



How to Teach Circular Economy to Young Designers and Engineers? Examples of Dual Education Initiatives between ESTIA Engineering Institute and a Sports Company

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Improving the creativity and innovation skills of students is a key point for any academic school or university organization. These soft skills can also be one of the most requested by the companies when they are hiring new young collaborators. It is well known that entrepreneurs and innovators have commonly certain attitudes and characteristics that lead them to success, i.e., curiosity, passion and never giving up attitudes. Today, with the environmental challenges, the circular economy is one of the promising paradigms that need to change the mindset and organisation of companies and challenge the individual and collective industrial practices in all departments (design, production, sales, aftersale...)

However, it is a big challenge for most educational institutions to propose multiskilled environments to develop these kinds of soft skills for their students. During their teaching program, it's not easy to immerse students in the circular economy, to experiment and practice the different strategies of circularity (like the 10-R: Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle and Recover). Indeed, most of the time, young people are separated from the professional world and they are in different schools or universities with specific teaching programs according to their orientation for engineering, design, marketing, sales, administrative...

This article aims to explore different pedagogic initiatives based on academic and enterprise collaboration between Ecole Supérieure des Technologies Industrielles Avancées (ESTIA), a French engineering higher education institution, and Decathlon, a worldwide company working in sports product design and retail. Through an analysis of the history of different formats of collaboration, beginning in 2008, our intention is to understand how bringing the industrial problem-based activities inspired by real situations faced by the company can impact the learning process of future engineers. We explain how this collaboration started by promoting interaction between enterprise and students during classrooms, especially through the participation of the 24h of innovation (hackathon), different workshops in school or organised inside the company during one week, and led also to the creation of a research program with the Chair BALI dedicated to promoting the circularity in the company and more generally in the textile sector.

The paper is structured as follows: in the first section, we present the history of the different collaborations between ESTIA and Decathlon since 2008 to highlight the different solutions and forms of interactions between the students and the company to promote dual education.

In the second section, we present our initiative "The 24h of innovation" which has been developed to promote interaction between companies, and students. This hackathon-like format has been developed since 2007 and we organised 90 editions in 5 different continents. This operation is interesting to start new collaborations with companies and involve students coming from different schools.

In the third section, we present the results of different workshops involving students and companies. This work is mainly based on a design methodology to stimulate and teach circular economy concepts to engineering students. Students are invited to explore circular strategy solutions to improve different current products designed by the company (for example diving masks and swimming goggles, paddles for standup or canoes...). For example, they have to imagine the reuse of the material for recycling or recuperating spare parts for repair strategies... During these workshops, we propose to follow the methodology based on the Double Diamond diagram for innovation, starting from a general problem to get to a specific solution. Deliverables include machinery and tool prototypes, as well as service design.

During these workshops, the different designers and engineers of the company are involved in proposing problems to solve and giving feedback to the different solutions proposed by the students. The teachers are also participating but the role is different from traditional courses

as they are involved in the learning process as coaches and the objective is to help the students to solve complex problems proposed by the company. During the design process of the workshops, they have to take the opportunity of problems situations, and questions from the students to teach in real time some technical, methodological, or organisational knowledge.

At the end of the workshop, students are invited to present their work in teams. They have to produce a short pitch in a few minutes to develop skills for the presentation of technical solutions in a limited time. This exercise helps them also to develop communication aptitudes to structure their oral presentation in front of a professional jury composed of different experts of the company.

Finally, students evaluated the course, presenting promising results regarding support materials, interest in the course, and comprehension of the circular economy.

Our main objective with this paper is to show how these “short experiences of dual education collaborations” are useful to stimulate real skills learning by the students who will face complex professional situations with the growth of the circular economy in industrial companies. We think that these soft skills like creativity are here encouraged to prepare the next generation of designers and engineers to find innovative and transdisciplinary solutions (based on technical, economic, organisational...) to promote circular business models in different industrial sectors.