a more interactive and enjoyable experience, this approach can lead to improved success and excellence rates as well as motivational and behavioural outcomes Gianni & Antoniadis, 2023; Jaramillo-Mediavilla et al., 2024).

To address the pressing need for effective and engaging training in sustainability and ecodesign, Be Circular was developed. This mobile application was designed as a training resource for advanced-level education to be used primarily outside the university context. Be Circular adopts an interdisciplinary approach to tackle decision-making in the design phase of fashion products by evaluating how each decision contributes to the circularity of the product in order to leverage gamification to enhance learning outcomes. Be Circular simulates the design process of a jacket, providing different options for materials, colours and other components such as pockets, collars, padding and others. Each option as a specific score that reflects how it changes the circularity of the final item. The stages of the design process have different weights in the final score, that reflect their importance. Be Circular is designed to stimulate discussion among its users, encouraging them to engage in meaningful conversations within the training program.

Methodology

In order to provide an innovative, practical and empirically based solution, a methodology was developed as shown in Figure 1, the details of which are outlined in the following subsections.

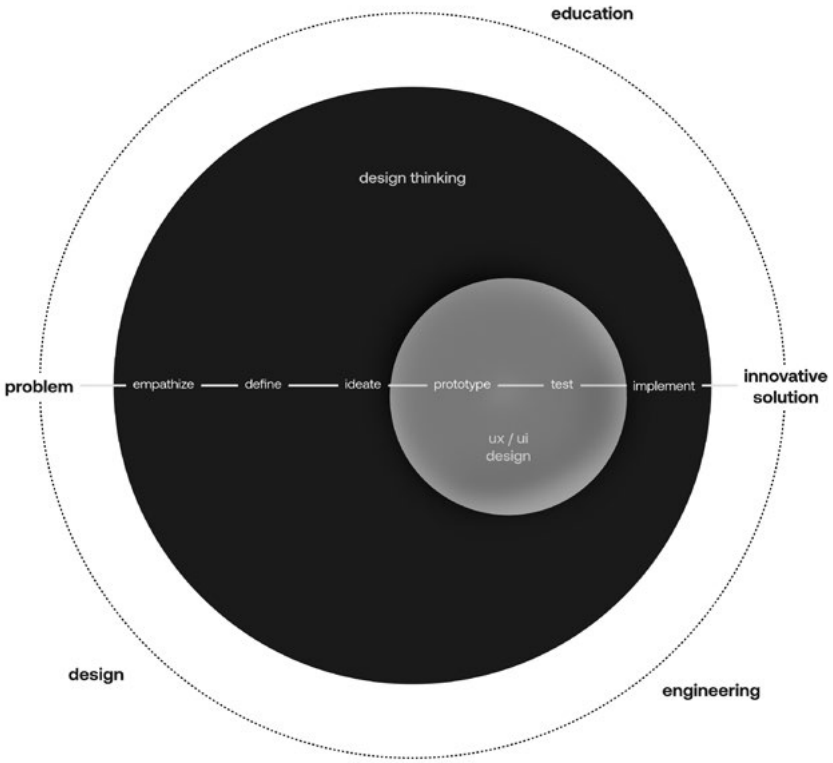

Figure 1. Methodology.

Introduction to methodological framework

- *Design methodologies*

The development of BeCircular was grounded in a human-centred, integrated methodology that combined design thinking with user experience (UX) and user interface (UI) design principles. Design thinking, a methodology that blends insights into user needs with

technological and business requirements, provided the foundation. This approach supported a deep understanding of user needs and challenges by immersing the development team in the users' context and empathizing with their experiences. Through iterative cycles of prototyping and feedback, design thinking encouraged creative problem-solving and helped ensure the final product was both functional and user-friendly (Nair, 2024).
The UX/UI methodologies complemented design thinking by focusing on the creation of intuitive, engaging interfaces that prioritize user satisfaction and usability. This process involved comprehensive user research, iterative prototyping, and usability testing, ensuring the app's functionality met user expectations.
Together, these methodologies leveraged their complementary strengths. While design thinking's broad, problem-solving framework fostered empathy and innovation, UX/UI provided the precision necessary for optimal usability, creating a balanced and robust approach for Be Circular's development (Berni & Borgianni, 2021; Sailer & Homner, 2020).

