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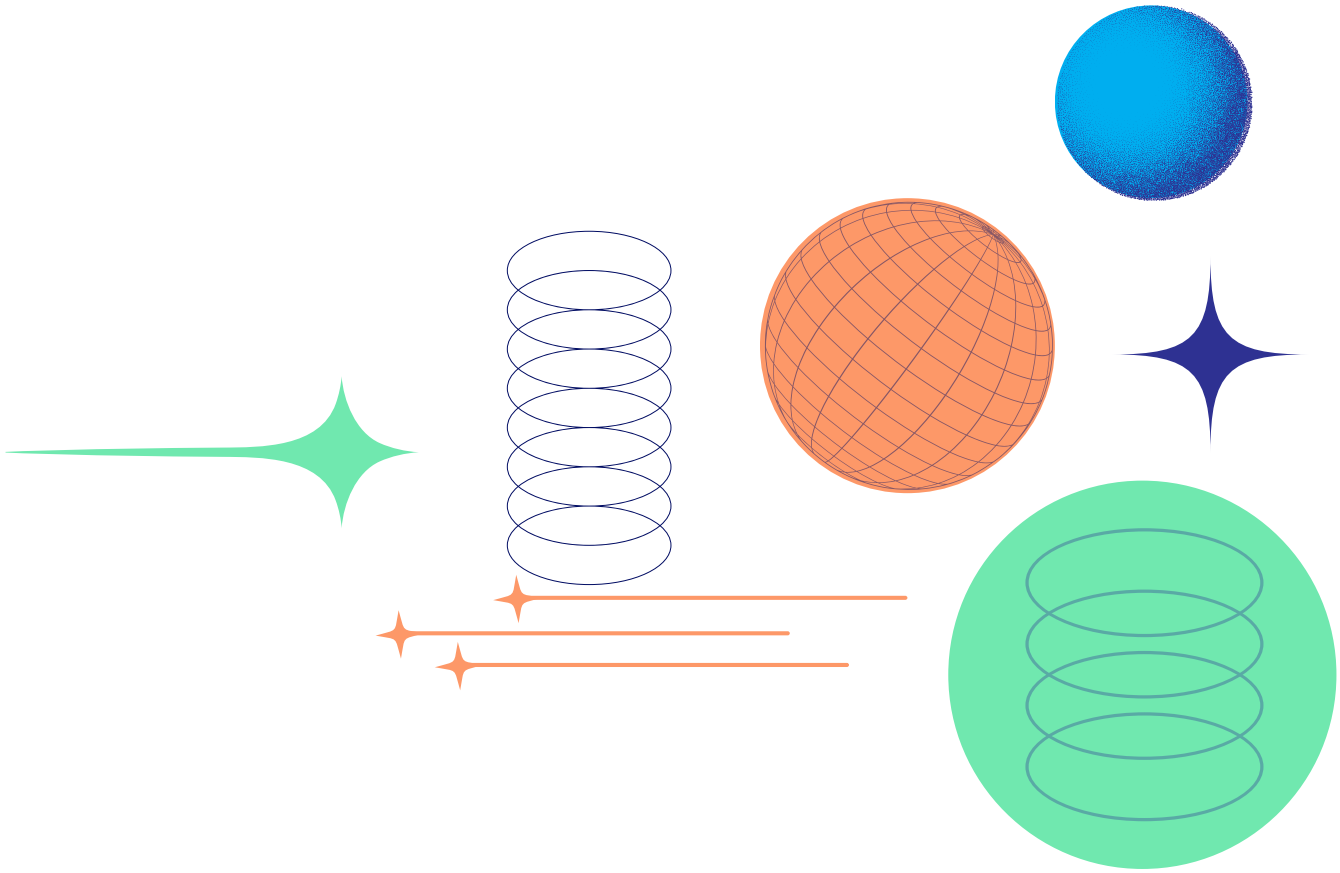
Erasmus Talent & Innovation Labs

UBC for Transformation:

A Literature Review on Student Competence Development in Sustainability, Entrepreneurship, and Digital Innovation



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This Publication was developed in the framework of the ETI LABS project, Grant Agreement: 101184321, ERASMUS-EDU-2024-PCOOP-ENGO (Partnerships for Cooperation - Cooperation Partnerships in the fields of Education and Training, and Youth submitted by European NGOs)

UBC for Transformation: A Literature Review on Student Competence Development in Sustainability, Entrepreneurship, and Digital Innovation

Published by:

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Design: Erasmus Student Network

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Contact: This publication is the outcome of in-depth consultations undertaken by the ETI Labs Consortium:

Erasmus Student Network AISBL
Association Européenne d'Institutions de l'Enseignement Supérieur
Assemblée des Régions d'Europe Association
École Supérieure des Sciences Commerciales d' Angers Association
Høgskulen På Vestlandet
MCI Management Center Innsbruck Internationale Hochschule Gmbh
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Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

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0 Introductions

Introduction

The Erasmus Talent & Innovation Labs (ETI Labs) project, part of the Erasmus+ programme, aims to bridge the gap between higher education and the labour market by enhancing student and graduate employability through innovative learning methods and strategic partnerships. It includes developing an online hub, experimenting with living labs, a traineeship track for recent graduates, and advocating for better University-Business Cooperation (UBC). Building on the 2018 report on UBC in Europe (Davey et al., 2018), ETI Labs focuses on an innovative learning methodology inspired by the 'Science Shop' model. The goal is to boost competencies in Social Entrepreneurship, Sustainable Competencies, and Digital Transformation, facilitating direct engagement with the labour market through internships, mentorships, and collaborative projects.

We conducted desk research to identify the benefits, challenges and best practices to transfer knowledge and technologies between universities and businesses, tailored to different sectors and regions. Starting from the 2018 report (Davey et al., 2018), we updated the UBC landscape and focused on integrating environmental, social, and governance (ESG) criteria into UBC projects. Our research aims to understand how UBC can improve students' digital, entrepreneurial, and green skills to meet the expectations of companies, local authorities, and the European Commission. We also explored the potential of the science shop methodology to enhance UBC.

This documentary research, which utilised more than 80 scientific publications and reports, is organised as follows: The first section defines UBC. The second section examines ESG criteria and European frameworks of DigComp, EntreComp, and GreenComp. The third section highlights the benefits of UBC for various stakeholders. The fourth section discusses the challenges of UBC. The fifth section explores various best practices for effective UBC projects. Finally, the science shop methodology is considered a potential option for ETI Labs.

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What is UBC?

1. What is UBC?

a. Definition, stakeholders and objectives of UBC

UBC refers to a set of structured collaborations and partnerships between higher education institutions (HEIs) and the economic sector, aimed at bridging the gap between the academic world and industry needs. UBC includes any form of interaction between HEIs and companies for mutual benefit, ranging from joint research projects to work-study programs, including knowledge and technology transfer (Davey et al., 2018). This cooperation is increasingly considered as a cornerstone for tackling societal challenges, fostering innovation, enhancing employability and strengthening regional development.

At the heart of UBC lies an ecosystem of diverse stakeholders, each bringing specific skills and resources.

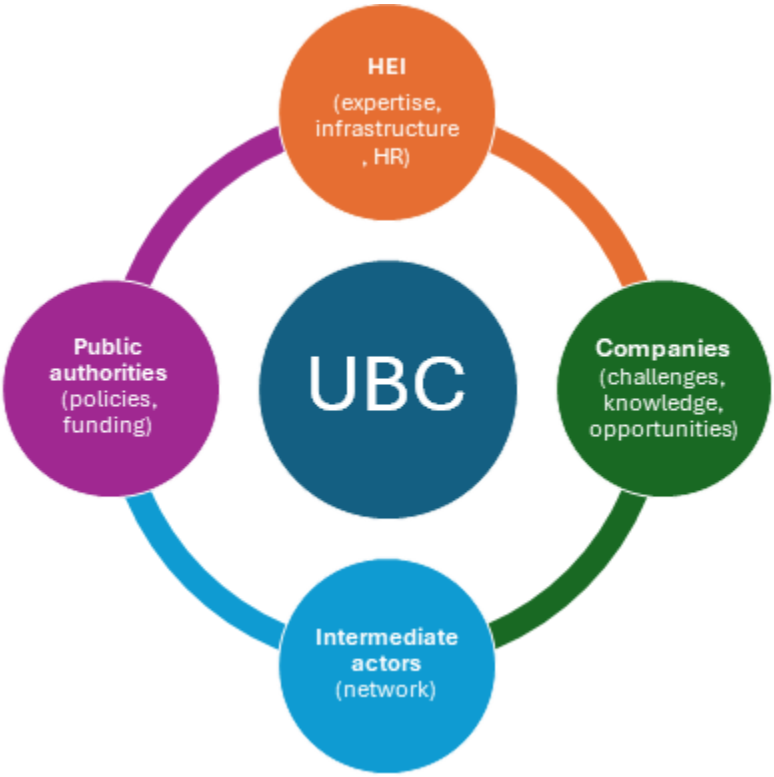
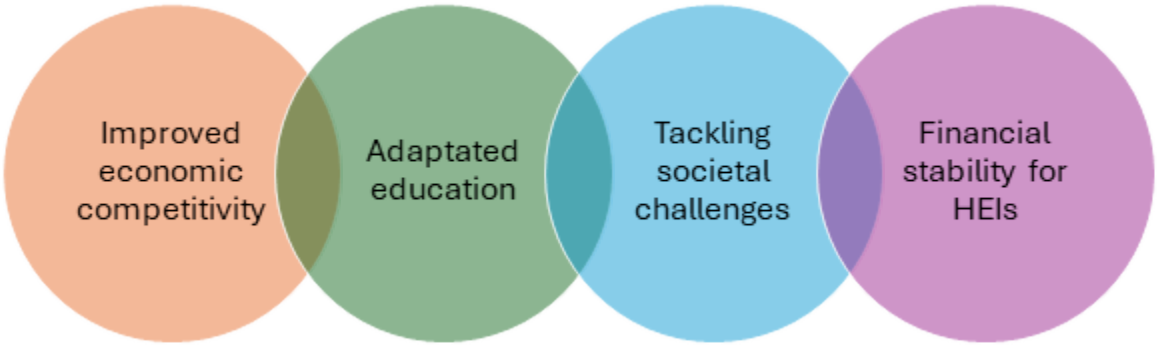


Figure 1. Ecosystem of UBC

1. **HEIs**, such as universities and schools, offer their academic expertise (with professors and doctoral students), research infrastructures, and a pool of talented students.
2. Companies, on the other hand, contribute their knowledge of market needs, concrete challenges, and ability to transform research and knowledge into innovations, such as products and services.
3. Intermediate actors, such as incubators, science parks, and professional associations, play a catalytic role in fostering connections and collaboration between higher education institutions (HEIs) and industry, although HEIs themselves may also assume this intermediary function.
4. Finally, public authorities, through policies and funding, encourage and support the development of UBC, recognising its potential to stimulate innovation, economic growth, and social progress.

The expected objectives of UBC can be associated with several dimensions.



Improvement of economic competitivity. UBC stimulates innovation and technological development by facilitating the transfer of knowledge and technology from universities to companies. This, in turn, strengthens business competitiveness and creates economic value (Jirapong et al., 2021; Mandard, 2013; Nikounejad et al., 2021).

