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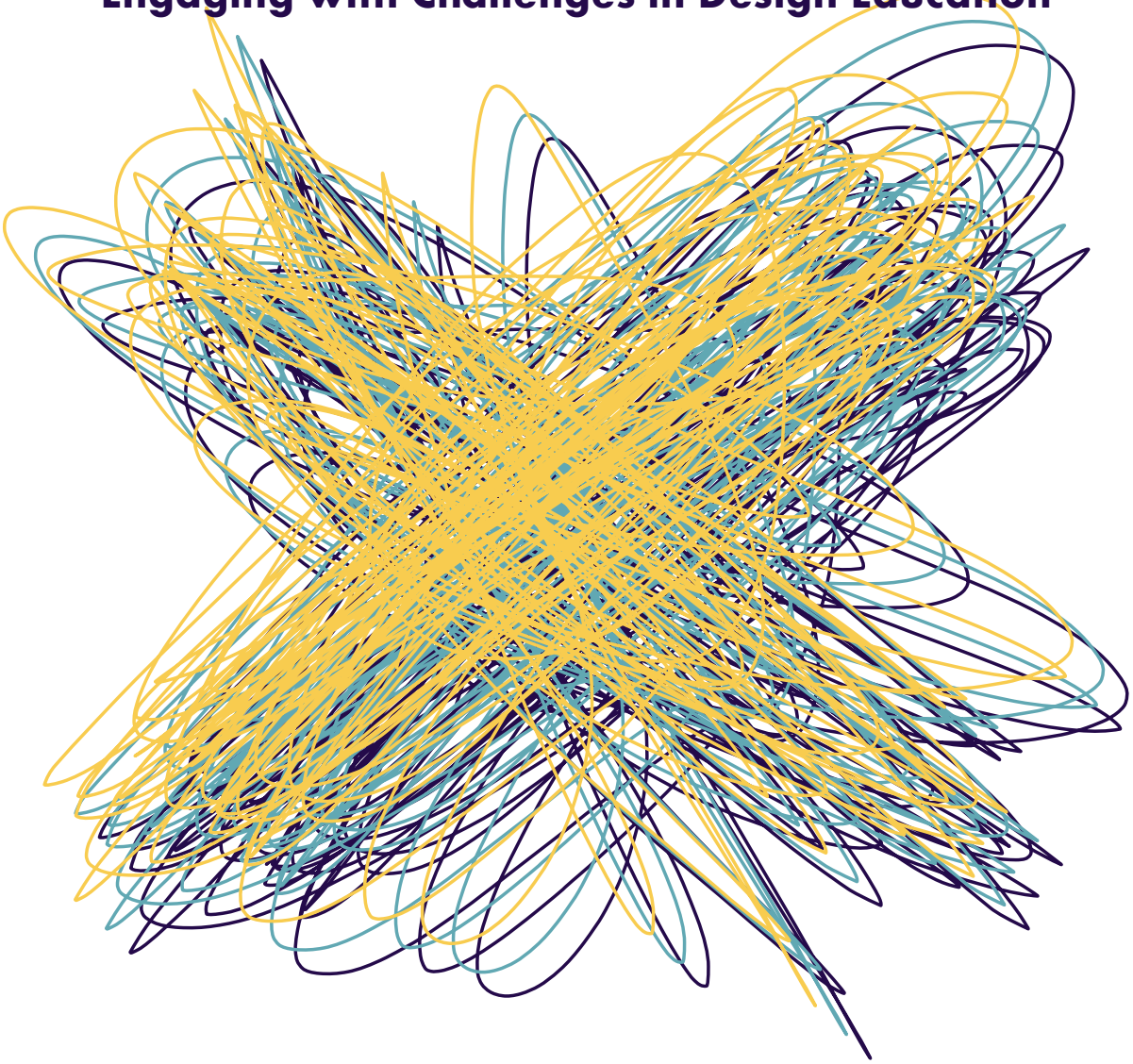
Engaging with Challenges in Design Education



6th International Conference for Design Education Researchers

24–26 September 2021
Jinan | China

Editors
Erik Bohemia
Liv Merete Nielsen
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Yang Zhang

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Engaging with Challenges in Design Education

10th Anniversary of the International Conference for Design Education Researchers
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Liv Merete Nielsen
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LEARN X DESIGN 2021
Engaging with Challenges in Design Education
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Systemic Design Education in Interdisciplinary Environments

Enhancing a Co-Disciplinary Approach Towards Circular Economy

Asja Aulisio, Amina Pereno, Fabiana Rovera and Silvia Barbero
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The transition of our linear economic models towards a Circular Economy is perceived as a pressing need at European level. A growing body of literature highlights the demand for new skills to facilitate this transition: more than new professions, it is about specific professional skills for circular businesses. The European Erasmus+ project MULTITRACES falls within this scenario and is based on the co-creation of a multidisciplinary online training programme that involved Systemic Design in collaboration with other scientific and economic disciplines. The learning process focused on the acquisition of both hard and soft skills relevant to the Circular Economy in the rural area, through a structure combining a vertical approach to disciplinary topics, with a horizontal approach based on teamwork on industrial issues. The experience gained within the Systemic Design module opens a structured reflection on how to teach design to students from different backgrounds, how design skills can foster a co-disciplinary approach to complex issues, such as the Circular Economy, and how digital tools can support design education.

Keywords: systemic design, circular economy, co-disciplinary learning, interdisciplinary education, digital learning tools

Introduction

Acquiring New Skills for the Circular Economy

The transition towards the vast and complex world of the Circular Economy first requires an understanding of how to develop and implement innovative circular models (European Commission, 2020) and, at the same time, how to define new skills necessary to interface with it. In particular, it is crucial to identify a series of expertise – *specific professional skills* – so as to obtain a healthy and smooth transition towards sustainable development and training of new professional profiles in this field. Naturally, the definition of these skills cannot be unambiguous and definitive, because the Circular Economy is a constantly evolving field, but it is possible to bring out those skills by matching supply and demand in the circular labour market.

