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VIRTUAL REALITY FOR SUSTAINABLE FASHION EDUCATION: THE FASHION.ED PROJECT EXPERIENCE

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Abstract: *Virtual Reality (VR) is transforming education by creating immersive and interactive learning environments that enhance student engagement, motivation, and knowledge retention. In higher education, VR offers new possibilities for experiential learning, allowing students to explore complex concepts, develop practical skills, and apply theoretical knowledge in simulated real-world contexts. Through realistic simulations and hands-on virtual activities, learners can engage with content in ways that traditional methods cannot provide, promoting critical thinking, creativity, and problem-solving. As digitalization becomes increasingly important in education, VR stands out as a powerful tool to support innovation, flexibility, and personalized learning experiences across various disciplines.*

This article presents the results of the Erasmus+ project Supporting Entrepreneurship in Eco Design–FASHION.ED (2023-1-ES01-KA220-HED-000157440). The main outcomes include the development of the e-learning course Eco-Design in Fashion, the creation of a Virtual Reality (VR) laboratory offering interactive 3D eco-design experiments, and the organization of an international competition focused on eco-design entrepreneurship for fashion and textiles students. These activities demonstrate the potential of combining digital innovation with sustainability education.

The project results underline the importance of integrating VR technologies in higher education to create immersive learning experiences, enhance practical skills, foster creativity, and better prepare students for the challenges of the modern labor market.

Key words: *Fashion.ED, Erasmus+ project, Virtual Reality, education*

1. INTRODUCTION

Virtual Reality (VR) is an advanced digital technology that enables users to experience and interact with computer-generated environments in a seemingly real or physical way. Although initially developed for fields such as military simulation and gaming, VR has evolved into a

powerful tool across various sectors, notably education [1]. A historical overview of VR, including the definition of basic terminology, classification of system types, and its applications across science, work, and entertainment, is provided by Tomasz and Michael [2]. Their study also offers an in-depth analysis of typical VR systems, examining the relationships between input devices, output devices, and software components, while discussing the influence of human factors on the design of virtual environments and outlining future technological and social developments.

By immersing learners into realistic and controlled environments, VR offers unique opportunities to enhance understanding, motivation, and engagement, surpassing traditional teaching methods. In educational contexts, VR allows for experiential learning where students "learn by doing," which is considered crucial for the acquisition of complex skills [3]. For example, VR can simulate engineering operations, biological processes, or historical events, providing learners with experiences that are otherwise difficult to replicate in a classroom setting. This immersive approach can cater to different learning styles—visual, kinesthetic, and auditory—thus personalizing education and improving learning outcomes [4].

Recent research highlights that VR fosters not only technical skills but also cognitive and emotional competencies essential for future workplaces. Indrie et al. [5] emphasize that using VR technologies, such as those implemented in the CircuTex laboratory activities of Erasmus+ project, can make teaching processes more productive, significantly increase student motivation, and contribute to the development of vital social and interpersonal skills, including empathy and teamwork. Moreover, VR allows for highly flexible and customized educational content, adapting training to the specific needs of various industries and educational levels.

Furthermore, VR creates a safe environment for practicing tasks that could be dangerous or costly in real life, such as performing surgical procedures, flying an aircraft, or handling hazardous materials. According to Jensen and Konradsen [6], students who learn through VR demonstrate greater confidence and competence compared to those using conventional methods. Additionally, VR fosters collaboration and critical thinking, as many applications are designed to support group activities and problem-solving tasks.

As educational institutions face the challenges of the digital age, integrating VR offers an innovative pathway to bridge theoretical knowledge with practical application. Its potential to transform classrooms into dynamic, interactive spaces highlights the importance of continued investment in VR technologies for education, ensuring that future generations are better prepared for complex real-world scenarios.

This article presents the activities carried out within the framework of the Erasmus+ project *Supporting Entrepreneurship in Eco Design-FASHION.ED (2023-1-ES01-KA220-HED-000157440)*. The project leverages Virtual Reality (VR) technology to promote sustainability and innovation in the fashion and textiles industry. Recognizing that this industry is one of the world's largest polluters, the project addresses urgent environmental challenges by encouraging the adoption of eco-friendly materials, waste reduction, and ethical production practices. Fashion.ED aims to cultivate an entrepreneurial, digitally-driven educational environment that enhances students' skills in eco-fashion and stimulates the growth of the circular economy.