Preparing Students for the Job Market. UBC helps tailor curricula to meet job market demands by integrating practical skills and current knowledge[12]. Internships, collaborative projects, and other experiential learning programmes provide students with opportunities to acquire skills valued by employers, aiding their professional integration (Bogacz-Wojtanowska et al., 2022; Borah et al., 2021).

Addressing Societal Challenges. UBC can help solve societal issues by leveraging the skills and resources of universities and businesses to create sustainable, innovative solutions (Davey et al., 2018) . This approach also influences the direction of these solutions, as universities and businesses act as critical societal actors. To this end, ETI Labs particularly focuses on developing students' digital (DigiComp), entrepreneurial (EntreComp), and ecological (GreenComp) skills.

Financial and performance benefits for HEIs. Business cooperation can alleviate financial pressures on universities, offering stability and security for research, teaching, equipment, and facilities. In addition, companies involved in UBC and looking to further educate their employees can pay for shorter, module-based courses that support lifelong learning, providing significant income to higher education institutions. Moreover, cooperation allows universities to reconfigure and develop their skills, leading to new research opportunities and substantial long-term performance improvements (Bogacz-Wojtanowska et al., 2022; Borah et al., 2021; Meerman et al., 2018; Perkmann et al., 2021).

Business cooperation can **ease the financial pressure on universities,** providing financial stability and security for research, teaching, equipment and facilities. Curricular units taught at the university can be updated based on the university's experience in the collaborative environment. Companies that are seeking to further educate their employees can also pay for shorter module-based courses which support ‘life-long learning’. This can provide significant income to the HEIs (Bogacz-Wojtanowska et al., 2022; Borah et al., 2021; Meerman et al., 2018; Perkmann et al., 2021).

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1 https://eismea.ec.europa.eu/funding-opportunities/calls-proposals/expanding-academia-enterprise-collaborations-horizon-eie-2024-connect-02-01_en

2 https://www.utt.fr/actualites/collaboration-inedite-entre-la-start-up-inouqa-et-lutt-un-stage-tipi-transitions-industrielles-par-linnovation-pour-une-etudiante-ingenieure-de-lutt

b. Typology of UBC

UBC can take many forms, ranging from one-off interactions to long-term strategic alliances. This variety reflects the complex needs and goals of the stakeholders involved (Davey et al., 2018).

UBC AREAS	UBC ACTIVITIES
Education	1. curriculum co-design (e.g. employers involved in curricula design with HEIs) 2. curriculum co-delivery (e.g. guest lectures) 3. mobility of students (e.g. student internships/placements) 4. dual education programmes (e.g. part academic, part practical) 5. lifelong learning for people from business (e.g. executive education, industry training and professional courses)
Research	6. joint R&D (incl. joint funded research) 7. consulting to business (e.g. contract research) 8. mobility of staff (i.e. temporary mobility of academics to business and of business people to HEIs)
Valorisation	9. commercialisation of R&D results (e.g. licencing/patenting) 10. academic entrepreneurship (e.g. spin offs) 11. student entrepreneurship (e.g. start-ups)
Management	12. governance (e.g. participation of academics on business boards and business people participation in HEI board) 13. shared resources (e.g. infrastructure, personnel, equipment) 14. industry support (e.g. endowments, sponsorship and scholarships)

Figure 2. UBC areas and activities from Davey et al. (2018)

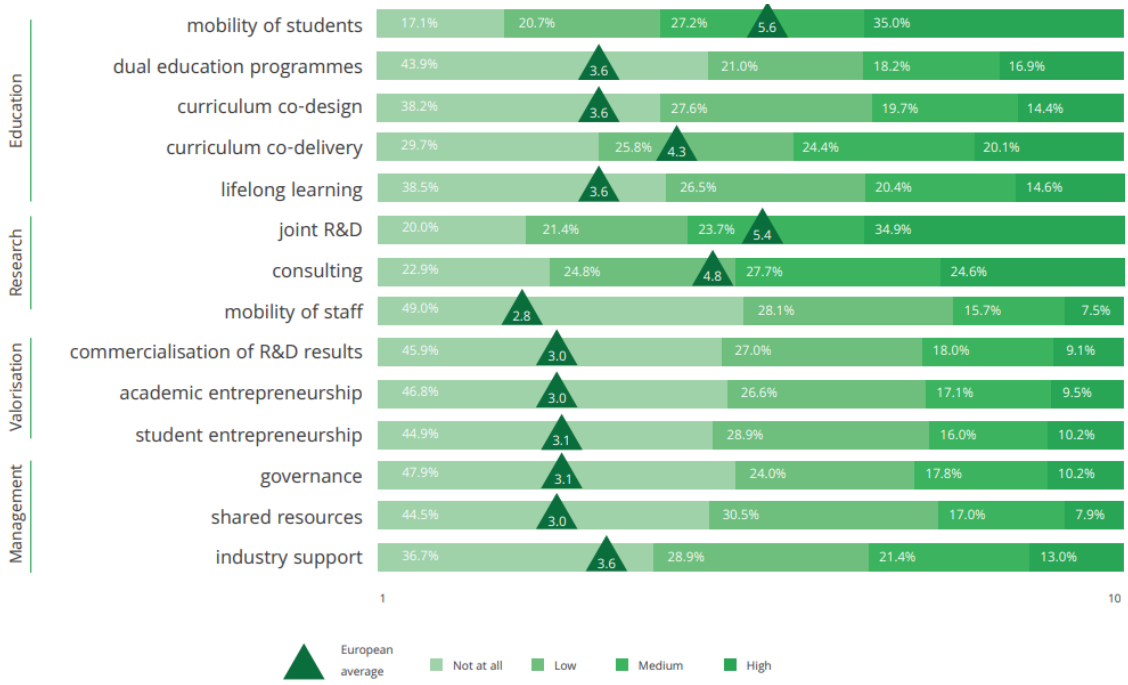

Figure 3. To what extent do you cooperate with businesses? From Davey et al. (2018)

Based on Figure 2, which presents survey results from higher education institutions (HEIs) about their cooperation with businesses, we can identify the most common types of UBC.

The highest average (5.6%) is represented by **student mobility**, such as internships, apprenticeships, and placements. Alternance, for example, is a form of UBC that allows students to combine theoretical training at school with practical experience in a company (Bogacz-Wojtanowska et al., 2022; Donaldson, 2025; Franco & Pinho, 2019; Staring François et al., 2019). Internships and apprenticeships are concrete examples of work-study programmes that emphasise the acquisition of professional skills and the integration of young graduates (Borah et al., 2021; Donaldson, 2025; HEC, 2023; Jirapong et al., 2021).

Secondly, **R&D projects** (Research and Development) have an average score of 5.4%. These joint research projects, whether fundamental or applied, involve universities and companies collaborating to develop new knowledge or technologies (Meerman et al., 2018).

Another common initiative (4.8%) is **service contracts** (i.e., consulting, expertise, and similar services). These contracts offer companies access to cutting-edge skills and provide universities with opportunities to showcase their know-how (Jirapong et al., 2021; Mandard, 2013; Nikounejad et al., 2021).

Dual education programmes and co-designed curricula, which make up 3.6% of UBC in the sample, are less common but particularly valuable for enhancing the theoretical and practical skills sought by employers. Dual education programmes involve hybrid training where students simultaneously complete a degree programme at a HEI and gain professional certification and/or experience in a company. This requires students to spend significant time in both environments. Co-designed curricula refer to the collaborative creation of fixed course programmes or new training paths by HEIs and companies.

Another type of cooperation, though less common, is the creation of spin-offs and start-ups from university research (3%) and student projects (3.1%). These companies are established by researchers and/or students who wish to commercialise their work. University incubators and start-up support programmes play a crucial role in this process[3][4].

[3] https://makeithappenmakeitbig.com/report/global-report-HEC.pdf
[4] https://makeithappenmakeitbig.com/report/global-report-HEC.pdf

Although less common, companies do participate in the governing bodies of HEIs, such as boards of directors or scientific councils (3.1%). This involvement allows companies to influence the strategic direction of HEIs and ensure that training courses align with their needs. (Borah et al., 2021; Donaldson, 2025 ; Jirapong et al., 2021; K et al., 2022; Staring et al., 2019)

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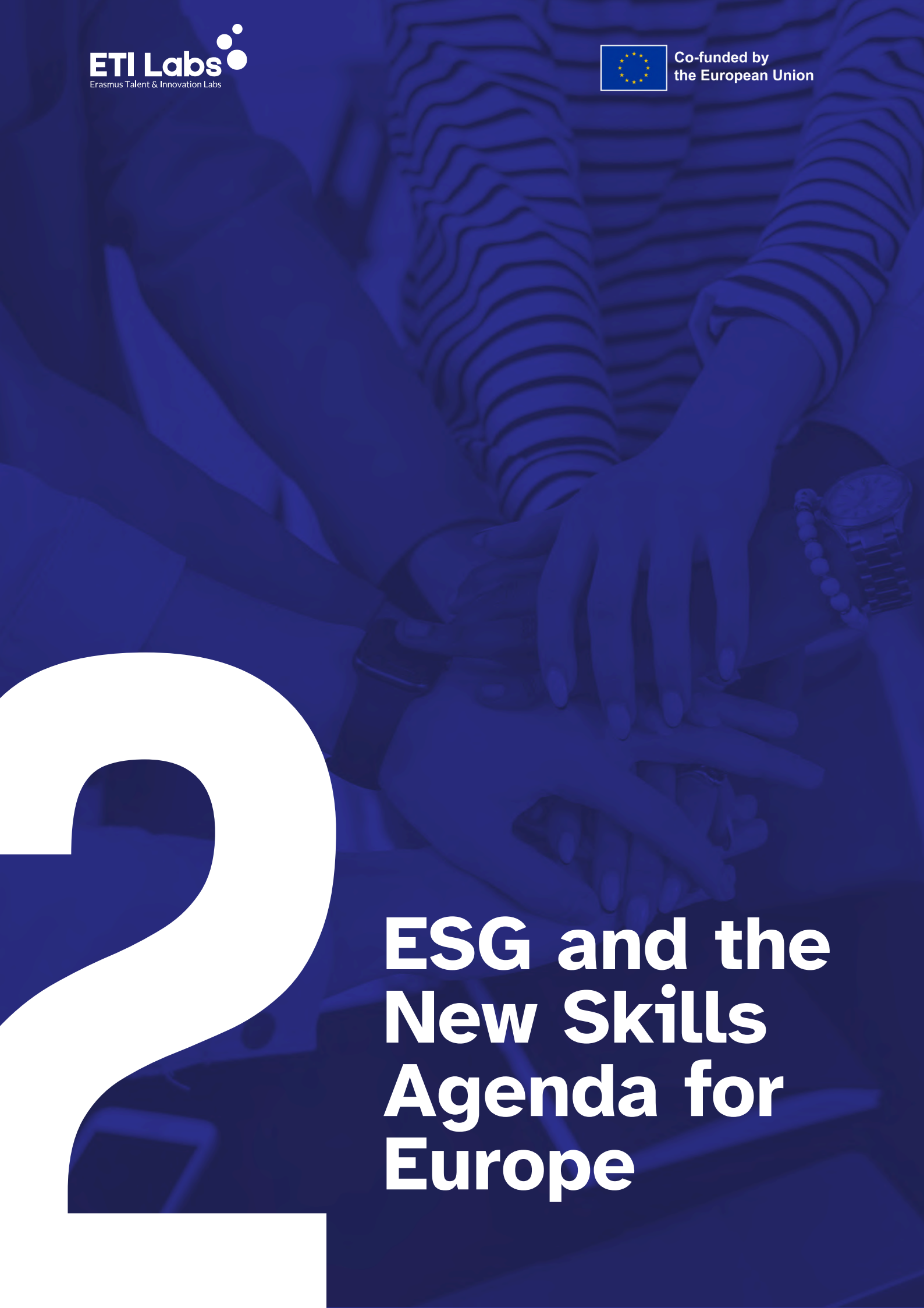

2

ESG and the New Skills Agenda for Europe

2. ESG and the New Skills Agenda for Europe

a. Defining ESG

Environmental, Social, and Governance (ESG) is a framework that guides stakeholders in understanding how an organisation manages risks and opportunities related to ESG criteria. By going beyond traditional financial metrics, ESG promotes transparency and enables a comprehensive evaluation of an organisation's sustainability performance[5].