- *Interdisciplinary approach*

The interdisciplinary development of Be Circular drew on design, textile and environmental engineering, and educational expertise, each providing key insights toward sustainability goals. Design contributed user-centred methods and prototyping for an intuitive, engaging interface. Textile and environmental engineering informed the app's technical accuracy and integrated sustainable practices, emphasizing material properties, durability, and recyclability. Educational insights structured content for an interactive learning experience, ensuring accessibility and user motivation for eco-friendly practices. This integration enabled Be Circular to deliver a comprehensive, practical solution tailored to the needs of the Textile and Clothing Industry.

Design process

- *Empathise*

Within the scope of the be@t project, a comprehensive needs assessment was conducted to evaluate the current state of training and identify knowledge gaps within the Portuguese textile industry. This assessment highlighted essential areas for skill enhancement, particularly in sustainability, ecodesign, and ecoengineering. In response, the be@t project has outlined targeted initiatives with specific key performance indicators (KPIs) to address these training needs, establishing advanced courses to support the development of sustainable industry practices.
To meet these objectives, two main activities were defined:

- A2. Design of Thematic Training Resources: Development of accessible and engaging materials focused on Sustainability, Eco-design, and Eco-engineering, aimed at inspiring sustainable practices among textile professionals.
- A3. Testing, Validation, and Fine-tuning: Ensuring high-quality training resources through iterative testing, validation, and feedback from industry experts and end users.

This framework facilitated a deeper problem analysis and provided insight into effectively meeting the needs of Portuguese textile industry professionals.
The Empathize phase employed several key methods to gain a thorough understanding of user needs and training gaps. A State-of-the-Art (SoA) Analysis involved a detailed review of literature, industry reports, and existing training resources to identify knowledge gaps and assess available options. Brainstorming Sessions were conducted collaboratively with stakeholders, including researchers, industry professionals, educators, and trainers, to define essential training themes and approaches. Additionally, Case Studies were analysed to understand best practices and address specific contextual challenges, ensuring the methodology was well-informed and relevant to real-world scenarios.
The research was based on a combination of primary and secondary sources. A variety of data sources were employed in the course of the research, including the CITEVE internal SharePoint documents, journals, magazines, research websites (such as Web of Science and ResearchGate), Google Scholar, and other similar databases.

- *Define*

The concept for BeCircular was shaped by synthesizing findings to outline the core challenges and opportunities in sustainable textile design. This phase involved a detailed analysis of data gathered during the empathise phase, identifying key user needs and gaps in current sustainable practices.
User personas were developed to represent target users, capturing diverse roles and perspectives within the textile industry. These personas, along with clearly defined problem statements, helped to frame the primary idea of a game/app and subsequently goals and functionalities.

- *Ideate*

The ideation phase commenced with an in-depth benchmarking research, analysing relevant case studies to inspire a range of potential solutions. Key methods employed included brainstorming sessions, collaborative workshops, and mind mapping to expand the scope of innovative ideas. The team also developed conceptual sketches and wireframes to explore diverse interface options that enhance both usability and sustainability.
The digital maturity of partnering companies was considered, influencing the app's features to ensure compatibility and ease of use across varied user experience levels. Additionally, gamification elements, such as a score system, were incorporated to increase user engagement and make the learning experience more interactive by leveraging game design principles in a non-gaming context.
Throughout the design process, the principles of ecodesign and life cycle thinking were integral to structuring the app, its user flow and the scoring system. The team utilized Sphera and ecoinvent 3.8 databases, standard tools in life cycle assessment (LCA) studies, to assess the environmental impact of raw materials and production processes, ensuring that sustainability metrics were foundational in each design choice J(aramillo-Mediavilla et al., 2018).

- *Prototype*

The initial prototype phase commenced with the formulation of user flows that structured the product development process for a jacket. This entailed the delineation of each interaction step, encompassing material selection, processes, jacket construction details, and minor text elements, in addition to user engagement points.

Following the user flow creation, layout designs were developed to prioritize simplicity, efficiency, and accessibility. Low-fidelity and medium-fidelity prototypes, including paper sketches and digital wireframes, were produced. The design was created in accordance with the be@t project's communication guidelines, particularly in colour schemes and typography.

An interdisciplinary team supported this process: textile and environmental engineers advised on material selections for digital assets to accurately represent textile properties and sustainability impacts, while educators contributed ideas for interactive elements to enhance user engagement. The prototype development utilized interactive and collaborative digital platforms, namely Google Docs and Miro, to facilitate real-time collaboration and refinement. Additionally, design tools such as Figma, Adobe Illustrator, and Clo3D were employed.