A key innovation of the project is the use of Virtual Reality to create a virtual library of 3D eco-design experiments, enabling fashion and textiles students to explore sustainable solutions remotely in six languages.

2. MATERIALS AND METHODS

In the present article, we introduce the activities developed within the Erasmus+ project FASHION.ED.

This project addresses the urgent need for sustainability in the fashion and textiles sector, an industry widely recognized as the second-largest global polluter after oil, responsible for excessive waste generation, the use of harmful chemicals, and significant pollution of water and soil resources. To confront these challenges, Fashion.ED aims to foster the creation of more sustainable clothing by emphasizing eco-friendly material sourcing, waste minimization, and ethical labor practices across the supply chain. The project also seeks to cultivate an entrepreneurial, digitally-driven, and innovative higher education environment, enhancing students' entrepreneurial skills and encouraging careers in eco-fashion.

A central innovation of the project is the creation of a virtual library of interactive 3D eco-design experiments. Through VR simulations, fashion and textiles students and professionals can explore sustainable design practices, test eco-design solutions, and develop critical skills remotely, without requiring physical presence in a laboratory. The VR activities are available in English, Greek, Spanish, Lithuanian, and Romanian, ensuring broad accessibility across Europe. By integrating VR into higher education, Fashion.ED not only fosters deeper engagement and knowledge acquisition but also prepares students to meet the future demands of a more responsible and sustainable fashion industry.

By doing so, Fashion.ED contributes to the development of the circular economy and promotes eco-design practices in alignment with the objectives of the EU Education Area.

Fashion.ED is implemented by a consortium of six European partners over a period of two years (01/11/2023 – 31/10/2025): the Polytechnic University of Valencia (UPV), Spain; Kaunas University of Technology (KTU), Lithuania; the University of Western Attica (UNIWA), Greece; the University of Oradea (UO), Romania; IDEC, Greece and BDF, Netherlands. This diverse partnership brings together expertise in fashion, textiles, digital education, and entrepreneurial training to ensure a multidisciplinary approach to sustainable innovation.

3. RESULTS

3. 1. E-learning course Eco-design in fashion

The e-learning course ***Eco-design in fashion*** targets students and professionals in the fashion and textile sectors who are interested in eco-design. It provides interactive content, such as case studies, centered on sustainable practices. By completing the course, participants deepen their knowledge of eco-design principles, strengthen their skills in sustainable processes, and are encouraged to adopt environmentally responsible approaches within the textile and fashion industries.

The courses were initially developed in English and then translated into Romanian, Spanish, Greek, Dutch, and Lithuanian. They were uploaded onto the project's e-learning platform (https://learn.fashionedproject.eu/) in Word and PowerPoint formats, as well as video presentations.

The course consists of five modules that have already been uploaded to the project's e-learning platform.