Environmental Factors (E): These measure an organisation's impact on the environment and its approach to risk management. Metrics include direct and indirect greenhouse gas emissions, responsibility for natural resource conservation, and the ability to withstand climate risks such as rainstorms, flooding, and wildfires.

Social Factors (S): This pillar focuses on assessing an organisation's relationships with its stakeholders. Key metrics include human capital management (HCM), such as fair salaries and employee wellbeing, and the broader impact on communities, including job growth and occupation rates. There is a growing expectation for companies to consider social impact beyond their operations, extending to supply chain partners, especially in developing economies with weaker environmental and labour standards.

Governance Factors (G): These metrics measure aspects of corporate governance, including how leadership and management structures are organised. ESG metrics assess how leadership incentives align with stakeholder expectations, the organisation's approach to shareholder rights, and internal controls to ensure transparency and accountability.

ESG ratings can be assessed through aggregated scores that combine environmental, social, and governance factors, or by focusing on individual elements like climate risks. They can also be evaluated using different methodologies, such as double materiality or single materiality, and may involve analyst-driven or data-driven approaches.

ESG ratings are increasingly important in investment decisions, helping investors incorporate ESG-related risks and impacts into their sustainable investment strategies.

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5 https://commission.europa.eu/document/download/0779df8d-3a39-4d84-8ebd-3300175c5ce4_en?filename=annual-activity-report-2021-financial-stability-financial-services-and-capital-markets-union_en.pdf

Companies use ESG ratings to identify operational risks, discover investment opportunities, and benchmark their ESG performance against industry peers[6][7].

The importance of ESG has surged recently, especially post-COVID-19, driven by the **EU Green Deal** and urgent societal and environmental challenges. To achieve **net zero by 2050** and enhance transparency, the EU introduced the Corporate Sustainability Reporting Directive, requiring large and listed companies to report on social and environmental risks and impacts (ibid).

The EU also implemented the Sustainable Finance Package, including the EU Taxonomy, to improve ESG rating transparency and integrity[8]. These regulations ensure clear, comparable information for investors and stakeholders, promoting transparency and combating greenwashing.

ESG criteria have significantly impacted businesses, requiring adaptation to new requirements and highlighting the need to enhance future employees' competencies.

b. Introduction to the New Skills Agenda for Europe

Building on the New Skills Agenda for Europe launched in 2016[9], a holistic approach to education and skills development was deemed necessary to foster societal growth. The plan aims to equip individuals and businesses with key competencies to enhance sustainable competitiveness, ensure social fairness, and build resilience. These competencies include literacy, numeracy, science, foreign languages, and transversal skills such as digital literacy, entrepreneurship, and critical thinking. In this context, several framework competencies have been developed, including the Digital Competence Framework for Citizens (DigComp), the Entrepreneurship Competence Framework (EntreComp), and the European Sustainability Competence Framework (GreenComp). Additionally, the broader framework encompasses other competencies like the Digital Competence Framework for Educators (DigCompEdu), the Life Competence Framework (LifeComp), and the Digital Competence Framework for Educational Organisations

[6] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022L2464
[7] https://commission.europa.eu/document/download/e2e3bfd9-0f9c-4689-abf0-61777d8c562a_en?filename=FISMA_AAR_2023_final.pdf
[8] https://commission.europa.eu/document/download/e2e3bfd9-0f9c-4689-abf0-61777d8c562a_en?filename=FISMA_AAR_2023_final.pdf
[9] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016DC0381

(DigCompOrg)[10]. These frameworks, produced by the Joint Research Centre (JRC), align with existing policy priorities such as the Green Deal.

In the context of the European Qualifications Framework, competences are defined as a combination of knowledge, skills, and attitudes (Vuorikari et al., 2022):

- **Knowledge** refers to the assimilation of information through learning, encompassing facts, principles, theories, and practices related to a field of work or study.
- **Skills** are the ability to apply knowledge and use know-how to complete tasks and solve problems, and can be cognitive (involving logical, intuitive, and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools, and instruments).
- **Attitudes**, which motivate performance and underpin continued competence, include values, aspirations, and priorities (European Commission, 2016).

10 https://joint-research-centre.ec.europa.eu/projects-and-activities/education-and-training/key-competences-lifelong-learning_en

Digital Competence Framework

Digital skills are a key priority in European policy, with initiatives aimed at **equipping citizens for the digital transition.** The EU's digital skills strategy, including the European Skills Agenda and the Digital Education Action Plan, focuses on enhancing digital literacy and fostering a robust digital education system. By 2030, the EU aims to ensure that at least 80% of the population possesses basic digital skills and to **increase the number of ICT specialists to 20 million,** as outlined in the Digital Compass and the European Pillar of Social Rights Action Plan. For over a decade, the DigComp has provided a common reference for defining and measuring digital skills across the EU.

Figure 4 depicts the five key competence areas outlined by the DigComp framework. These competences are interconnected and mutually supportive. Mastering skills in one area reinforces the development of skills in another.

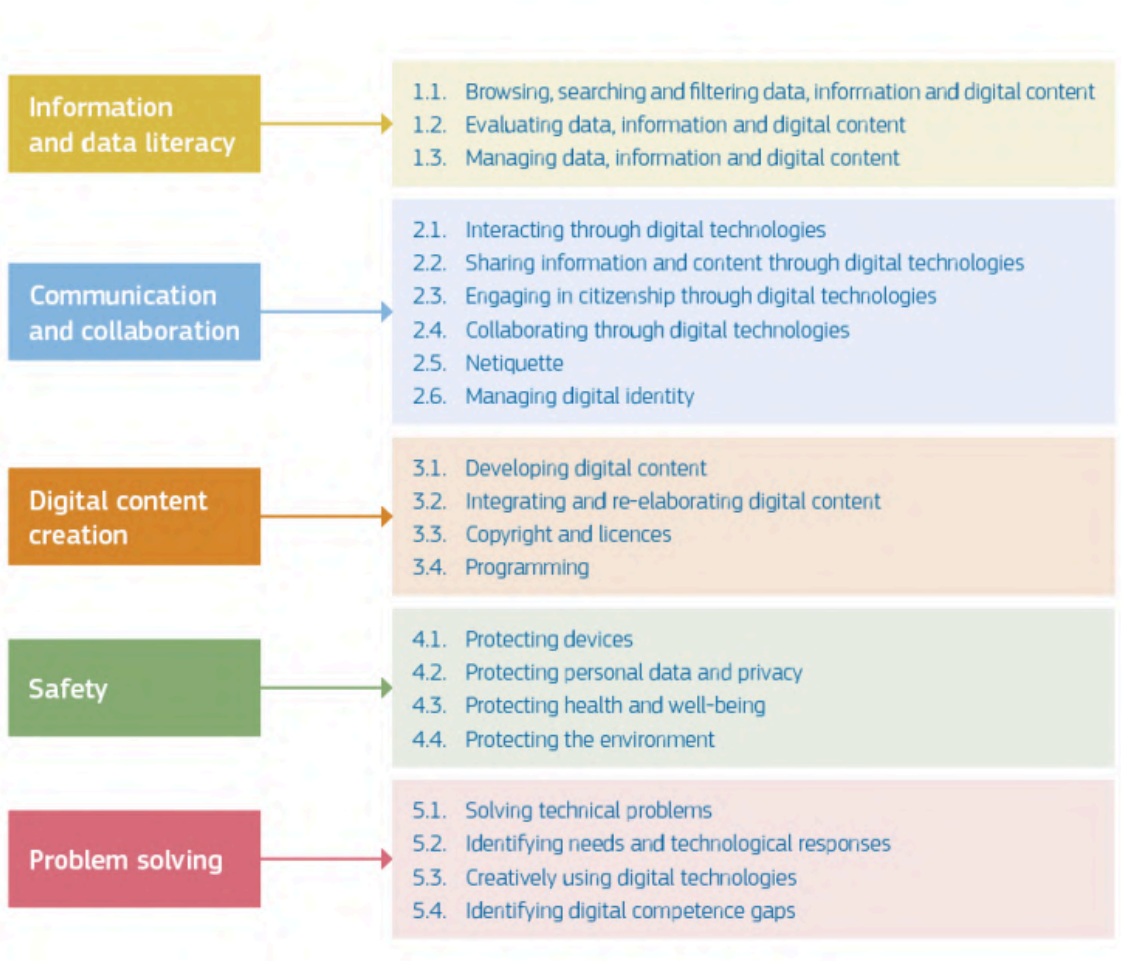

Figure 4. DigComp conceptual reference model. From Vuorikari et al., 2022.

As technology evolves with **Artificial Intelligence (AI), virtual and augmented reality (VR/AR), and the Internet of Things (IoT)**, digital literacy requirements are expanding to address growing concerns over misinformation. The increasing use of AI could lead to a risk of complacency among users, while mastering the design of effective prompts becomes an essential skill for interacting with these systems. Thus, digital literacy is evolving to incorporate the understanding and strategic use of AI. Sustainability and environmental considerations are also becoming integral to the digital framework. To meet these challenges, DigComp has been updated to DigComp 2.2, reflecting emerging skill needs (Vuorikari et al., 2022).

Entrepreneurship Competence Framework (EntreComp)

EntreComp offers a structured approach to fostering entrepreneurial skills, based on the idea that **entrepreneurship as a competence is developed through actions by individuals or groups to create value for others.** It encompasses the entire entrepreneurship competence, broken down into its constituent parts, which both focuses on competence related to starting new ventures (entrepreneurship) and promoting innovation in existing organisations (intrapreneurship). Developed by the JRC for DG EMPL, EntreComp builds on the EU's 2006 recognition of entrepreneurship as a key lifelong learning competence.

While EntreComp provides a comprehensive framework for fostering entrepreneurial skills, extending to the creation of new ventures, **it is crucial to underscore the equally significant dimension of 'intrapreneurship'.** This refers to the ability to promote innovation and drive change within established organisations. This broader scope acknowledges that a substantial proportion of graduates will pursue careers within existing companies, and these individuals require 'entrepreneurial learning or thinking' that is applicable beyond start-up creation.