To this end, it is necessary to focus on the needed competence, which can be defined as "a bricolage of knowledge and the ability to act knowledge in specific contexts" and "a provisional outcome of a mainly spontaneous individual and collective learning process" (Cepollaro, 2008, p. 44). Indeed, learning processes play a key role for the acquisition of specific skills and professional knowledge, in fact it is significant to operate strategically at an educational level researching the most suitable learning models to educate different kinds of professional profiles able to deal with the systemic complexity of the Circular Economy. As mentioned before, students need to acquire specific *professional skills* to work in the Circular Economy today, but it is imperative to go beyond the existing scenario, defining the skills that will be needed in the future.

Moreover, it is important to highlight that the new skills for Circular Economy can be divided into two main types: hard and soft skills. The hard or vertical skills have a technical-content nature, each individual is able to use them independently and responsibly and derive from previous knowledge, they can be defined as *knowing-how* (Jones & Lichtenstein, 2000). The soft or horizontal skills concern the distinctive characteristics of an individual, they are essential for transforming one's knowledge into behaviour. So, what are the soft and

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hard skills most useful for creating and strengthening the curriculum of potential professional profiles in the field of Circular Economy?
The literature (Burger et al., 2019; De los Rios & Charnley, 2016; Rovera, 2020) shows how the hard skills should focus on:

- the possible interactions or relationships that develop between Circular Economy models and the labour market
- the methodologies for communicating circular project through action of promotion and dissemination
- the knowledge of physical, chemical, sensory and organoleptic properties of a product and its by-products in order to enhance them
- the technical know-how, for understanding how to manage circular innovation, for example the procedures or technologies for accomplishing an efficient management of environmental resources and energy

Instead, the soft skills should be directed towards three different kinds of competences: the general competences that "lend themselves well for comparison across a wide range of contexts, but are often rather abstract, ambiguous, and difficult to measure" (Allen, Remaekers & Van Der Velden, 2005, p.52), the key-competences for *sustainability* (UNESCO, 2017) and the *key-competencies of Circular Economy* (Rovera, 2020). The first, the general competences, can consist in:

- leadership, in particular the concept of motivational leadership, the importance to know how to coordinate a work group from a cognitive, emotional and behavioural point of view
- team work's, to know how to interact and communicate with people belonging different fields and nationality, being close-knit and proactive towards others and their ideas
- professionalism, autonomy, knowing how to make informed decision and how to organize one's work
- flexibility, to develop critical and reflective thinking
- time management, to manage time optimally

The second, the *key competences for sustainability*, consist in the achievement of the Sustainable Development Goals. The third, the *key-competencies of Circular Economy*, are the most closely linked to the it and consist in knowing how:

- to work in a multi-interdisciplinary team with different professional profiles
- to observe and be curious towards the innovative solutions
- to manage challenges and changes in business activities
- of qualitative communication skills to talk about company projects and activities
- be flexible in managing new tasks and new challenges related to the implementation of Circular Economy models

The above-mentioned hard and soft skills represent the key expertises to optimally approach the complex domain of Circular Economy. Design disciplines, with their *infraordinary* nature (Celaschi, 2008; Perec, 1984) are capable of teaching and transmitting competences in a simple and immediate way. The term *infraordinary* indicates the intrinsic capacity of Design to be a discipline among others. The Design tries to join disciplines constructively and making them dialogue profitably and interconnected. In particular the action is possible thanks to the valuable support of trans-disciplinary mediation skills developed by the designer to face-up different project, from socio-technical prospective, that is emerges as a link for connecting between different disciplines. On the other side, Design and, in particular, Systemic Design owns a very crucial and valuable role in the context of sustainable development. Thanks to *its key principles and methodology* (Bistagnino, 2011; Battistoni, Giraldo Nohra, & Barbero, 2019), Systemic Design becomes the effective and preeminent tool to be able to face the complex field of Circular Economy, due to the use of *systemic thinking*, in fact, as Senge (1990) states "this discipline helps us to see how to modify systems more efficiently and to act more in harmony with the natural processes of the natural and economic world".

Systemic Design in Circular Economy Education: The MULTITRACES Erasmus+ Project

The literature shows how the Circular Economy is not demanding a dedicated profession, but new skills that complement and renovate existing educational programmes.
The Erasmus+ MULTITRACES project takes place in this scenario, involving four European universities (University 'Vasile Alecsandri' of Bacau, Politecnico di Torino, International Hellenic University, Universidad De Alicante) that collaborate around the topic of Circular Economy for rural areas. The framework of rural areas, indeed, is undergoing phenomena of abandonment due to increasing urbanization and lack of interest in agricultural activities by new generations. Circular businesses can bring new economic, social and environmental opportunities to these areas, since sectors such as agro-industry and agro-forestry have a high

circular potential for valorizing natural resources and by-products.
For this reason, the three-year MULTITRACES project aims to develop a common vision of the topic, bringing together different national (Romania, Italy, Greece, Spain) and disciplinary experiences (environmental and production engineering, Systemic Design, agronomy and forestry sciences, business and management), with the active support of four partner companies. Starting from this common vision, the universities have built an international and interdisciplinary training programme which involves 56 students, aiming at providing them with the skills they need to train in the field of Circular Economy, both as future professionals and as future entrepreneurs.
The authors actively participated in the co-design of the training programme, which is divided into four thematic modules, and in particular they personally implemented the Systemic Design for the Circular Economy module, taking up the challenge of teaching Design methods and tools to students from different countries and disciplines. Besides the trans-disciplinary mediation skills that characterize all design disciplines, Systemic Design "provides practical tools to approach complex scenarios with a holistic perspective, while supporting active cooperation among involved stakeholders" (Giraldo Nohra, Pereno & Barbero 2020). The scope of Systemic Design is that of complex systems, hence in recent years it has built strong synergies with the Circular Economy, which aims to rethink linear economic models from a broader and more systemic perspective.
This paper illustrates the design process of the entire training programme and focuses specifically on the methodology and results of the Systemic Design training module in order to answer two main research questions:

1. What is the role of Design in a multi/inter/co-disciplinary approach to the Circular Economy?
2. How can the trans-disciplinary mediation skills of designers contribute to the training programme?