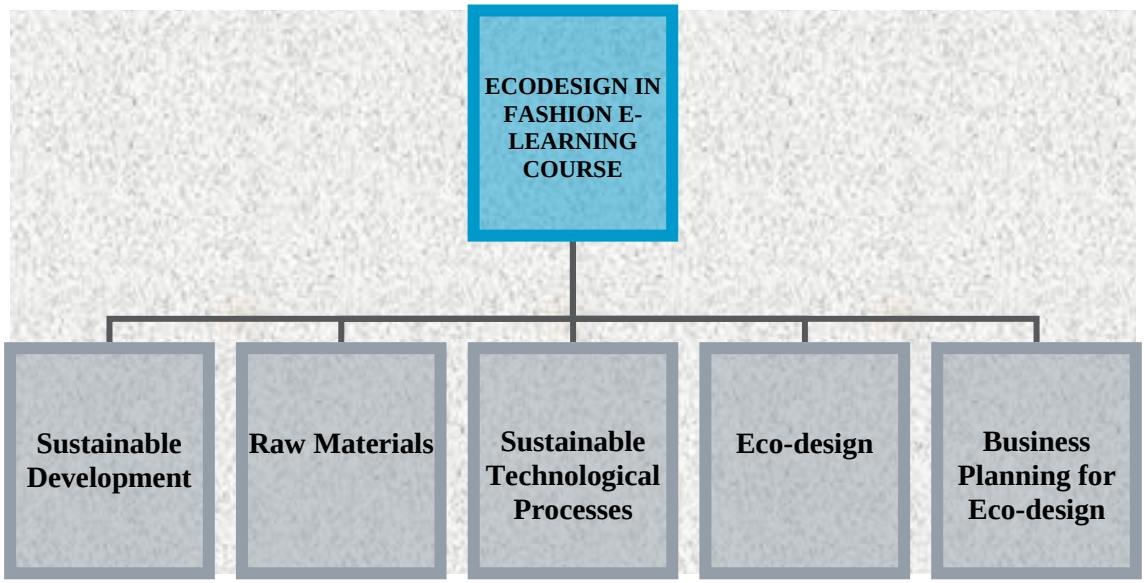
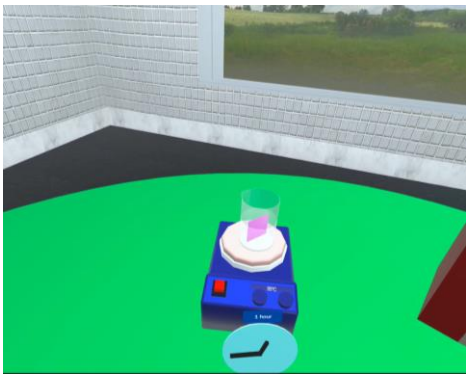


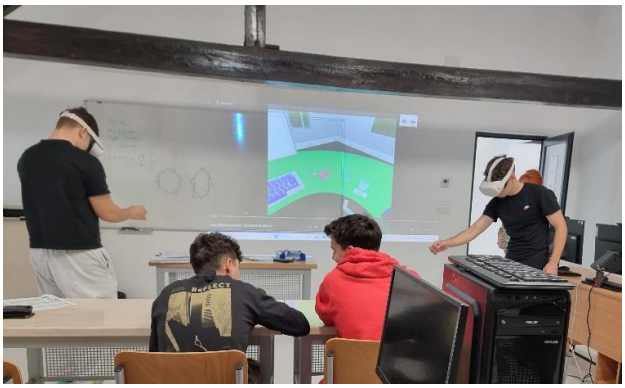
Fig. 1. *The modules of the e-learning course*

3.2. Virtual Experiments on ECO Design

A distinctive feature of the project is the integration of Virtual Reality (VR) technology to support experiential learning in eco-design. VR offers an immersive educational environment where students can engage directly with sustainable design concepts, enhancing motivation, creativity, and critical thinking. Among the key activities is the development of a virtual library of interactive 3D eco-design experiments. Through VR simulations, fashion and textiles students can conduct experiments that improve their understanding of eco-design principles and allow them to test sustainable solutions for the fashion and textiles industry without requiring physical presence in a traditional laboratory.

These experiments are accessible in six languages—English, Greek, Spanish, Lithuanian, Dutch, and Romanian—thus supporting a wide and diverse audience across Europe.