EntreComp identifies three key competence areas (ideas & opportunities, resources, and into action) and 15 competences to enhance learning outcomes and proficiency levels. These areas and competences are interconnected, forming a unified framework. Entrepreneurship integrates elements from all three areas and is built on these 15 foundational competencies. Each competence includes guidance for development and specific descriptors. Overall, EntreComp comprises 3 competence areas, 15 competences, 15 descriptors, 8 proficiency levels, and 442 learning outcomes.

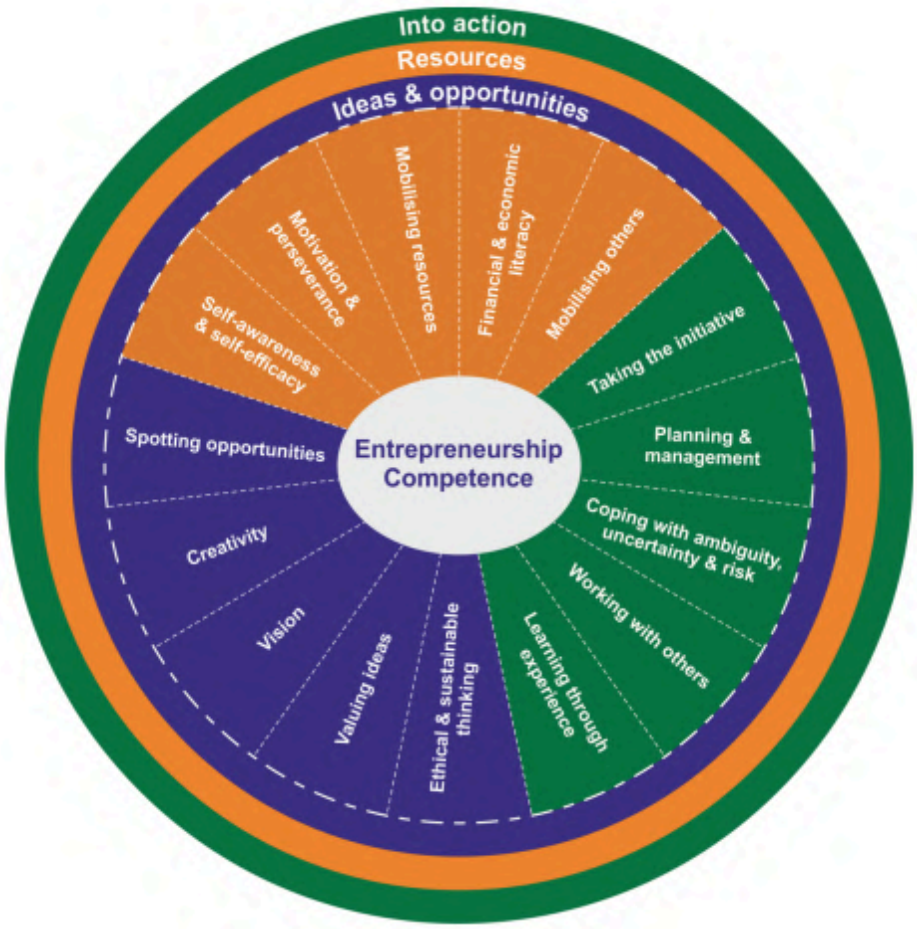

Figure 5. Areas and competences of the EntreComp conceptual model. From Bacigalupo et al., 2016.

DG EMPL and JRC are working to expand the adoption of EntreComp across Europe. Alongside DigComp 2.2 and GreenComp, this framework supports both public and private initiatives in training, mentoring, and fostering an entrepreneurial mindset to tackle Europe's skills challenges (Bacigalupo et al., 2016).

Sustainability Competence Framework (GreenComp)

GreenComp outlines a set of sustainability competences designed for integration into educational programmes, helping learners develop the **knowledge, skills, and attitudes needed to act responsibly towards the planet and public health.** Developed through literature reviews and expert consultations in sustainability education and lifelong learning, GreenComp offers a flexible framework applicable to diverse learning contexts.

It also establishes shared definitions of sustainability to foster collaboration between experts and stakeholders.

GreenComp comprises four interrelated competence areas: "embodying sustainability values," "embracing complexity in sustainability," "envisioning sustainable futures," and "acting for sustainability." Each area includes three equally important competences (12 in total), each with specific descriptors outlining the skills required to develop the competence.

Area	Competence
1. Embodying sustainability values	1.1. Valuing sustainability
	1.2. Supporting fairness
	1.3. Systems thinking
2. Embracing complexity in sustainability	2.1. Systems thinking
	2.2 Critical thinking
	2.3. Problem framing
3. Envisioning sustainable futures	3.1. Future literacy
	3.2. Adaptability
	3.3. Exploratory thinking
4. Acting for sustainability	4.1. Political agency
	4.2. Collective action
	4.3. Individual initiative

Table 1. GreenComp. From Bianchi et al., 2022

As a non-prescriptive reference, GreenComp serves as a guide for educational initiatives that promote sustainability as a core competence. It addresses the growing need for individuals to enhance their knowledge, skills, and attitudes to live, work, and act sustainably (BIANCHI Guia et al., 2022).

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3 The benefits of UBC

3. The benefits of UBC

In this section, we outline the various benefits of UBC, focusing on its main stakeholders: businesses, students, regional authorities, and HEIs.

a. Benefits for businesses

Innovation and Technological Development. For businesses, UBC is a crucial driver of innovation and technological advancement. By forging close links with higher education institutions, companies gain privileged access to academic expertise in collaborative research and development. Additionally, UBC provides businesses with access to new skills and knowledge from universities. While universities contribute advanced theoretical knowledge, industries offer a practical perspective on their needs. This collaboration stimulates the development of disruptive technologies and optimises industrial processes, thereby enhancing the competitiveness of companies. (Bogacz-Wojtanowska et al., 2022; Franco & Pinho, 2019; Jirapong et al., 2021; Mandard, 2013; Nikounejad et al., 2021)

An example of this synergy between academia and industry is the start-up Spectral. Supported by the IMT Starter campus incubator and utilising the FabLab ETOILE of Télécom SudParis for prototyping its augmented reality software for industrial technicians, Spectral demonstrates how UBC can lead to the successful development of new products (Institut Polytechnique de Paris, n.d.). The university provides resources and a favourable environment, while the company develops and prototypes its products.

Top Talent Recruitment. Industries can greatly benefit from student involvement in collaborative environments, as it is an effective way to attract and nurture top talent (Hyytinen et al., 2023). Access to the human resources of academic partners, including students, provides a significant advantage for recruiters. (Archi & Benbba, 2022; Borah et al., 2021; Boudhrâa, 2020; Donaldson, 2025; Jirapong et al., 2021; Kyndt et al., 2022; Orazbayeva et al., 2021; Staring et al., 2019)

Better Alignment Between Education and Employers' Needs. Finally, UBC offers companies the opportunity to influence curricula to better meet their recruitment and talent development needs. By participating in the design of training programmes, companies can ensure that education is tailored to their specific requirements (Boudhrâa, 2020). This beneficial collaboration between universities and industries also enhances students' employability (Borah et al., 2021; Donaldson, 2025; Jirapong et al., 2021; Kyndt et al., 2022; Staring et al., 2019) by ensuring that future graduates possess the skills and

knowledge they truly need (Archi & Benbba, 2022; Orazbayeva et al., 2021). Still, UBC can also help set directionality in companies' needs as critical and reflexive knowledge on e.g. sustainable development produced in HEIs can provide companies with new viewpoints and perspectives (i.e. establishing new needs in companies).

b. Benefits for students

UBC enhances student employability by offering practical experience and skills that are highly valued by employers, thereby improving their professional integration. It also exposes students to cutting-edge technologies and helps them develop advanced competencies (Bogacz-Wojtanowska et al., 2022).

Practical Learning: Participation in collaborative projects (Borah et al., 2021) provides students with essential practical experience, complementing the theoretical learning offered at university. Students often note that their training is too theoretical, and collaboration with companies would allow them to integrate new managerial practices (Kyndt et al., 2022). By working on real-life issues, often proposed by partner companies, students face the concrete challenges of the professional world, enhancing their understanding of these issues and their ability to apply their knowledge in a practical context.

Developing Competences Sought by Companies: These collaborative experiences develop skills targeted by employers, facilitating students' professional integration (Donaldson, 2025), which aligns with the objectives of the ETI Labs project. UBC promotes the acquisition of business-relevant skills, including social entrepreneurship, sustainability, and digital transformation (Staring et al., 2019). By integrating environmental responsibility into learning, UBC aligns with the GreenComp framework, offering students opportunities to engage in green innovation, sustainable business models, and climate-conscious decision-making. Collaborative projects with companies addressing eco-friendly solutions enhance students' ability to think critically and act sustainably. Through industry collaborations, students refine their ability to identify opportunities, manage resources, and take action, key areas of the EntreComp framework. Additionally, UBC fosters creativity, initiative, and problem-solving by immersing students in real-world challenges that require entrepreneurial thinking (Donaldson, 2025; Staring et al., 2019).

Exposure to Technology: Involvement in UBC projects exposes students to cutting-edge and emerging technologies, aligning with the objective of ETI Labs to enhance students' DigComp. By collaborating with companies, particularly on research and development

projects, students can familiarise themselves with the latest tools, techniques, and innovations used in the professional sector. UBC helps students engage with real-world digital applications, fostering skills in data literacy, cybersecurity, digital collaboration, and content creation. Through industry-driven projects, students gain hands-on experience with AI, IoT, and digital transformation, aligning with the DigComp framework.

c. Benefits for regional Authorities

The involvement of regional authorities in UBC generates significant positive spin-offs for regional economic strengthening. UBC plays a crucial role in connecting small and medium-sized enterprises (SMEs) and intermediate-sized enterprises (ETIs) with local universities, fostering the emergence of dynamic ecosystems. In specific contexts, this collaboration can also help mitigate brain drain, ensuring that highly skilled individuals remain within the region, contributing to sustainable local growth and innovation (Bogacz-Wojtanowska et al., 2022; Borah et al., 2021; Perkmann et al., 2021).

Stimulation of Technological Development and Innovation: Connecting SMEs with local universities provides companies with access to the expertise and cutting-edge knowledge available in higher education institutions (Bogacz-Wojtanowska et al., 2022; Franco & Pinho, 2019). Through collaborative research projects, even the smallest companies can benefit from the scientific and technological advances developed at universities, stimulating regional innovation and technological development (Mandard, 2013; Nikounejad et al., 2021). This collaboration can lead to the optimisation of industrial processes and the development of disruptive technologies, making local companies more competitive. Additionally, access to the human resources of university partners, including talented students, is a major advantage for regional companies in terms of recruiting and developing top talent.

Dynamic Local Ecosystems: UBC plays a pivotal role in the development of dynamic local ecosystems. By fostering interactions and partnerships between universities and local economic players, UBC encourages the emergence of collaborative networks[11][12][13]. These dynamic ecosystems promote innovation, the creation of new businesses, and the expansion of professional networks, thereby strengthening the regional economic fabric. The Science Shop model, which will be showcased in the final part of this report, can also

[11] https://www.ip-paris.fr/sites/default/files/Page%20Innovation/IP_Etudiant_Entrepreneur_FINAL_FR.pdf
[12] https://www.pantheonsorbonne.fr/sites/default/files/inline-files/Annuairedernierereversion_5.pdf
[13] https://cordis.europa.eu/project/id/309048/reporting

play a role in this process by connecting the needs of civil society and local SMEs with the resources of university research.