The experience of the MULTITRACES project provides an interesting use case to address these questions and open up new reflections on the contribution of Design disciplines to complex, cross-sectoral and inter-disciplinary issues such as the Circular Economy.

Methodology

Designing the Role of Design in a Multidisciplinary Training Programme

The MULTITRACES course is based on a multidisciplinary approach to the issue of the Circular Economy in rural areas, which has led to identifying the key disciplines to be involved in the project: Systemic Design, environmental and production engineering, agronomy and forestry sciences, business and management. Each discipline has defined its own expertise and topics to be addressed over four disciplinary modules. However, while the participation of different disciplines ensures the multidisciplinary nature of the course, the common aim was to offer an interdisciplinary vision to the topic of Circular Economy, by adopting a shared approach to the educational programme.
Hence, the development of the MULTITRACES course consisted of three main phases, illustrated in Figure 1

1. Multidisciplinary and interdisciplinary programme development. The first phase involved the four partner universities that shared a common research path on the Circular Economy in rural areas to build a common vision. At the same time, the partners jointly investigated the hard and soft skills needed by students for a career in the Circular Economy. This led to the definition of a horizontal and vertical structure of the course modules, combining vertical knowledge on each subject with the development of horizontal skills related to management, teamwork and communication aspects.
2. Design education. The second phase especially involved the Politecnico di Torino team in the development of the Systemic Design module. Once the approach and main contents had been shared with the other disciplines, it was essential to define what skills design can bring both to the Circular Economy and to students and future professionals from different disciplines. While the team has extensive experience in teaching Systemic Design in Circular Economy, within MULTITRACES it had to define what cross-disciplinary skills to offer to a multidisciplinary class and how to teach them. In that view, the direct collaboration with a company that deals with circular business in the rural area (Agrindustria Tecco), was crucial to working on practical issues, building a use case of design experimentation for the students.
3. Co-disciplinary experiential learning. Having students from four different countries and backgrounds is an important experience in itself. Again, limiting the course to multidisciplinary runs the risk of limiting students' engagement and teaching effectiveness. For this reason, developing an experiential activity (named "mini-challenge") in collaboration with the company made it possible to implement a

learning-by-doing approach based on teamwork, fostering cultural and skills contamination among the students, and enhancing design skills acquisition.

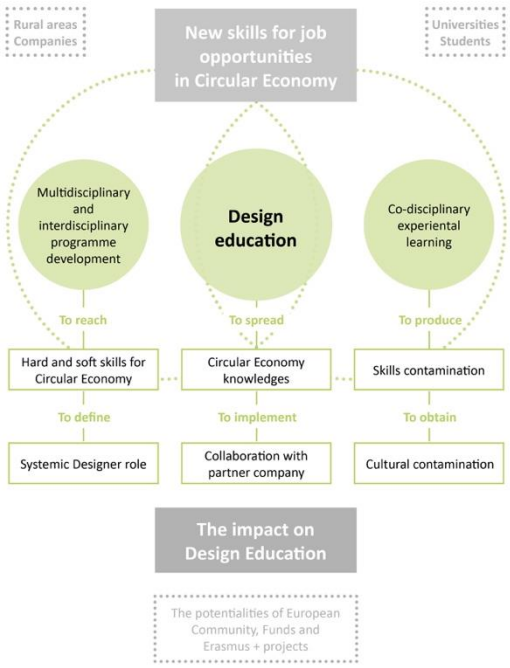

Figure 1. Summary scheme of the impact of Design Education for enhancing new skills in the Circular Economy field, 2021

Overall, the methodology adopted enabled to build an interdisciplinary training programme based on a common approach to the complex issue of the Circular Economy in rural areas, defining the contribution of Design both towards the topic addressed and towards the different disciplines interacting within circular businesses.

Experiential Learning in a Digital Setting

The whole MULTITRACES course was run online to allow all students to attend the lessons remotely. This choice was taken before the COVID-19 pandemic, in order to facilitate access from all parts of Europe for all students, compatible with their academic courses. The online course allowed a large number of students to easily participate in high-level international training: the current health emergency has further increased the value of online courses for equitable access to education.

In detail, the course is divided into thematic modules, which has made it possible to define a replicable starting framework adaptable to any discipline. The first module of Systemic Design included 2 hours per week of theoretical frontal lessons on key themes, methodologies and working tools of the discipline. The various methodological insights were covered by lecturers and researchers with expertise in each specific area to ensure timely teaching on the topics addressed. The digital platform in this case has allowed them to carry out the lessons live, recording them, thus giving the students the possibility to enjoy them at any time, catching up or deepening the topics asynchronously.

In the preliminary phase of the course setting up, it was fundamental to reflect on the educational impact of e-learning platforms, due to their multimedia, interactivity and virtuality features. At the same time, it was important to reflect on their potential, in terms of engagement, going beyond the focus on the technical use of digital tools as communication media. From that perspective, the main goal was to propose a different way of thinking and experiencing the transversal integration of digital tools into education.