- *Test*

The testing phase for BeCircular encompassed multiple stages. Initially, the development team conducted internal testing to identify primary usability issues. This was followed by a focus group test involving professionals from the textile and clothing sectors, selected to provide targeted, industry-specific feedback. Their insights informed a round of refinements to align the app more closely with industry expectations.

The app was then presented at two public events as a demonstration application, allowing for broader feedback collection from a diverse audience over a two-day period. The final testing stage, scheduled for integration into advanced course settings, is yet to be completed.

- *Feedback*

Feedback was systematically collected throughout the test phase using a semi-structured questionnaire with open-ended questions designed for test groups. The team followed an iterative process, refining prototypes based on interdisciplinary insights and feedback loops to continually enhance the app. Researchers closely evaluated the data collected to prioritize adjustments, ensuring that each iteration addressed user needs effectively.

This structured, data-driven approach allowed the team to progressively improve BeCircular's functionality and user experience, ensuring its readiness for broader deployment.

- *Implementation*

The implementation of BeCircular is scheduled for early 2025, when the advanced courses will be launched. The current focus is on finalizing and preparing the solution for deployment. This involves high-fidelity prototyping, beta testing, and strategic launch planning. Additionally, the UX/UI design is being refined to enhance visual and interactive elements, ensuring an optimal user experience upon release.

Results

The BeCircular app (Figure 1) emerged as an educational tool that simulates the design process for a jacket in a straightforward and accessible way, making it useful for both design and non-design professionals involved in product development.

Figure 2. Be Circular app overview.

Overview of the app and user flow

Be Circular is designed to guide users through a structured decision-making process for designing a jacket, emphasizing sustainability and circularity concepts. Upon launching the app, users are greeted with a welcome message and an introduction to the app's purpose and functionality. The app's user flow is divided into six stages (subsections 3.1.1 to 3.1.7), each focusing on different aspects of the jacket design. As the user progresses through each stage, the virtual representation of the jacket is updated to reflect their design choices creating an interactive experience to promote engagement.

- *Stage 1: Jacket Exterior*

In the first stage, users select the primary material for the jacket, with options for monomaterials or a mixture of materials. They then choose the color of the jacket, with the option to select either a solid colour or a pattern. Additionally, users can decide whether

to add embroidery to the jacket. This stage raises awareness of the significance of selecting primarily biobased or recycled raw materials and considers the environmental impact of dyeing and printing.

- *Stage 2: Interfacing*

In the second stage, users choose whether to include interfacing in the jacket. Interfacing can be added to provide stability and structure to the jacket or even for warmth. This stage encourages reflection on durability versus recyclability.

- *Stage 3: Fillin*

The third stage involves deciding if filling should be included in the jacket. Filling adds heating conserving abilities, affecting the warmth and comfort of the final garment. It emphasizes the importance of material reduction for circularity, even as filling enhances durability.

- *Stage 4: Lining*

In the fourth stage, users choose whether to add lining to the jacket. If it is chosen, users can select whether it is made from the same material as the exterior or a different one and choose its colour. This stage promotes preferences for biobased or recycled materials while encouraging consideration of monomateriality to reduce environmental impact.

- *Stage 5: Opening*

The fifth stage involves selecting the opening method for the jacket. Users can choose between buttons, a zipper, a belt, or no closure at all. This choice influences both the style and practicality of the jacket. The choice highlights considerations for reparability and ease of disassembly to aid in circularity.

- *Stage 6: Accessories*

In the final stage, users decide on additional features such as adding a collar, pockets, and cuffs. For pockets, users can choose the style (zipper, buttons, or open pocket) and whether they are made from the same material as the jacket or a different material. This stage underscores the complexities of disassembling a product with many components and encourages choices that enhance reparability and monomateriality.

- Scoring *System* and Feedback

Upon completing all the stages of the app, which mimic the design process, users receive a final score based on their choices. Each decision made during the design process had associated points that are summed up to give a comprehensive score. This final score is presented using a traffic light system: a green score indicates a circular design, fully aligned with ecodesign principles; a yellow score represents a hybrid design, incorporating some circular design concepts but with room for improvement; a red score denotes a linear design, which does not consider ecodesign strategies and should be avoided by designers (Figure 3).