Avoiding Brain Drain: UBC plays a crucial role in limiting brain drain. Aligning curricula with regional economic priorities, as seen in Australia with the extractive industry or the Netherlands with medical technologies (IPING R. et al., 2021; Rebecca Todesco, 2024), can increase the likelihood of graduates finding local job opportunities, thereby reducing the migration of young talent to other regions or countries. Similarly, the ETI Labs project aims to make the skills acquired through mobility more visible and applicable in the local job market.

d. Benefits for HEIs

The involvement of HEIs in UBC initiatives is proving to be a catalyst for enhancing their core missions of teaching, research, and societal service. Various sources underscore numerous significant benefits for HEIs participating in such collaborations.

Enhanced Financial Stability: UBC is a crucial source of funding and financial stability for Higher Education Institutions (Bogacz-Wojtanowska et al., 2022; Borah et al., 2021; Perkmann et al., 2021). Commercial partnerships can alleviate financial pressures on universities, ensuring support for research, teaching, equipment, and facilities (Galib et al., 2015). Additionally, governments are encouraged to fund project consortia that extend their cooperative activities beyond research to include education, commercialisation, and management (Alunurm et al., 2020; Rybnicek & Königsgruber, 2019).

Improved Quality of Education: UBC significantly enhances the quality of education. It helps identify knowledge gaps and update curricula, allowing universities to modernise their teaching. UBC also opens new research and teaching opportunities, fostering long-term development of university skills. Collaboration with businesses introduces new managerial practices, making education more relevant for students who often find it too theoretical (Archi & Benbba, 2022; Bogacz-Wojtanowska et al., 2022; Kyndt et al., 2022; Orazbayeva et al., 2021). Additionally, UBC helps universities adapt their curricula to ESG criteria, addressing contemporary societal issues. It can prevent brain drain by creating local opportunities for graduates and strengthening regional economic ties. Ultimately, UBC drives technological progress, workforce readiness, and regional development (Meerman et al., 2018).

Better Access to Resources: UBC provides HEIs with privileged access to resources, including human resources, equipment, and specialised knowledge from partner

companies. Expanding the network of personnel benefits both academia and industry. UBC also opens new research opportunities by identifying concrete problems that require academic investigation, stimulating innovative research projects with potential economic and social benefits (Jirapong et al., 2021; Mandard, 2013; Nikounejad et al., 2021).

e. Synthesis of benefits

UBC serves as a crucial driver for shared progress and societal development, offering distinct yet interconnected benefits to the primary stakeholders:

Beneficiaries	Benefits
Companies	• The capacity to incorporate cutting-edge scientific developments into their operations. • Driver of innovation and technological development through privileged access to academic expertise in collaborative R&D. • Access to new skills and knowledge from universities. • Access to human resources of academic partners, including students, facilitating recruitment and talent development. • Opportunity to influence curricula to better align with their recruitment and talent development needs. • Potential to develop disruptive technologies and optimise industrial processes, thereby enhancing competitiveness. • Ability to integrate the latest scientific advances into their activities.
Students	• Enhanced employability through the acquisition of practical experience and skills valued by employers. • Exposure to cutting-edge technologies. • Development of advanced competencies. • Engagement with real-world professional challenges. • Integration of modern managerial practices. • Acquisition of skills in social entrepreneurship, sustainability, and digital transformation.
Regional	• Connecting small and medium-sized enterprises (SMEs)

Authorities	and intermediate-sized enterprises (ETIs) with local universities, fostering dynamic ecosystems. • Potential to limit brain drain. • Stimulating regional innovation and technological development. • Contributing to the creation of dynamic local ecosystems, fostering innovation, new business creation, and the expansion of professional networks.
Higher Educational Institutions	• Essential source of funding and financial stability. • Significant improvement in the quality of education through identifying knowledge gaps and updating curricula. • Opportunity to create and open new research and teaching avenues. • Privileged access to resources, such as human resources, equipment, and specialised knowledge from partner companies. • Strengthening their role as central actors in regional or national innovation systems. • Potential to reconfigure and develop skills, leading to substantial long-term performance. • Valorisation of academic research through practical applications and the commercialisation of results.

Table 2. Summary of benefits by stakeholder

It is evident that UBC transcends a mere one-time interaction, evolving into a vital strategic partnership that maximises synergies between academia and the economic sector. This collaboration yields lasting benefits and significantly contributes to addressing societal, economic, and technological challenges. The continuation and enhancement of support mechanisms for UBC, along with a focus on factors that promote cooperation, are crucial to fully harness its potential within initiatives such as Erasmus+.

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4 The challenges of UBC

4. The challenges of UBC

To organise our analysis and enhance comprehension of the issues, we have categorised the challenges of University-Business Collaboration (UBC) into three main areas: difficulties related to coordination and mutual trust, the diversity of UBC across disciplines and institutions, and the limitations of existing UBC models. Many challenges identified by Davey et al. (2018) regarding the state of UBC persist in more recent publications, suggesting they may not have been fully addressed.

a. Difficulties related to coordination and mutual trust

One of the primary challenges identified in the literature is the crucial need for coordination and the establishment of robust trust between HEIs and the economic sector. The nature of UBC involves interactions among stakeholders who may have differing cultures, objectives, and operational methods.

The challenges of divergent cultures, goals, and organisational structures: The 2018 report on UBC highlights that mutual trust, commitment, common interests, and shared goals facilitate cooperation among stakeholders. Enhancing interactions between the academic and entrepreneurial sectors is crucial (Davey et al., 2018).

Recent studies show these challenges persist. Differences in strategic priorities and time constraints between companies and HEIs hinder joint initiatives. Universities often follow rigid procedures and value confidentiality in research, contrasting with the agile, profit-oriented culture of businesses (Alpaydın & Fitjar, 2021; Franco & Pinho, 2019; Moutinho et al., 2023; Olvera et al., 2020; Pažur Aničić & Divjak, n.d.; Rudawska & Kowalik, 2019).

Differing motivations between academics and businesses complicate establishing common goals (Davey et al., 2024; Rybnicek & Königsgruber, 2019). Companies with social objectives do not always see collaboration with universities as a means to achieve their sustainable development goals (Chouat et al., 2019; Jirapong et al., 2021).

Building Trust Relationships: Establishing trust is essential for overcoming the previously mentioned differences and ensuring the success of UBC. This trust is cultivated through transparent communication and a mutual understanding of each party's needs and expectations (Alpaydın & Fitjar, 2021; Franco & Pinho, 2019; Moutinho et al., 2023; Olvera et al., 2020; Pažur Aničić & Divjak, 2022; Rudawska & Kowalik, 2019). A lack of

communication or misunderstandings can quickly undermine trust and jeopardise cooperation.

UBC as Individual Initiatives: UBC projects are often initiated at the individual level rather than the institutional level. Indeed, academics and businesses see themselves as the primary instigators of these collaborations (Davey et al., 2018). These projects rely on the goodwill and personal resources of certain individuals, particularly their networks, which can hinder the implementation of larger-scale initiatives. This also underscores that UBC is still insufficiently addressed at the institutional level, such as through company or university policies. This reality underscores an inherent fragility: if the individual leading the project leaves their institution, or if strong interpersonal relationships are not established and maintained, the initial momentum of the project may falter or never materialise.

b. Heterogeneity across fields, countries and institutions

Our literature review has highlighted the variable presence of UBC across different academic disciplines and types of HEIs. It is important to examine the factors contributing to this uneven distribution and its implications.

Heterogeneous Distribution by Field: Although UBC is relevant for all disciplines and types of HEIs (both private and public), sources suggest differences in how it manifests and is facilitated. Certain fields of study, often those with a more direct application in the economic sector or a tradition of collaborative research, tend to develop more active links with businesses (Davey et al., 2018; Rybnicek & Königsgruber, 2019). For instance, engineering, computer science, and certain branches of life sciences historically have more frequent interactions with the professional world due to the applied nature of their research and the career opportunities for their graduates. This concentration of UBC in certain sectors can limit cooperation and knowledge transfer opportunities in other fields that could benefit from business collaborations to stimulate innovation and adapt their training to labour market realities (Davey et al., 2018).

National Context Matters: Some countries have a stronger tradition of UBC than others, due to more favourable public policies, a more developed culture of collaboration, and more effective innovation systems. Examples of countries such as Germany, the Netherlands, and South Korea, often cited as models for UBC, highlight the importance of an ecosystem conducive to collaboration between universities and businesses. The sectoral specialisation of a country's economy (e.g., extractive industry in Australia, medical technology in the Netherlands) can also influence the most developed forms of

UBC (Davey et al., 2018). However, it is important to emphasise that the advantages and challenges of UBC appear similar on an international scale, regardless of regulatory differences and economic models.

Specificities of HEIs: The public or private status of HEIs significantly shapes their engagement in UBC (Alpaydın & Fitjar, 2021). Private institutions often maintain closer ties with the business sector than public institutions, largely due to differences in funding models and organisational cultures. Whereas private HEIs are typically more reliant on private sector partnerships and exhibit a market-oriented ethos, public institutions tend to operate within more rigid administrative frameworks and possess fewer dedicated resources for fostering external collaborations.

These institutional distinctions contribute to a differential capacity for UBC. The administrative flexibility of private HEIs and their responsiveness to business needs make them more inclined and better positioned to develop partnerships with industry (Alpaydın & Fitjar, 2021; Chouat et al., 2019; Jirapong et al., 2021; Päällysaho et al., 2021; Pažur Aničić & Divjak, 2022). In contrast, public institutions often encounter constraints such as limited human resources and bureaucratic hurdles, which may impede their ability to engage effectively in UBC initiatives.

Moreover, UBC itself remains a fragmented and loosely defined domain, further contributing to diverse levels of engagement across institutions. This heterogeneity, particularly between public and private HEIs, poses a structural challenge to achieving more balanced and inclusive cooperation within the higher education landscape.

In conclusion, the diversity of UBC across fields and institutions is a complex reality, shaped by the nature of academic disciplines, the specificities of HEIs, particularly their public or private status, and national contexts. This uneven distribution underscores the need for initiatives like ETI Labs to promote and facilitate cooperation across a broader range of fields and institutions, maximising the potential benefits of UBC for higher education, businesses, and society as a whole.

c. Limitations of prevailing UBC models

The most common models of UBC, such as internships, research and development (R&D) projects, and consulting, while frequent forms of interaction, seem insufficient to effectively bridge the persistent gap in employability for students and young graduates.

It appears that the most common models of UBC, such as internships, research and development projects (R&D projects) and consulting, although frequent forms of interaction, prove insufficient to adequately bridge the persistent gap in employability for students and young graduates.