The choice of digital tools, in fact, is not irrelevant. Some knowledge does not exist as a given content in itself, regardless the form in which it is taken (De Rossi & Ferranti, 2017). Its didactic form, transposed and mediated on a digital platform, starting from the source, takes on different characteristics depending on the type of media and tools that convey it. Moreover, technological advances have revolutionised teaching and learning processes (Aristovnik, 2012). In this scenario, the digital technologies determine a re-mediation of knowledge and produce a technological adaptation by the teacher and the student that introduces and produces a further level of knowledge, that of new digital tools.

To fulfil this, the e-learning platform selected and used for MULTITRACES is *Moodle* (acronym of Modular Object-Oriented Dynamic Learning Environment), an open-source tool designed to offer teachers and students a secure and integrated system for creating personalised learning environments beyond the University. The platform is a computer-based course management environment, born from the constructionist ideology that all learning is facilitated by the use and integration of tangible tools. With the use of *Moodle*, it was possible to organise and manage the entire course, which was made up of four interconnected modules. The tools already available on the platform for managing the work were integrated when necessary (such as quizzes, forums, chat). Starting from this kind of collaborative tool, capable of creating similar interactions to those experienced in a university classroom, the further integration with other digital tools became necessary. During distance learning, it was even more important to engage and interact with the students, to motivate them to complete the course, maintaining a high level of interest even in topics different from their standard academic paths. The interaction strategies adopted, such as individual and collective gamification, – using quizzes, Q&A sessions, debates and surveys – indirectly allow the application of co-design practices in the training programme.

The implemented digital training system has employed standard tools (such as video lessons) for acquiring hard skills, while it has made use of innovative interactive and teamwork tools for acquiring soft skills. The educational approach based on the *experiential learning* theorised by John Dewey (Dewey, 1938) can and should be a constant reference also in digital learning contexts.

In this way, in addition to relational and cultural exchange skills, the level of digital adaptation also brings learning. One of the most effective digital tools used during the course was MIRO, a platform with a well-designed User Experience, that enhances workflows and shared dashboards, both in real time and asynchronously. The complexity of Systemic Design projects, especially in multidisciplinary teams, requires a tool able to support different students in assessing and visualising the socio-technical system they take into analysis. To do this at remote locations, the authors have assessed different tools to support students in performing this task remotely Figure 2.

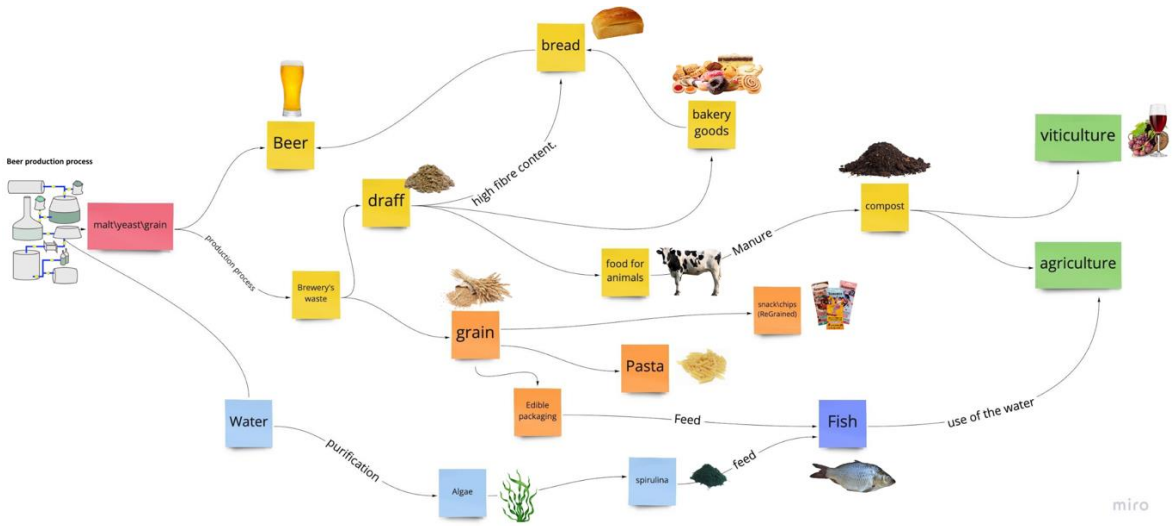

Figure 2. One of the concept examples made by a group of students, 2021

Preliminary results

Interdisciplinary and Cross-Sectoral Collaborations for Design Education. The Relevance of Synergy Among Academic World and Company Partner

One of the aims of the MULTITRACES course is to train students, from different academic backgrounds, to meet the present and future market needs of the Circular Economy. Therefore, it is first necessary to investigate what those needs are, so as to be able to clearly and comprehensively define them and, at the same time, identify the key competences that a practitioner should learn in order to meet them.

It is precisely on this last point that the entire European MULTITRACES Erasmus+ project devotes greater attention: what are today and what will be in the immediate future the skills needed for the Circular Economy market? What design skills different professionals should acquire, particularly in rural areas? As mentioned in

the introduction, it is possible to define two different types of skills: acquired competences (hard skills) and transversal competences (soft skills). In order to properly define these skills and make students more empowered for their professional future, the synergy among the Academic world and Company partner plays a crucial role. The advantages of collaborating with companies located in the various territories where the project partner universities are based enabled the identification of practical cases to work on with the students. Within the piedmontese territory, the Politecnico di Torino collaborated with the Agrindustria Tecco company in a constant comparison that further highlighted the unexpressed needs of the agri-food sector. Agrindustria Tecco is a small company, located in the area of Cuneo, it has been operating since 1985 and was born to transform secondary vegetable materials into industrial products useful for man. The company started reusing local waste to produce new sustainable vegetable products, moving from the agro-industrial sector to other fields of application, anticipating what we now call Circular Economy issues. The company, aims to treat niche products with the care and seriousness of an artisan business, boasting customers in Italy and abroad, as well as a series of assiduous collaborations with universities, innovation centres and other national companies, always with a view to enhancing the value of local products and fully respecting what nature teaches and makes available. The Company's attitude to establishing virtuous connections within local territorial systems, was important in the MULTITRACES course, providing a practical view on how to interconnect and consciously exchange resources. Agrindustria Tecco and Politecnico di Torino, collaborated in defining the topics for the students to work on within the mini-challenges. The three topics selected and proposed to the students were:

- analysis of the use and re-use of processing waste of dyeing plants
- mapping and study of natural porous materials, with a focus on their possible use as soundproofing materials
- valorisation of waste from the brewing process

Thanks to several discussion sessions with the student groups, it was possible to directly involve the CEO of the company, who provided effective and practical feedback to the groups for possible implementations of the circular solutions presented per each topic.
With this preamble, the role of the designer assumes a position of importance. The designer by definition has a role as a *mediator between knowledge*, (Celaschi, 2008). This has facilitated dialogue and interaction between disciplines both in the university environment and in the realisation of professional projects. It is with this assumption that the project emphasises the potential of Design Education to establish a cross-sectoral connection that generates contamination between the actors involved. Systemic Design, specifically, promotes the ability to communicate the complexity of a project, made up of relationships between actors and interconnection of material flows, in a clear and effective way through the use of different communication techniques and skills. Beyond the specific form of Design, Fry (2009) said, "The intrinsic capacity of design is to transform and shape the contemporary world". There is nothing more contemporary than fostering multi/inter/co-disciplinary educational projects in connection with the real sustainable needs of companies. The industry-academia collaboration of the MULTITRACES course has underlined how the first step in promoting an industrial transition to the Circular Economy is to create an awareness among companies that they need professionals with new skills in the field of circular businesses. For this the dialogue between Universities and Companies can do no more than facilitate an innovative and cross-sectoral transition towards Circular Economy.

From a Multidisciplinary to a Co-Disciplinary Approach: Fostering Cultural and Skills Contamination in Education

The main idea behind the MULTITRACES project was to create a “MULTIdisciplinary TRAining in Circular Economy and Smart valorization of the rural area for new business models''. Indeed, initially, the brief of the project was to pursue a multidisciplinary approach to the construction of an innovative training course. This choice has been hypothesized and recommended from a top-down perspective in which it is possible to allow the division of the work among different professors. As Peruccio, Menzardi and Vrenna (2019) state, “multidisciplinary is intended as the use of solutions borrowed from another discipline”. However, the main limit of a multidisciplinary approach is that it aims at putting together multiple knowledge relating to different disciplines, in a purely additive way. To avoid this risk, the four universities involved in the MULTITRACES project have decided, through a *co-design* action and a *bottom-up approach*, characterized by a detailed and structured knowledge management strategy, to design a learning course that is based, also, on *co-disciplinary* experiential learning.
Concerning this, the most challenging aspect came with the practical component of the course, as illustrated in Figure 3. How can we get a group of students from different backgrounds to work together, overcoming the

lack of a physical place for students and teachers to meet, get to know each other and work together? To meet this task, the engagement of the project companies was decisive. Starting from their specific requests or project suggestions in the field of Circular Economy, topics were defined on which to apply the notions seen in the lessons through the creation of mini-challenges assessment to achieve in a multidisciplinary team.

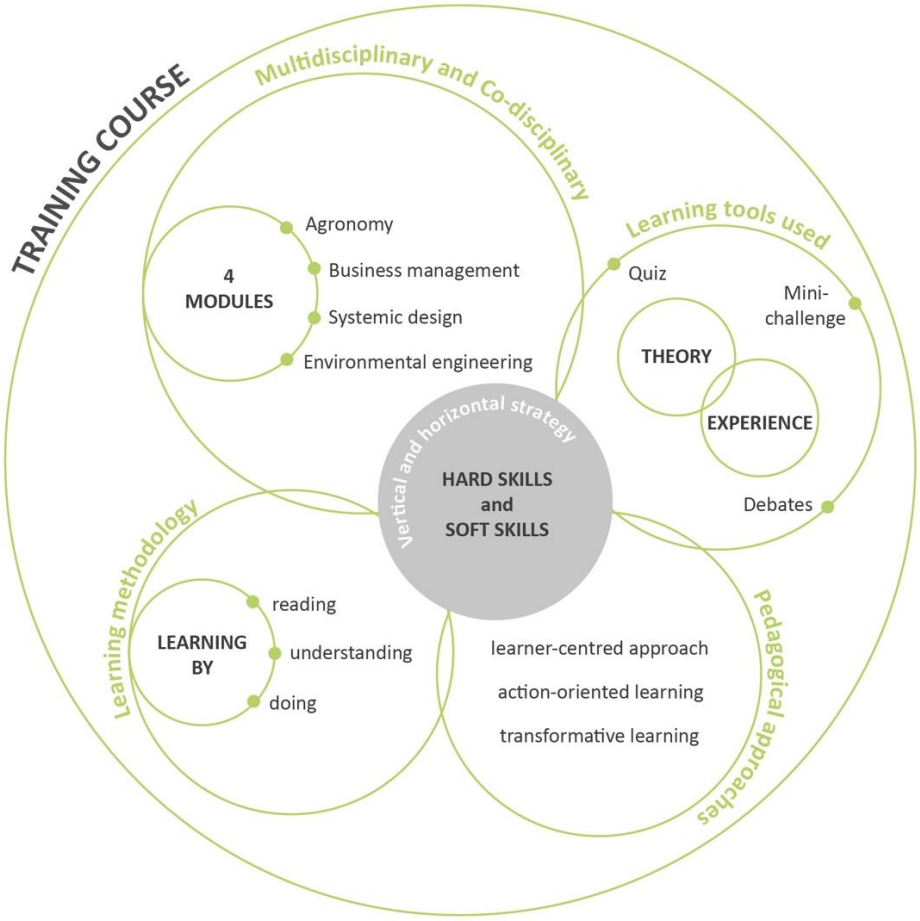

Figure 3. Summary scheme about the focal points of the training course MULTITRACES, 2021