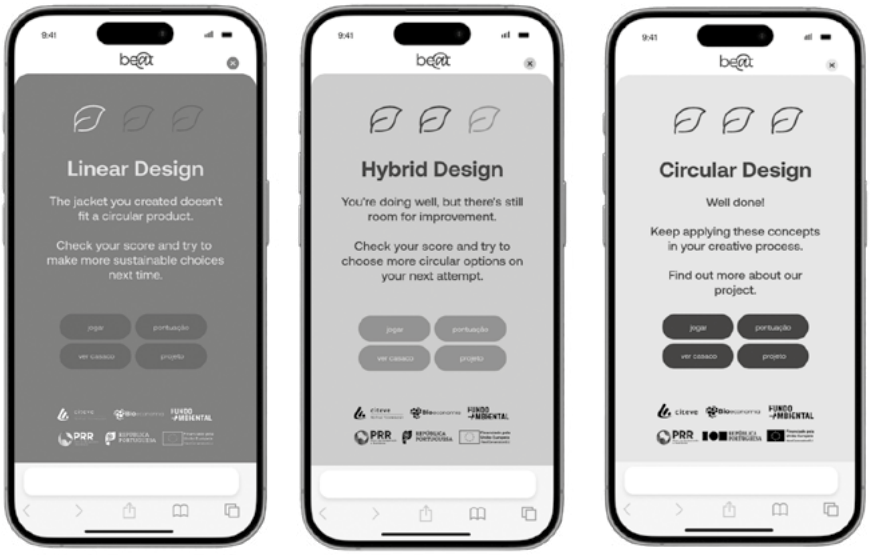

Figure 3. Be Circular score stage.

Figure 4. Be Circular score description and final design example.

In addition to the overall score, users can explore detailed feedback for each individual stage (Figure 4). This allows them to identify specific areas where improvements can be made. For instance, even if the final score is green, there may be sections with yellow or red scores, highlighting opportunities for further enhancement in those areas. This detailed feedback helps users understand the impact of their choices and encourages continuous improvement in their design practices.

User feedback

User feedback on BeCircular was overwhelmingly positive. Participants found the app easy to use, interactive, and visually appealing. Even some users with prior experience in ecodesign concepts, reported learning something new. The app generated questions about why certain choices were not optimal, which was one of the intended outcomes, as it was designed to be integrated into a training program where such discussions will be held accompanied by an expert.

Many users expressed curiosity about how their design choices affected the recyclability of the garment and sought to understand the reasons behind these impacts. Additionally, the app allowed users to reflect on the malleable nature of the concept of sustainability. It became evident that it is difficult to label a material or specific choice as inherently unsustainable, as the best solution often depends on the context. For instance, while the use of padding was scored as "red", indicating a less sustainable choice, it is essential for producing a warm jacket capable of withstanding cold temperatures. Removing padding from a winter jacket could result in a garment that fails to protect users from the cold, ultimately making it less sustainable due to reduced functionality and usability.

The easiness of use and simple interface of BeCircular allowed for users to make multiple attempts and experiment with different combinations and even try to recreate their own jackets.

Conclusions

The development of BeCircular exemplified the synergy of design thinking, UX/UI design, and interdisciplinary methodologies. Design thinking's broad problem-solving framework fostered empathy and innovation, while UX/UI methods provided the precision required for optimal usability, resulting in a balanced, effective approach to the app's development.

As a training resource, BeCircular is intended to encourage critical thinking, independent learning, and awareness of sustainability. While the app introduces users to sustainable design principles, it is not a substitute for in-depth study or structured analysis in a formal training setting. The carbon footprint variations within the app are purely illustrative. Additionally, all game content is copyrighted and may not be reproduced without permission.

BeCircular has proven to be a valuable educational tool for promoting training within the Textile and Clothing Industry (TCI) in sustainability, ecodesign, and eco-engineering. It further supports technological and digital transformation by introducing innovative, inclusive resources into education and professional training.
Moreover, the app's success inspires future research and the development of educational resources both within Portugal and internationally, highlighting its potential impact on sustainable design education globally.

Acknowledgements

Integrated Project be@t – Textile Bioeconomy, to strengthen the National Bioeconomy, financed by the Environmental Fund through Component 12 – Promotion of Sustainable Bioeconomy (Investment TC-C12-i01 – Sustainable Bioeconomy No. 02/C12- i01.01/2022), of European funds allocated to Portugal by the Recovery and Resilience Plan (RRP), within the scope of the European Union (EU) Recovery and Resilience Mechanism, framed in the Next Generation EU, for the period 2021 – 2026.
We would like to thank João Salgado and Joana Santos for their valuable contribution to the design prototyping process, which have significantly enhanced the quality of the interface.