Internships Are Not Sufficient. The literature highlights that internships, although widespread, are not enough to bridge the gap between higher education and labour market needs. Students often find that what they learn at university is largely theoretical (Archi & Benbba, 2022; Bogacz-Wojtanowska et al., 2022; Kyndt et al., 2022; Orazbayeva et al., 2021), and internships are intended to provide practical experience. However, internships do not always succeed in addressing employability issues or adequately preparing students for the realities of the business world (Archi & Benbba, 2022; Bogacz-Wojtanowska et al., 2022; Kyndt et al., 2022; Orazbayeva et al., 2021). These points not only to the need for more internships, but also for better-quality internships that are more closely integrated with students' academic learning and future career paths. This is an issue we aim to address with the ETI Labs project through the creation of an innovative traineeship track. For instance, existing research highlights that Erasmus+ internship participants struggle to leverage their acquired skills.

R&D and Consulting Projects Involve Professors and PhDs. Although collaborative research and consulting missions linking HEIs and companies are common forms of UBC, they primarily involve professors and PhD students (e.g., through CIFRE agreements or PhD mobility), without necessarily addressing the skill development of undergraduate and graduate students. This is why ETI Labs aims to create a learning ecosystem that not only recognises the value of skills acquired through mobility at higher academic levels but also enhances their visibility and applicability in the labour market on the graduate level, thereby helping to bridge the identified skills gap (Davey et al., 2018). Dual-education programmes seem particularly suited to this goal, as they provide both practical and concrete experiences to students, preparing them more effectively for the demands of the labour market.

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5

The challenging integration of Green/Entre/ DigComp in Higher Education

5. The challenging integration of Green/Entre/DigComp in Higher Education

Implementing GreenComp, EntreComp, and DigComp mirrors the broader challenges in UBC, especially in aligning higher education with labour market needs and fostering innovation. Harmonising these frameworks across diverse educational, professional, and policy landscapes is complex. Factors such as cultural and territorial diversity, financial resources, stakeholder engagement, communication clarity, and different academic disciplines significantly impact UBC. These factors also influence how the three competence frameworks are integrated into academic curricula and absorbed by students entering the job market. Assessing job market readiness for students with GreenComp, EntreComp, and DigComp skills is crucial[14] (da Costa et al., 2025).

Another challenge is the mismatch between competency development and employability. Even when students are trained according to these frameworks, it does not always lead to practical application or job opportunities.

Integrating these frameworks into curricula and workforce training requires significant coordination, investment, and adaptability from policymakers, educators, and organisations. They may struggle with alignment, measurement, and large-scale implementation. Coordination, trust, and structured engagement between academia and industry are essential to ensure these competencies are not just taught but embedded in real-world applications.

a. The specific challenges of GreenComp

GreenComp, which promotes sustainability competencies, faces challenges in embedding environmental awareness across sectors without creating bureaucratic burdens or resistance to change. This includes sectoral resistance and difficulties in integrating sustainability principles into diverse curricula.

A 2024 study by Technopolis Group and 3S, commissioned by the European Commission, explored how various institutions and individuals have used GreenComp. The study

14 https://www.oecd.org/en/publications/building-competencies-for-digital-and-green-innovation-in-higher-education_d3869c1f-en.html

mapped initiatives using GreenComp, examining education levels, resources, funding, and geographical spread. Most initiatives focused on school education (primary and secondary). Notably, Finland, Greece, Italy, and Spain had numerous initiatives, while some EU Member States had none, indicating GreenComp's limited recognition (Javorka et al., 2024).

Stakeholders agreed that sustainability competence should be transdisciplinary, incorporating social, economic, and cultural aspects alongside environmental focus. This adds complexity to academic curricula and raises expectations for graduates' preparedness. While the framework is initially easy to understand, full comprehension requires deeper, resource-intensive engagement.

Another study highlighted GreenComp's potential for widespread adoption by policymakers but questioned its effective integration into teaching practices (VARE, 2022). Research in Greece showed vocational teachers' motivation to develop sustainability competencies in students using GreenComp (Sourgiadaki & Karkalakos, 2023). However, it emphasised the need for targeted professional development programmes to bridge the gap between teachers' motivation and their training on sustainability issues and innovative pedagogical practices.

b. DigComp facing inclusiveness issues

To develop the competencies outlined in DigComp, disparities in digital access and literacy must be addressed to ensure equitable opportunities for all. Geographical and territorial differences, such as those in rural areas, significantly impact access to digital tools and the education sector's ability to provide students with the necessary resources.

The gap between the implementation of the DigComp framework and the actual development of students' digital competencies cannot be attributed solely to issues of access to digital tools. A significant contributing factor is the limited ability of some young people to use information and communication technologies (ICT) intelligently and creatively. This includes the capacity to engage with digital tools, such as AI, with critical awareness, rather than relying on them passively (Rózewski et al., 2021).

Nevertheless, this should not obscure the fact that many students are also exhibiting innovative uses of these technologies, applying them in novel contexts and pushing the boundaries of conventional applications.

Approaches such as UBC, science shops, and hackathons —which are central to the development of the ETI Labs initiative—offer promising avenues for fostering deeper and more purposeful engagement with digital tools. These formats can stimulate students to develop digital and AI literacy and to integrate these technologies into the learning process in a more meaningful and transformative way, moving beyond superficial or passive usage.

c. EntreComp, requiring financial support and better guidance

EntreComp, focused on entrepreneurial skills, aims to balance fostering innovation with ensuring inclusivity, avoiding a narrow focus on business creation at the expense of broader problem-solving and resilience skills (which are also of relevance for existing companies). Integrating these frameworks into curricula and workforce training requires significant coordination, investment, and adaptability from policymakers, educators, and organisations, who may struggle with alignment, measurement, and large-scale implementation (Sánchez-Hernández & Maldonado-Briegas, 2023). Financial resources play a crucial role, with private HEIs benefiting from administrative flexibility and closer industry ties, making it easier to incorporate EntreComp. In contrast, public HEIs may face regulatory constraints that slow implementation (Cunningham et al., 2024).

A study involving 348 responses from 47 countries assessed EntreComp's implementation in entrepreneurial education (Seikkula-Leino et al., 2021). The framework is widely recognised and valued, with respondents motivated to integrate it into their work. However, challenges include a lack of shared vision, difficulty understanding the framework, limited translations, and the need for further guidance and training. EntreComp is mainly used to raise awareness and engage stakeholders rather than for deep curriculum integration, indicating it is still in the early stages of implementation.

While awareness of entrepreneurial education is improving, many respondents need more support to demonstrate its impact and benefits effectively. The study emphasises the importance of learning communities, both local and global, in driving successful educational reform. Psychological and social belonging within these communities enhances engagement with EntreComp. Cultural and policy differences influence implementation across countries, with varying levels of integration seen in the UK, Italy, Finland, Germany, Spain, and Iceland.

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6

Good practices in UBC

6. Good practices in UBC

This section builds on the recommendations from the 2018 UBC Status Report (Davey et al., 2018), highlighting the good practices implemented since its publication. We also identified successful strategies for UBC to contribute to the development of DigComp, GreenComp, and EntreComp.

a. A better integration of the three competence frameworks

To enhance the development of GreenComp, EntreComp, and DigComp, HEIs must integrate these frameworks into their academic programmes, but also in extracurricular activities in HEIs taking place 'outside the classroom'. This approach also applies to business and regional development strategies. Additionally, companies and industries need to better understand and value the skills students acquire through GreenComp, EntreComp, and DigComp to ensure a smooth UBC relationship.

A study by Bacigalupo (2022) suggests that competence frameworks should be used flexibly rather than followed rigidly. These frameworks allow for broad customisation, influenced by factors such as institutional support, educators' willingness to engage in competence-based education, and the availability of peer networks and communities of practice for professional learning. Competence frameworks should be viewed not as a final goal or a means of transport, but as a guiding tool on the lifelong learning journey, with each learner following their own unique path.

The lens of responsible innovation (RI) offers a powerful approach to better integrating the GreenComp, DigiComp, and EntreComp frameworks in order to develop critically engaged, future-ready graduates. Rather than focusing solely on meeting current industry demands, UBC should also cultivate anticipatory, reflective, inclusive, and responsive competencies—core to RI (Stilgoe et al., 2013). This perspective positions HEIs as active contributors to reshaping innovation practices by embedding sustainability, ethics, and social responsibility into collaboration models. Initiatives like ETI Labs, based on the Science Shop methodology, exemplify how students can apply these competences in real-world contexts—aligning with EU priorities on Responsible Research and Innovation (RRI) and fostering intrapreneurial capacity. Ultimately, this integrated approach empowers graduates not only as skilled employees but as agents of transformative change in business and society (Ogoh et al., 2023; Spruit, 2014; Tassone et al., 2018).

b. Creation of more practical education programs

Davey et al., (2018) recommended three main strategies to improve UBC by modifying HEIs' education programmes:

- **Creating more opportunities for cooperation** with employers, including practical programmes within and between faculties.
- **Supporting the creation and continuous modernisation of curricula.**
- **Extending the benefits of cooperation beyond research** to improve employability, career paths, valorisation, and management-level cooperation.

Since then, various approaches have been implemented, focusing on pragmatic methodologies applicable in different educational contexts to strengthen ties between HEIs and the business world. These include:

- **Employer participation in co-designing curricula** to align them with market needs (Boudhrâa, 2020).
- **Dual training programmes** combining academic theory and professional practice, such as internships and industrial projects, to enhance graduate employability (Franco & Pinho, 2019). Additionally, challenges proposed by partner companies allow students to solve real-world problems[15].

These methodologies foster mutually beneficial interactions, enabling businesses to share their needs and challenges while HEIs provide theoretical and practical expertise (Bogacz-Wojtanowska et al., 2022; Franco & Pinho, 2019; Jirapong et al., 2021; Mandard, 2013; Nikounejad et al., 2021).. Co-designed educational programmes, dual training, and internships can expose students to sustainability challenges, entrepreneurial thinking, and digital transformation, ensuring the development of competencies from GreenComp, EntreComp, and DigComp (Bacigalupo et al., 2016; Bianchi et al., 2022; Vuorikari et al., 2022).

For example, the strategic partnership between the Universities of Technology group (UTBM, UTC, UTT) and the EDF group aims to better prepare students for future energy and environmental challenges, including nuclear and renewable energies. EDF advises the universities on academic content, influencing the study programmes directly. This collaboration enriches educational programmes, with EDF integrating its expertise into university courses and participating in conferences and seminars. It also promotes innovation projects within regional ecosystems.

[15] https://www.pantheonsorbonne.fr/sites/default/files/inline-files/Annuairedernierereversion_5.pdf

Advantages of this partnership include better preparation for energy transition challenges, increased internship and apprenticeship opportunities at EDF, enhanced professional integration of graduates into the energy sector, and continuous adaptation of training to industry needs.

Dual education programmes are based on real use cases, allowing students to gain practical experience and skills. Businesses benefit from innovative solutions, access to future talent, and a better understanding of the latest academic advancements, and HEIs benefit from close integration with real-life working environments (Bogacz-Wojtanowska et al., 2022; Borah et al., 2021). These approaches must consider industry and regional specificities. For example, the needs of an SME in the service sector differ from those of a large technology company, and economic priorities and innovation ecosystems vary across regions. Therefore, dual education programmes must be flexible and adaptable to address this diversity effectively. Integrating AI-driven skills matching and gamified learning environments into curricula can enhance accessibility and engagement, ensuring that sustainability, digital, and entrepreneurial competencies remain adaptable to evolving market demands.

c. Development of cooperation structures

Research on UBC highlights a lack of knowledge and calls for new opportunities in research and teaching, stemming from the exploration of concrete problems. Additionally, collaborations encourage universities to enhance their teaching quality by better understanding market needs and valuing academic research through practical applications and commercialisation of results.