The management strategy of the course is characterized through the two approaches just mentioned above: in the first part a multidisciplinary *vertical approach* to disciplinary topics based on lessons with a technical-content nature for learning hard skills and, in the second ones, a *horizontal approach* on practical activities – mini-challenge – to work on industrial issues and challenges. The horizontal structure gives soft skills but also allows students to confront each other independently, experiencing work dynamics in multi-interdisciplinary groups and building a common vision to the topics proposed to them which is no longer multidisciplinary but co-disciplinary. In fact, thanks to the co-disciplinarity approach, each professional profile can achieve at maximum a certain familiarity or empathic understanding with the knowledge of another one's. Empathy becomes an essential element to allow for co-thinking, thanks to a critical, reflective and systemic thinking. Naturally, it is also crucial to specify that each professional profile cannot master the *language* or the disciplinary knowledge of another one's (Blanchard-Laville, 2000). The co-disciplinarity experiential learning is the ideal answer for promoting the development and the acquisition of new design skills, both vertical and horizontal and, at the same time, for a cultural skills contamination among students of different nationality. Finally, it is important to develop a consideration starting from the thought of Rossi (2017): "it highlights the need to put in place a teaching able to mobilize all the resources favoring the knowing how to act as a mental habitus" (p.194). In the next paragraph will be reported an in-depth examination of how education, Systemic Design discipline and a *systemic culture* (Barbero et al., 2019) can break down the current barriers for sustainable development and circular transition thanks to innovative learning approaches as the knowing how to act.

The Role of Digital Tools to Connect People Around Europe to Experience “Learning by Doing” Approach

As we mention in the previous section (see par. 2.2), the selection of a digital platform for distance learning is crucial. It is necessary to have high-performance tools to be able to carry out activities that are usually done in presence. In the MULTITRACES project the digital tools used became, as affirmed by Angels & Valanides (2009), “cognitive partners”, able to amplify the methodological repertoire, in order to facilitate and personalize student learning. One interesting aspect is that in this epochal phase, education in general has to adapt, defining new contexts in which to transfer knowledge. From that perspective, ICT (Information and Communication Technologies) in university teaching offer the possibility of enriching strategies and formats by means of multimodality, flexibility and personalization in line with the complementary development of hard and soft skills (De Rossi & Ferranti, 2017).

It is also essential to be able to involve students and stimulate their attention and involvement, especially in a remote, digital, and international context. For this reason, teachers should be able to make appropriate choices by transforming teaching methods. All this thanks to the development, updating and awareness of other knowledge such as pedagogic-didactic and technological know-how (Angeli & Valanides, 2009).

The structure of the MULTITRACES course has at its core, a learning approach characterized by *learning by reading, understanding, doing* (Rovera, 2020). These approaches are the most suitable for developing high-quality education, based on the "creation of knowledge" (Kember, 2009; Samuelowicz & Bain, 2001) with active learning at the centre. Furthermore, it is strategic, especially in the context of distance learning on digital platforms, to complement the three learning aspects described above with other three pedagogical approaches (UNESCO, 2017):

- a *learner-centered approach*, in this case the student is able to comprehend and assimilate knowledge autonomously, in an active way and, in particular, the role of the teacher changes, as it is not simply the one who transfers knowledge in a traditional, structured way (Barth, 2005), but it is the one who must facilitate, encourage the student to reflect, manage and monitor his knowledge.
- an *action-oriented learning*, in this case the approach focused on action and experimentation, only through experience, cognitive, emotional or sensorial nature, the student can learn and develop personally. At the same time, it is possible to speak about experiential learning, a theory to which various personalities have contributed over time including John Dewey (1938), Jean Piaget (1950) and David Kolb (1984).
- a *transformative learning*, in this case the learner is able to be critically aware of tacit assumptions or expectations and evaluate their relevance (Merizov, 2000). The teacher, instead, is the one who stimulates the students to form their own and unique vision of the world.

These pedagogical approaches influenced the co-design process of the structure of the MULTITRACES course and, in particular, the role of students and professors, fostering a context of mutual exchange aimed at stimulating interaction and co-learning processes. Teamwork fosters cultural as well as skills transfer by facilitating a dynamic and collaborative workplace that empowers students to achieve a shared goal. However, doing this at a distance involves experimenting with digital tools that facilitate brainstorming and support simultaneous work.

Discussion and Conclusion

The co-disciplinary approach pursued within MULTITRACES permeates the whole learning process, from the general training structure to the module dedicated to Systemic Design. In order to effectively assess the impact of this approach, a questionnaire was administered to the students, focusing both on their personal and educational experience. A condensed analysis of the feedback shows that the practical dimension closely linked to experiential learning has proved to be an excellent method for engaging and motivating students. Moreover, the dynamics of practical work in groups, through "mini-challenges", have promoted team dimensions, fostering interdisciplinarity and reducing the elements of individuality. Unfortunately, building a strong team spirit in a virtual environment was sometimes difficult: this results in communication problems which hindered the work fluidity of some groups. Some respondents also pointed out that real-life coaching is more effective and engaging than online tutoring, precisely because dialogue is often not interrupted by circumstances beyond one's control. Although positive, the limitation of these results lies in the focus on a specific module and not on the whole training programme. However, this preliminary feedback is a valuable input to improve features and elements for the next modules of the course, by increasing performance.