References

Abbate, S., Centobelli, P., Cerchione, R., Nadeem, S. P., & Riccio, E. (2024). *Sustainability trends and gaps in the textile, apparel and fashion industries.* Environment, Development and Sustainability, 26(2), 2837–2864. https://doi.org/10.1007/s10668-022-02887-2

Berni, A., & Borgianni, Y. (2021). *From the definition of user experience to a framework to classify its applications in design.* Proceedings of the Design Society, 1, 1627–1636. https://doi.org/10.1017/pds.2021.424

CITEVE. (2023). *Relatório de Sustentabilidade STV 2023: Be@t.* CITEVE.

Delaney, E., & Liu, W. (2023). *Postgraduate design education and sustainability—An investigation into the current state of higher education and the challenges of educating for sustainability.* Frontiers in Sustainability, 4. https://doi.org/10.3389/frsus.2023.1148685

European Commission. (2024, October 14). *Circular economy action plan.* Retrieved from https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en

European Commission. (2024, October 14). *Ecodesign for Sustainable Products Regulation.* Retrieved from https://commission.europa.eu/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/ecodesign-sustainable-products-regulation_en

European Commission. (2024, October 14). *Textiles strategy*. Retrieved from https://environment.ec.europa.eu/strategy/textiles-strategy_en

European Commission. (2024, October 14). *The European Green Deal.* Retrieved from https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

Gianni, A. M., & Antoniadis, N. (2023). *A novel gamification application for high school student examination and assessment to assist student engagement and to stimulate interest.* Information, 14(9), 498. https://doi.org/10.3390/info14090498

Henninger, C. E., Alevizou, P. J., & Oates, C. J. (2016). *What is sustainable fashion? Journal of Fashion Marketing and Management: An International Journal, 20*(4), 400–416. https://doi.org/10.1108/JFMM-07-2015-0052

Jaramillo-Mediavilla, L., Basantes-Andrade, A., Cabezas-González, M., & Casillas-Martín, S. (2024). *Impact of gamification on motivation and academic performance: A systematic review.* Education Sciences, 14(6), 639. https://doi.org/10.3390/educsci14060639

Kafaridou, M., & Kazamia, K. I. (2023). *Integration of environmental sustainability issues in design education curriculum.* European Journal of Sustainable Development, 12(3), 69. https://doi.org/10.14207/ejsd.2023.v12n3p69

Kozlowski, A., Searcy, C., & Bardecki, M. (2018). *The reDesign canvas: Fashion design as a tool for sustainability.* Journal of Cleaner Production, 183, 194–207. https://doi.org/10.1016/J.JCLEPRO.2018.02.014

Nair, D. (2024). *Design and design thinking: Elements, models, and implications.* In R. Huang, D. Liu, M. A. Adarkwah, H. Wang, & B. Shehata (Eds.), Envisioning the Future of Education Through Design (pp. 27–48). Springer Nature Singapore. https://doi.org/10.1007/978-981-97-0076-9_3

Shirvanimoghaddam, K., Czech, B., Wiącek, A. E., Ćwikła-Bundyra, W., & Naebe, M. (2019). *Sustainable carbon microtube derived from cotton waste for environmental application*s. Chemical Engineering Journal, 361, 1605–1616. https://doi.org/10.1016/j.cej.2018.11.157

Textile ETP. (2024). *Strategic Research and Innovation Agenda* (SRIA). Textile ETP.

Resumen: La industria textil y de la confección se enfrenta a un importante reto en la transición de un modelo económico lineal a uno circular, lo que se refleja en la falta de conocimiento de los profesionales sobre los conceptos de sostenibilidad. Aunque el sector textil portugués ya está a la vanguardia de las estrategias de sostenibilidad, ofreciendo al mercado alternativas destinadas a minimizar los impactos negativos inherentes a esta industria, es fundamental establecer un marco de formación adecuado para facilitar esta transición. En particular, las decisiones que se toman en la fase de diseño de un producto a menudo pasan por alto conceptos importantes relacionados con el impacto de los materiales y los procesos, así como la circularidad y la longevidad de los productos. Por lo tanto, es imperativo promover estrategias de diseño circular y ecodiseño.