To address this challenge, the report on the state of UBC (Davey et al., 2018) suggested that governments could fund project consortia to extend cooperation activities beyond research to include education, valorisation, and management. Consequently, since 2018, intermediary cooperation structures have been established, such as:

- **Joint laboratories, collaborative research centres** (CRC), or **co-location spaces** shared by HEIs and company staff.
- **Dedicated structures within HEIs.**
- **Co-design spaces and FabLabs**, immersing students in real innovation projects.
- **Living Labs and Science Shops.**

These collaborative structures provide businesses with easier access to academic expertise, enabling them to develop disruptive technologies and optimise their industrial

processes. In return, universities gain a better understanding of the industry's concrete needs. Research collaboration can occur on various scales, from specific projects to long-term partnerships (Bogacz-Wojtanowska et al., 2022; Franco & Pinho, 2019; Jirapong et al., 2021; Mandard, 2013; Nikounejad et al., 2021). Additionally, the knowledge and experiences gained from these collaborations can directly enhance study programmes, making them more relevant and suited to the labour market's needs (Savoia et al., 2017).

Joint laboratories and research centres facilitate sustainable and structured collaboration between universities and businesses[16][17][18][19]. These intermediate structures, such as Labcoms, foster dynamic local ecosystems and enhance student employability through internships and CIFRE theses[20][21][22].

Work-Integrated Learning (WIL) integrates workplace learning into formal education programmes, making professional experiences a core part of the learning process. For example, the Faculty of Organisation and Informatics (FOI) at the University of Zagreb systematically incorporates WIL, supported by the Student Support and Career Development Centre (CPSRK), which collaborates with employers and connects them with teaching staff (Pažur Aničić & Divjak, 2022).

Other structured models involve professionals directly engaging with students through workshops and teachings focused on entrepreneurship and innovation. For instance, the Institut Polytechnique de Paris (IP Paris) offers "Transversal and Personalised Support" with student entrepreneurship advisors who guide students in their projects through workshops, coaching sessions, and sharing their expertise and networks[23]

These structures also facilitate resource sharing and strategic alignment between academic and industrial partners. For example, joint research projects can identify new skills required by future graduates, prompting universities to adapt their curricula

[16] https://www.ip-paris.fr/sites/default/files/Page%20Innovation/IP_Etudiant_Entrepreneur_FINAL_FR.pdf
[17] https://www.flsh.unilim.fr/master/co-design-et-experience-utilisateur-pour-interfaces-numeriques-sensorielles/
[18] https://www.flsh.unilim.fr/master/co-design-et-experience-utilisateur-pour-interfaces-numeriques-sensorielles/
[19] https://cordis.europa.eu/project/id/309048/reporting
[20] https://www.unilim.fr/codemaker-la-fondation-partenariale-de-luniversite-de-limoges-dote-lavrul-dun-espace-de-co-conception/#:~:text=COdeMAKER%20est%20un%20centre%20de,%3A%20test%20%E2%80%93%20maquettes%20%E2%80%93%20am%C3%A9liorations%E2%80%A6
[21] https://www.univ-poitiers.fr/accompagner-les-entreprises/innover/laboratoires-communs/mach4-controle-et-virtualisation-machine-pour-lindustrie-4-0/
[22] https://makeithappenmakeitbig.com/report/global-report-HEC.pdf
[23] https://www.ip-paris.fr/sites/default/files/Page%20Innovation/IP_Etudiant_Entrepreneur_FINAL_FR.pdf

accordingly. Similarly, the involvement of companies in research can lead to the integration of new managerial practices in university teaching (Archi & Benbba, 2022; Bogacz-Wojtanowska et al., 2022; Kyndt et al., 2022; Orazbayeva et al., 2021).

Dedicated Structures in HEIs. The co-location of company departments and R&D staff near universities, particularly in science parks, promotes collaborative research and knowledge dissemination (Ashyrov et al., 2019; Olvera et al., 2020). The creation of dedicated structures within universities plays a crucial catalytic role in UBC. University-business liaison offices, technology transfer services, incubators, and science parks serve as interfaces to facilitate and structure interactions between academia and the economic sector. These structures provide administrative, legal, and logistical support to UBC initiatives, help identify potential partners and promote collaboration opportunities. Appointing a person responsible for UBC at the executive level within the university can also strengthen the institution's strategic commitment.

Co-design Spaces and FabLabs. Co-design spaces and FabLabs offer students the chance to tackle real-world challenges, often linked to societal needs, as seen in "Science Shops." These environments immerse students in professional complexities, enhancing their employability through hands-on experience and access to prototyping, while also developing their DigComp.

For example, the FabLab ETOILE is a rapid prototyping space at the heart of the ETOILE Centre, dedicated to innovation and entrepreneurship on the Télécom SudParis campus in Evry, France. It collaborates with other fab labs such as the Placi Lab of Planète Science and the C-19 of ENSIIE, aligning with the global network of digital fabrication that promotes collaborative innovation.

Similarly, the CodeMaker institute, established in 2015 in the Nouvelle-Aquitaine Region of France and affiliated with the University of Limoges, fosters innovation and creativity through collective intelligence. The institute specialises in co-design, a collaborative design method involving all stakeholders in the creative process.

Similarly, **Living Labs and Science Shops** serve as knowledge bridges between academia and businesses, where students collaborate with industry partners and other stakeholders to address real-world sustainability and business challenges. This approach reinforces GreenComp's focus on systemic thinking, adaptability, and initiative(Mulder et al., 2009). Innovation Hubs also support hands-on digital and entrepreneurial learning, aligning with DigComp's emphasis on digital literacy and collaboration while fostering entrepreneurial creativity.

The Erasmus+ ASKFOOD project, "Alliance for Skills and Knowledge to Widen Food Sector-related Open Innovation, Optimisation and Development," exemplifies how open innovation can enhance sustainability-driven entrepreneurship. It provides a model for integrating entrepreneurial and digital skills into sector-specific training (Martin et al., 2013).

d. Establishment of strategic frameworks and support mechanisms

The report by Davey et al., (2018) recommended that governments create management and funding supports for cooperation:

- Audit the existing environment to **better understand support mechanisms and needs** before implementing UBC mechanisms.
- Provide a **clear development strategy and policy for UBC**, aligned with the organisation's mission.
- **Fund longer-term cooperation initiatives** to allow for the development of expertise and the maturation of relationships.

The sustainable effectiveness of UBC relies not on isolated initiatives but on a systemic and planned approach. This involves establishing solid foundations at both strategic and operational levels to frame, facilitate, and perpetuate collaborations.

Since its publication in 2018, several initiatives have been launched, including:

- **UBC Strategy:** Establishing common objectives and fostering trust between stakeholders (Alpaydın & Fitjar, 2021; Franco et al., 2024; Moutinho et al., 2023; Olvera et al., 2020; Pažur Aničić & Divjak, 2022; Rudawska & Kowalik, 2019).
- **Financial Support and Incentives:** Ensuring adequate funding, particularly from public authorities and local actors (Alunurm et al., 2020; Archi & Benbba, 2022; Olvera et al., 2020; Päällysaho et al., 2021; Rudawska & Kowalik, 2019; Rybnicek & Königsgruber, 2019).
- **Support for Student Entrepreneurship:** Integrating entrepreneurial pedagogy and mobilising the resources and networks of companies[24].
- **Evaluation Mechanisms:** Implementing systems to assess the effectiveness of these initiatives (Ashyrov et al., 2019).

[24] https://makeithappenmakeitbig.com/report/global-report-HEC.pdf

Referring to these recommendations is important as good practices are beginning to emerge and are recommended for broader development.

Defining a UBC Strategy. A crucial yet underdeveloped element is the creation of explicit UBC policies and strategies within HEIs. These strategies should be clearly defined and aligned with the institution's mission, articulating the vision for collaboration with the economic sector, identifying specific objectives (e.g., improving employability, stimulating regional innovation), and setting priorities for types of cooperation and sectors of activity (Alpaydın & Fitjar, 2021; Franco et al., 2024; Franco & Pinho, 2019; Moutinho et al., 2023; Olvera et al., 2020; Pažur Aničić & Divjak, 2022; Rudawska & Kowalik, 2019). Transparent communication of these policies to all stakeholders is essential.

Before implementing UBC mechanisms, it is recommended to conduct a thorough analysis of the existing environment. This evaluation should map out current support mechanisms, identify the needs of various stakeholders (universities, businesses, students, regional authorities), and understand the regulatory and socio-economic context. The results can then inform the development of the UBC strategy and the selection of the most relevant support mechanisms.

The effectiveness of UBC depends on the quality of coordination and communication among stakeholders. Establishing common and complementary objectives is essential to ensure fruitful collaboration and reduce misunderstandings. Fostering a climate of trust between academic and industrial partners is crucial (Donaldson, 2025; Kyndt et al., 2022; Moutinho et al., 2023; Päällysaho et al., 2021; Pažur Aničić & Divjak, 2022; Rudawska & Kowalik, 2019; Rybnicek & Königsgruber, 2019). Dedicated structures within universities, such as university-business liaison offices, facilitate and structure collaborations (Hayter, 2016; Orazbayeva et al., 2021; Watson-Capps, 2014). Additionally, establishing a favourable regulatory framework is important to facilitate UBC and overcome potential barriers[25].

Financial Support and UBC Strategy. Public policies and funding initiatives are powerful tools to encourage and support the development of UBC (Hayter, 2016; Orazbayeva et al., 2021; Rybnicek & Königsgruber, 2019; Watson-Capps, 2014). National and regional governments, as well as European institutions, can establish specific funding programmes to support collaborative projects in education, research, and innovation. Financial incentives, tax aids, or subsidies can encourage businesses, particularly SMEs, to engage in collaborations with universities (Alunurm et al., 2020).

[25] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52024DC0077

Participation in Erasmus+ projects, like the ETI Labs initiative, helps HEIs bridge the gap between education and the labour market, improve student employability, and promote innovation. This commitment fosters a culture of continuous improvement, inclusivity, and adaptability in higher education (Archi & Benbba, 2022; Bogacz-Wojtanowska et al., 2022; Borah et al., 2021; Franco & Pinho, 2019; Jirapong et al., 2021; Mandard, 2013; Meerman et al., 2018; Nikounejad et al., 2021; Orazbayeva et al., 2021; Perkmann et al., 2021).

Support for Student Entrepreneurship. University incubators and accelerators can bolster student-led startups by providing mentorship, access to funding, and training in business development, thereby reinforcing EntreComp's role in practical entrepreneurship education (Joensuu-Salo et al., 2023). However, it is crucial that EntreComp also encompasses the skills and competencies students can apply within existing companies. In other words, "entrepreneurial learning or thinking" should not only strengthen the entrepreneurial spirit itself but also intrapreneurship. To incentivise industry collaboration, which is highly dependent on financial availability and contextual factors, governments should offer tax benefits and grants to businesses engaging in competence-based UBC projects. Universities should also leverage additional funding from Erasmus+, Horizon Europe, and regional programmes to develop large-scale projects that address sustainable competence-building models (Abelha et al., 2020).