In the end, it is interesting to highlight that despite the difficulties encountered in this first phase of work, the ability of design to adapt to the different contexts in which it operates was crucial. Designers should work

as *design agents to adapt different roles* (Lee, 2008), from design facilitators to developers, especially when collaborating with different stakeholders in a cross-sectorial and inter-disciplinary context. The results from co-design practices carried out remotely through online, digital platforms show that it is increasingly necessary explore new interactive tools. Continuous research in this field is essential, especially for the education and training sector.

Concerning the research questions, today more than ever, the pandemic has made us adapt to new educational practices and raised new issues that requires experimentation and co-design of innovative tools and services to effectively interconnect students, professors, and working teams. The paper presents the methods and outcomes of the online training through a holistic perspective, which looks at the educational experience within a broader disciplinary, cultural and social context. The aim is to contribute to the debate on multi/inter/co-disciplinary education through a practical and interdisciplinary case study, which implemented new interactive tools for design education. Moreover, the MULTITRACES experience has highlighted the urgency of stimulating the production of critical consciences, promoting the development of a circular and systemic culture to which Design Education can act as a pioneer.

References

Allen, J., Ramaekers, G., & Van Der Velden, R. (2005). Measuring competencies of higher education graduates. In D.J. Weerts e J. Vidal (eds.), *Enhancing alumni research: European and American perspectives* (pp. 49-59). New directions for institutional research, 126 (summer). San Francisco, CA: Jossey-Bass.

Angeli, C., & Valanides, N. (2009). Epistemological and methodological issues for the conceptualization, development, and assessment of ICT-TPCK: Advances in technological pedagogical content knowledge (TPCK). *Computers & Education*, 52, 154-168

Aristovnik, A. (2012). The impact of ICT on educational performance and its efficiency in selected EU and OECD countries: a non-parametric analysis. *Turkish Online Journal of Educational Technology*, 11(3), 144–152. Retrieved from http://www.tojet.net/articles/v11i3/11314.pdf

Barth, M. (2015). *Implementing sustainability in higher education: learning in an age of transformation*. London: Routledge.

Barbero, S., & Systemic Design Research Group (2019). *Ricerca per mettere a sistema i siti UNESCO del Piemonte*. Retrieved from http://www.cr.piemonte.it/web/files/ricerca_Siti_Unesco.pdf [accessed on 15 March 2021]

Battistoni, C., Giraldo Nohra, C., & Barbero, S. (2019). A Systemic Design Method to Approach Future Complex Scenarios and Research Towards Sustainability: A Holistic Diagnosis Tool. *Sustainability*, 11(16), 4458. https://doi.org/10.3390/su11164458

Blanchard-Laville, C. (2000). De la co-disciplinarité en sciences de l'éducation. *Revue française de pédagogie. Evaluation, suivi pédagogique et portfolio*, vol. 132, 55-66. http://doi.org/10.3406/rfp.2000.1033

Bistagnino, L. (2011). *Systemic Design: Designing the Productive and Environmental Sustainability*. Bra (CN), Italy: Slow Food Editore.

Burger, M., Stavropoulos, S., Ramkumar, S., Dufourmont, J., & van Oort, F. (2019). The heterogeneous skill-base of circular economy employment. *Research Policy*, Volume 48, Issue 1, 248-261. https://doi.org/10.1016/j.respol.2018.08.015

Celaschi, F. (2008). Design as a mediation between areas of knowledge. In C. Germak (Ed.), *Man at the Center of the Project* (pp. 19–31). Turin, Italy: Allemandi & C.

Cepollaro, G. (2008). *Le competenze non sono cose*. Milano, Italia: Guerini e Associati.

De los Rios, I.C., & Charnley, F.J. (2016). Skills and capabilities for a sustainable and circular economy: The changing role of design. *Journal of Cleaner Production*, Volume 160, Issue September 2017, 109-122. https://doi.org/10.1016/j.jclepro.2016.10.130

De Rossi, M., & Ferranti, C. (2017). *Integrare le ICT nella didattica universitaria*. Padova University Press, 9.

De Rossi, M. (2017). Methodological demands, soft skill and ICT integration. In U. Margiotta (Ed.). *Formazione & Insegnamento XV – 1 – 2017: Education transformations: research perspectives.* Pensa MultiMedia Editore. ISSN 2279-7505

Dewey, J. (1938). *Experience and Education*. New York: Touchstone.

Dichev, C., & Dicheva, D. (2017). Gamifying education: what is known, what is believed and what remains uncertain: a critical review. *International Journal of Educational Technology in Higher Education*, 14(1), 9.

European Commission. (2020, 11 march). *COM (2020) 98 final: A new Circular Economy Action Plan. For a cleaner and more competitive Europe*. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52020DC0098&from=IT [accessed on 25 March 2021]