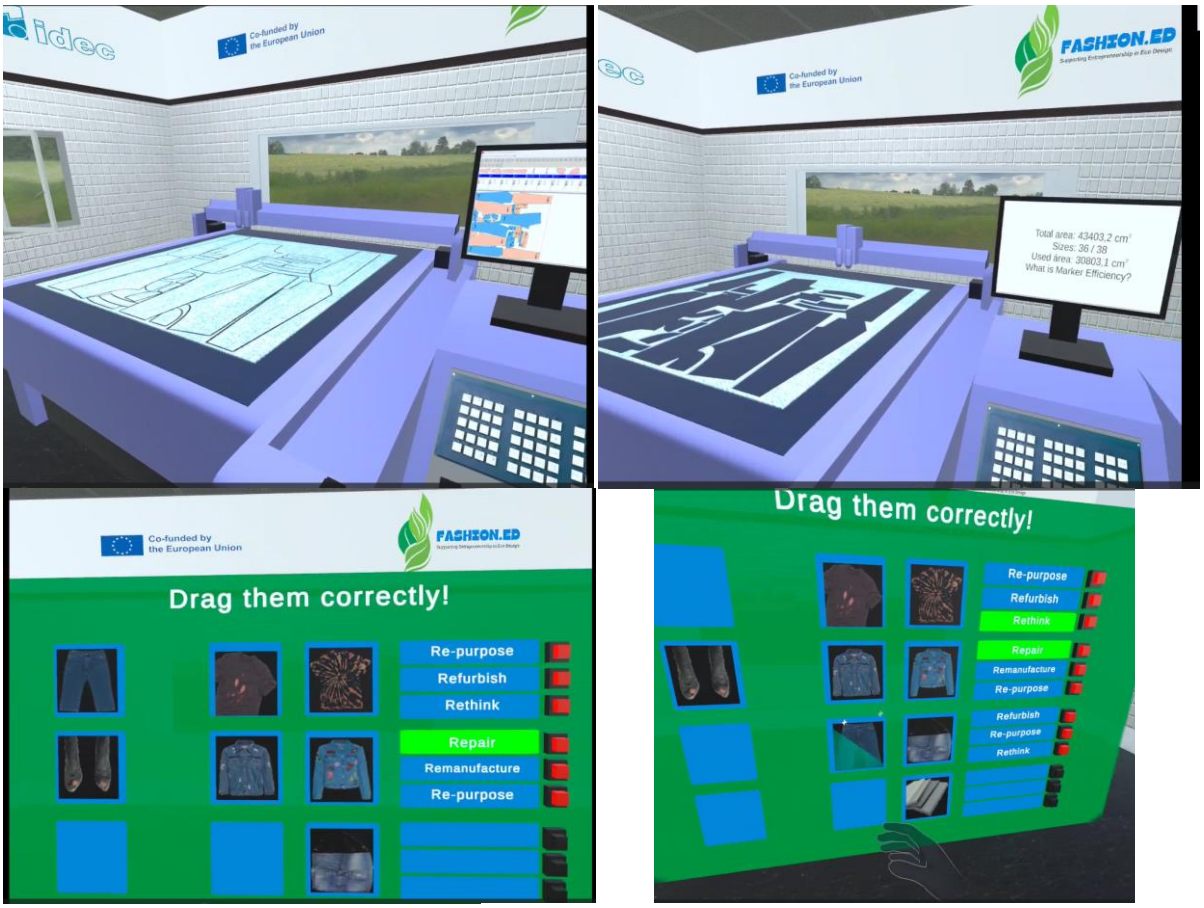


Fig. 2. *VR laboratory*

3.3. Eco-design challange

Between April 1–3, 2025, five students from each partner university — the University of Oradea (Romania), Kaunas University of Technology (Lithuania), University of Western Attica (Greece), and Polytechnic University of Valencia (Spain) — participated in the International Eco-Design Competition hosted by BDF in Leeuwarden, the Netherlands. During the event, students engaged in intensive training sessions focused on entrepreneurship, developed business plans based on eco-design principles, visited the FIRDA fashion department, and practiced effective pitching techniques. The competition concluded with each team presenting their sustainable business concepts, receiving valuable feedback to support their future entrepreneurial endeavors.

The students acquired the knowledge and competencies needed to establish successful and sustainable fashion businesses based on eco-design principles, while also fostering eco-design entrepreneurship.

5. CONCLUSIONS

The implementation of the Erasmus+ FASHION.ED project, clearly demonstrates that integrating Virtual Reality (VR) into higher education can significantly enhance students' engagement and understanding of eco-design principles. VR technology proved effective in offering

an immersive, hands-on learning experience that helped bridge the gap between theoretical knowledge and practical application, even without the need for physical laboratory spaces.

Providing training materials in multiple languages greatly contributed to the accessibility and inclusiveness of the educational content, facilitating broader participation across different countries and educational systems. The creation of a virtual library of eco-design experiments offered students innovative tools to simulate sustainable solutions in the fashion and textiles industry, encouraging experimentation, creativity, and problem-solving.

The international eco-design competition successfully fostered entrepreneurial thinking, equipping students with the necessary skills to transform sustainable ideas into viable business concepts. The collaborative activities and personalized support provided during the competition organized in Netherlands further stimulated critical thinking, teamwork, and innovation.

Overall, the project outcomes highlight the strong potential of combining sustainability education with digital innovation. They also emphasize the importance of creating flexible, technology-enhanced learning environments that can support the development of future professionals committed to responsible practices in the fashion and textiles industry.

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