En el ámbito del proyecto be@t - bioeconomía en los textiles, una de las iniciativas tiene como objetivo promover la educación y la formación en la Industria Textil y de la Confección (TCI) en áreas como la sostenibilidad, el ecodiseño y la ecoingeniería, mediante

la integración de plataformas de aprendizaje digital, recursos innovadores y metodologías inclusivas en la educación y la formación profesional. La creación deliberada de competencias amplias y especializadas ha llevado al desarrollo de programas de perfeccionamiento y reciclaje profesional para los trabajadores del sector, que responden así a las demandas de un mercado cada vez más orientado hacia una economía circular.
En este trabajo se analiza el desarrollo de una aplicación informática, BeCircular, una herramienta diseñada para ser utilizada como recurso formativo en la formación de nivel avanzado. Esta herramienta aborda de forma interdisciplinar la cuestión de la toma de decisiones en la fase de diseño de productos de moda, vinculando estas decisiones con las últimas innovaciones metodológicas y tecnológicas en el ámbito de la educación y la formación a través de la gamificación.
Este proyecto se basa en metodologías de design thinking y diseño UX/UI, que se reflejaron en la simulación de una chaqueta personalizable con diferentes opciones de materiales, colores y componentes como bolsillos, cuello, acolchado y forro. Los pasos del proceso se estructuraron con diferentes ponderaciones, y la puntuación final se basó en datos concretos de Análisis del Ciclo de Vida (ACV) de los materiales y procesos seleccionados.
Se realizaron sesiones de prueba beta para probar la herramienta, lo que dio como resultado un proceso colaborativo que refinó tanto la aplicación como el enfoque del problema.
BeCircular fue diseñado para proporcionar a los alumnos una oportunidad práctica de aplicar sus conocimientos, al tiempo que apoyaba a los formadores en la implementación de prácticas más interactivas. Además, sirve como una herramienta eficaz para comunicar la ciencia y concienciar a todos los profesionales de la industria textil y de la confección en Portugal.

Palabras clave: Formación - Gamificación - Diseño de Moda - Ecodiseño - Circularidad.

Resumo: A indústria têxtil e de vestuário enfrenta um desafio significativo na transição de um modelo económico linear para um modelo económico circular, que se reflete na falta de conhecimento dos profissionais sobre conceitos de sustentabilidade. Embora o setor têxtil português já esteja na vanguarda das estratégias de sustentabilidade, oferecendo ao mercado alternativas que visam minimizar os impactos negativos inerentes a esta indústria, é essencial estabelecer um quadro de formação adequado para facilitar esta transição. Em particular, as decisões tomadas na fase de concepção de um produto ignoram frequentemente conceitos importantes relacionados com o impacto dos materiais e processos, bem como a circularidade e a longevidade dos produtos. Portanto, é imperativo promover estratégias de design circular e de ecodesign.
No âmbito do projeto be@t – bioeconomia nos têxteis, uma das iniciativas visa promover a educação e formação na Indústria Têxtil e de Vestuário (ITC) em áreas como a sustentabilidade, o ecodesign e a ecoengenharia, através da integração de plataformas digitais de aprendizagem , recursos inovadores e metodologias inclusivas na educação e formação profissional. A criação deliberada de competências amplas e especializadas tem levado ao desenvolvimento de programas de desenvolvimento profissional e de reconversão dos trabalhadores do setor, respondendo assim às exigências de um mercado cada vez mais orientado para uma economia circular.

Este trabalho analisa o desenvolvimento de uma aplicação informática, BeCircular, uma ferramenta desenhada para ser utilizada como recurso formativo em formação de nível avançado. Esta ferramenta aborda de forma interdisciplinar a questão da tomada de decisões na fase de design de produtos de moda, ligando essas decisões às mais recentes inovações metodológicas e tecnológicas no domínio da educação e formação através da gamificação.
Este projeto baseia-se em metodologias de design thinking e UX/UI design, que se refletiram na simulação de um casaco customizável com diferentes opções de materiais, cores e componentes como bolsos, gola, forro e forro. As etapas do processo foram estruturadas com diferentes ponderações, e a pontuação final foi baseada em dados específicos da Análise do Ciclo de Vida (ACV) dos materiais e processos selecionados.
Foram realizadas sessões de testes beta para testar a ferramenta, resultando em um processo colaborativo que aprimorou tanto a aplicação quanto a abordagem do problema.
BeCircular foi concebido para proporcionar aos alunos uma oportunidade prática de aplicar os seus conhecimentos, ao mesmo tempo que apoia os formadores na implementação de práticas mais interativas. Além disso, serve como uma ferramenta eficaz para comunicar ciência e sensibilizar todos os profissionais da indústria têxtil e de vestuário em Portugal.

Palavras-chave: Formação - Gamificação - Design de Moda - Ecodesign - Circularidade.

[Las traducciones de los abstracts fueron supervisadas por el autor de cada artículo.]