Fry, T. (2009). *Design Futuring: Sustainability, Ethics and New Practice.* London, UK: Bloomsbury Academy.
Giraldo Nohra, C., Pereno, A., & Barbero, S. (2020). Systemic Design for Policy-Making: Towards the Next Circular Regions. Sustainability, 12(11), 4494. https://doi.org/10.3390/su12114494
Jones, C., & Lichtenstein, B. (2000). The "architecture" of careers: how career competencies reveal firm dominant logic in professional services. In M. Peiperl, M. Arthur, R. Goffee e T. Morris (eds.), *Career frontiers: new conceptions of working lives* (pp. 153-176). Oxford, England: Oxford University Press.
Kember, D. (2009). Promoting Student-Centred Forms of Learning Across an Entire University. *Higher Education*, 58(1), 1-13.
Kolb, D. A. (1984). *Experiential Learning: Experience as the Source of Learning and Development*. Englewood Cliffs, N.J.: Prentice-Hall.
Lee, Y. (2008) Design participation tactics: the challenges and new roles for designers in the co-design process, *CoDesign*, 4:1, 31-50, https://doi.org/10.1080/15710880701875613
Mezirow, J. (2000). *Learning as transformation: critical perspectives on a theory in progress*. San Francisco, Jossey-Bass.
Perec, G. (1984). *La vita, istruzioni per l'uso*. Milano, Italia: BUR, Rizzoli. ISBN 88-17-11025-6
Peruccio, P.P., Menzardi, P., & Vrenna, M. (2019). Transdisciplinary knowledge: A systemic approach to design education. In N.A.G.Z. Börekçi, D. O. Koçyıldırım, F. Korkut, D. Jones (eds.). *Proceedings DRS Learn X Design 2019: Insider Knowledge* (pp. 17-23). Ankara, Turchia: METU Department of Industrial Design. http://doi.org/10.21606/learnxdesign.2019.13064
Piaget, J. (1950). *The Psychology of Intelligence* (Piercy, M., & Berlyne, D.E., Trans.; 1st ed.). Routledge. https://doi.org/10.4324/9780203164730
Rovera, F. (2020). *Educare alla circolarità. L'educazione come strumento sociale per la transizione verso l'Economia Circolare del contesto rurale* [Master's thesis, Politecnico di Torino]. Webthesis, Biblioteche d'Ateneo. http://webthesis.biblio.polito.it/id/eprint/15558
Samuelowicz, K., & Bain, J. D. (2001), Revisiting Academics' Beliefs About Teaching and Learning. *Higher education*, 41(3), 299-325.
Senge, P. M. (1990). *The fifth discipline: the art and practice of the learning organization*. New York: Doubleday/Currency.
UNESCO. (2017). *Education for Sustainable Development Goals. Learning Objectives.* Paris, France: United Nations Educational, Scientific and Cultural Organization, © UNESCO, ISBN 978-92-3-100209-0

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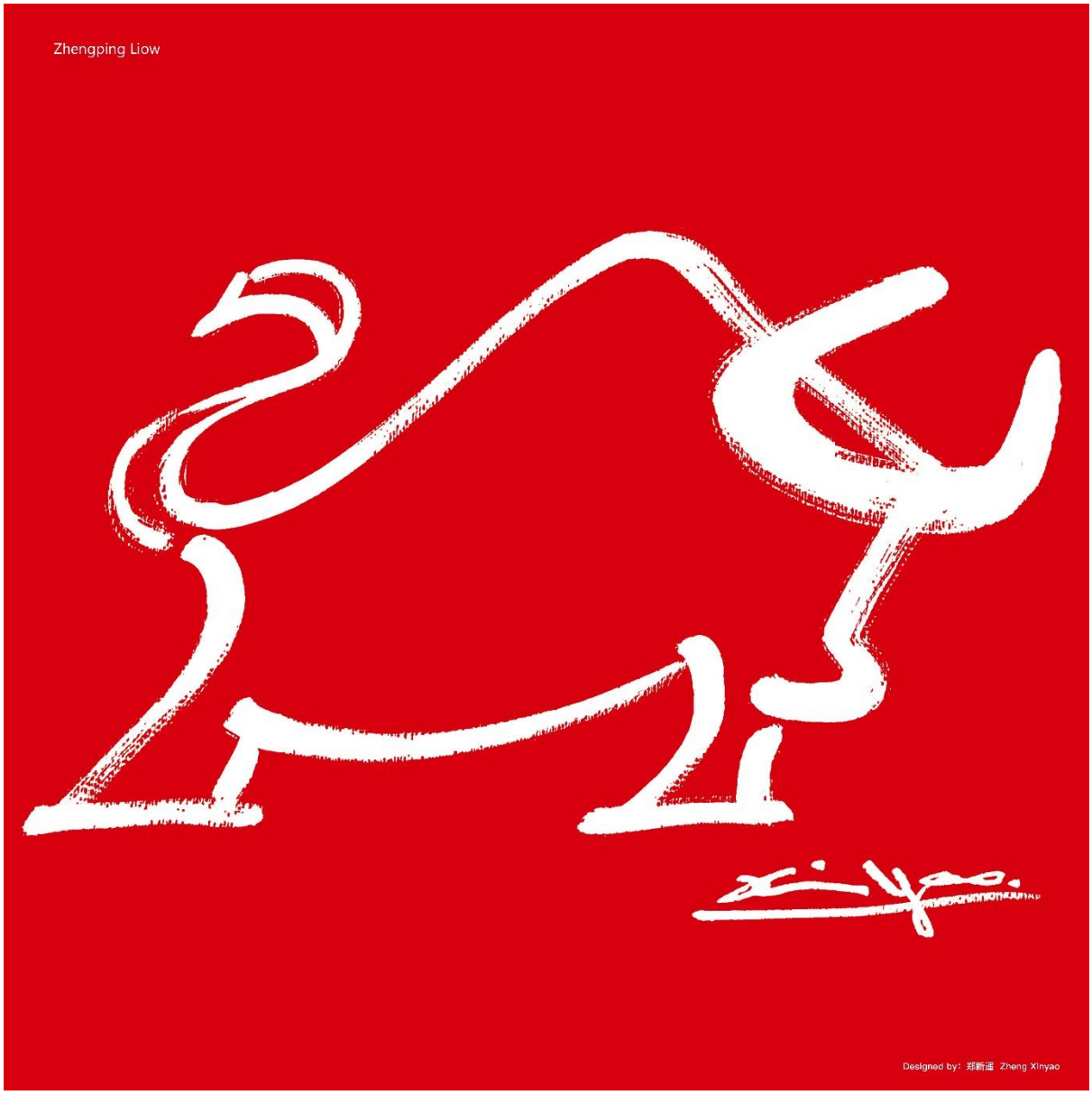

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