A study conducted within the "Green at You" project, co-funded by ESF+, highlights the potential of aligning UBC initiatives with certified micro-credential training modules. This approach increases employability in green and digital careers, particularly for disadvantaged groups, and underscores the need for structured certification and recognition systems.

Evaluation Mechanisms. A good emerging practice is to implement mechanisms for evaluating the impact of collaboration on student employability and other objectives. Using Key Performance Indicators (KPIs) allows for measuring the outcomes of UBC initiatives and identifying best practices and areas for improvement (Ashyrov et al., 2019). Evaluations can focus on skill acquisition by students, their professional integration, the creation of new companies, or the economic and social impact of collaborative projects. The results of these evaluations can then be used to adjust UBC strategies and support mechanisms. Additionally, integrating ESG criteria into the evaluation of collaborations is an important trend.

In conclusion, while some solutions have been implemented, there is still room for improvement in developing best practices for UBC. Establishing effective strategic frameworks and support mechanisms for UBC requires a shared and clear vision, an

in-depth understanding of needs and context, smooth coordination and communication, dedicated university structures, a favourable political and financial environment, and rigorous evaluation of the impact of collaborations. These elements are essential to maximise the mutual benefits of UBC for universities, companies, and society as a whole.

Ultimately, fostering cross-sector networks and public-private partnerships ensures that the skills taught align with the evolving landscape of sustainable industries, thereby strengthening both regional economies and global innovation capacity (Welter et al., 2017) and societal impact.

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7

The science shops methodology

7. The science shops methodology

a. Introduction to science shops

This literature review highlights the need to move beyond the dominant model of internships and explore other forms of UBC, such as collaborative research, industry projects integrated into the curriculum, science shops, and open innovation initiatives[262728] (Franco & Pinho, 2019). Combining different types of UBC can be more effective in achieving specific objectives. UBC should aim to develop key skills in students, such as digital, entrepreneurial, and green competencies. Integrating practical experiences and concrete projects into curricula significantly enhances graduates' employability.

The ETI Labs project aims to provide students with practical experience by working on initiatives that have tangible impacts on local businesses and communities. The science shop methodology is considered a means to facilitate direct collaboration between HEIs and Small and Medium-sized Enterprises, bridging academic research with real-world business challenges. In this context, science shops are viewed as a potential form of UBC. Specifically, a "science shop" refers to **an entity that offers independent and participatory research support in response to civil society's concerns** (Leydesdorff & Ward, 2005). This section provides an overview of this particular methodology.

The concept of science shops originated in the late 1970s in the Netherlands. During the 1980s, it expanded to Germany, France, Denmark, and Belgium, and in the 1990s, it reached Austria and the United Kingdom. By the late 1990s, science shops had spread to Eastern and Central Europe, South Africa, and developing countries (Urias et al., 2020). Today, science shops are a global and institutionalised phenomenon, supported by the European Commission since 2002 through a multifaceted strategy involving direct funding, capacity-building, and integration into broader research policy frameworks.

European support mechanisms have included:

- FP6 (2002-2006): Allocated €1 million through a dedicated "Science and Society" call.

[26] https://www.essca.eu/app/uploads/2024/09/rapport-activite-2022-2023.pdf
[27] https://www.horizon-europe.gouv.fr/expanding-academia-enterprise-collaborations-34648
[28] https://www.utt.fr/actualites/collaboration-inedite-entre-la-start-up-inouqa-et-lutt-un-stage-tipi-transitions-industrielles-par-linnovation-pour-une-etudiante-ingenieure-de-lutt

- Projects TRAMS and PERARES: Aimed at professionalising science shop operations across 12 countries.
- SciShops.eu (2017-2020): Funded under Horizon 2020's SwafS-01-2016 call with a €3.8 million budget.
- Horizon Europe (2021-2027): Incorporates science shops within its "Reforming and Enhancing the European R&I System" pillar.
- Digital Europe Programme (2023-2025): Allocated €28 million to upgrade science shop technological capabilities.
- Global Gateway Initiative (2021-2027): Aims to extend science shop models to the African Union (€28 million for establishing 14 science shops under the EU-Africa R&I Partnership) and ASEAN (€15 million digital twinning programme connecting European and Southeast Asian science shops).

Additionally, the Living Knowledge conference, first organised in 2001, has become a regular event, attracting hundreds of participants each time. It has now evolved into a formal international network, supporting the development of science shops worldwide.

b. Unpacking the characteristics of science shops

As shown in Figure 6 below, science shops involve various stakeholders:

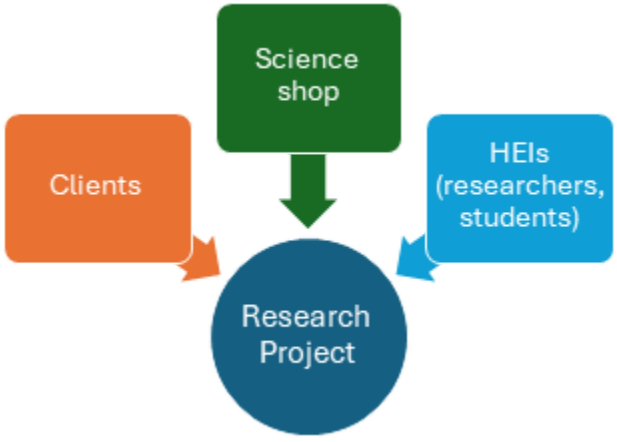

Figure 6. Stakeholders involved in Science shops

Clients: These can be societal organisations, NGOs, citizen groups, individuals, or sometimes SMEs (Urias et al., 2020), who express concerns, questions, or needs and are open to participatory research support.

HEIs: These institutions primarily provide human resources. Students typically undertake projects within science shops, supervised by researchers. These projects can be part of course activities (collective work) (Anginot et al., 2022) related to master's or bachelor's theses (individual projects) (Hawkins et al., 2013), or associated with internships (Piron, 2024). Universities and schools can also provide access to specific materials or offer financial support (Anginot et al., 2022; De Filippo et al., 2021).

Science Shop Team: This entity requires a dedicated team, typically one or two individuals, responsible for collecting research requests, translating them into projects suitable for an academic context, and finding researchers and students interested in carrying out these research projects (Piron, 2016).

In a science shop project, these stakeholders collaborate through a four-stage process:

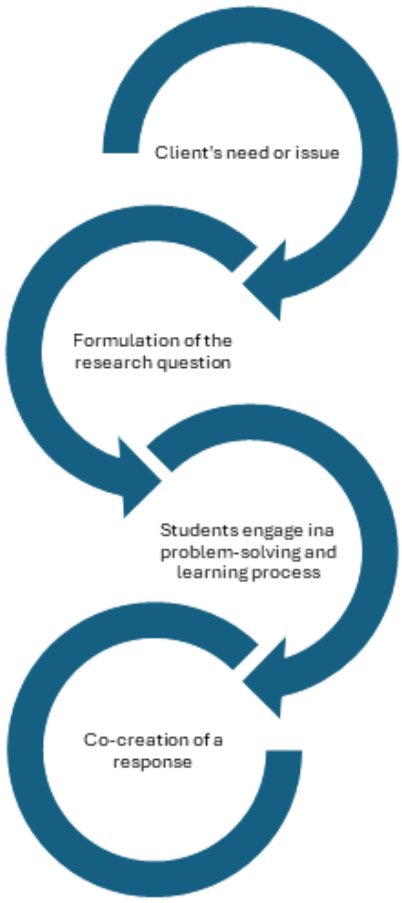

Figure 7. The stages of a science shop project, inspired by Hawkins et al. (2013)

According to (Piron 2016), depending on the size of the science shop, **between 100 and 300 projects can be undertaken each year**, involving hundreds of students.

In existing science shops, a diverse range of projects across various disciplines (both in the hard sciences and humanities) and of different natures have been conducted (Leydesdorff & Ward, 2005). These include:

- **Bibliographic or prospective studies** (Savoia et al., 2017).
- **Scientific research** (R Stewart & Havelange, 1989), **technological development, or adaptations** (Diouf, 2017) of existing technologies or devices to meet specific needs.
- **Public engagement activities** such as communication, mediation, advocacy, moderation, consultancy, evaluation, and the development and implementation of innovation-oriented solutions (Urias et al., 2020).

For instance, the Lyon Science Shop supports around ten supervised projects per year, aiming to combine knowledge to find original solutions. Students spend 4 to 6 months immersed in partner associations, receiving training in participatory research, investigative approaches, and mediation. This initiative is explicitly interdisciplinary, bringing together students from diverse academic backgrounds to collaboratively address societal issues, thereby fostering the cross-fertilisation of perspectives and expertise within each project.

Despite the diversity of projects, the common thread among science shop initiatives is that they provide free or very low-cost access to scientific and technological knowledge and research (Schlierf, 2010). The science shop model was created to complement for-profit research, which is typically conducted by private companies (Savoia et al., 2017). The aim of science shops is to contribute to the public good and general interest, for example, by improving clients' social and environmental conditions (Schlierf, 2010).Living Knowledge, the international science shop network, goes further by suggesting five criteria to avoid the risk of financial barriers (Hawkins et al., 2013):

1. The question should have a clear scientific or research component that can be investigated.
2. The findings from the research should be made publicly available and accessible to everyone.
3. The research question should be relevant and important to a large group of people.
4. The client should be able to understand and use the results of the research effectively.

5. The research question should **not be driven by commercial interests or relationships.**

Preventing commercial relationships might seem like a solution to the goal disparities among UBC stakeholders, which is one of its biggest challenges.

Regarding the impact on education and students' employability pursued by ETI labs, the literature has highlighted various benefits of the science shop methodology that echo the advantages of UBC previously mentioned. Firstly, studies have shown that students' competencies are enhanced through science shop projects (Savoia et al., 2017).Secondly, some science shops develop specific training related to the issues they aim to solve, which students may attend (Savoia et al., 2017).Thirdly, participation in science shop projects can lead to changes in curricula to better suit the requirements of such activities, as reported by around 40% of science shops during the European SCIPAS project (Hende & Jorgensen, 2001).

The Corvinus Science Shop streamlines the process of finding high-quality course projects by providing real-life, socially impactful cases that enhance student motivation and engagement. The teaching practices employed in science shop projects, such as service learning, problem-based learning, project-based learning, and community-based teaching, are proven methodologies that significantly improve the quality of education. Additionally, these educational methods can contribute to improving students' EntreComp.

In line with the GreenComp Framework, the projects allow students to address social and sustainability challenges they might not otherwise encounter.

In accordance with the DigComp Framework, science shops can be utilised to address uncertainties regarding the accuracy of digital information (c1.1. Information and data literacy). Additionally, emerging examples of virtual "e-Science Shops" aim to manage nearly all of their projects and communications online. One such example is the Universitat Oberta de Catalunya in Spain, a fully online university, which is experimenting with integrating an e-Science Shop into its general operations.

Other methodologies akin to science shops for the ETI Labs. The project aims to develop and successfully launch three comprehensive lab programmes, each aligned with a core thematic area: entrepreneurship, green initiatives, and digital technology. These programmes are designed to ensure a targeted and impactful learning experience. Two particularly suitable methodologies are open innovation and hackathons.

Finally, it is worth noting that other methodologies similar to science shops might be considered for the ETI Labs since the aims of the project are the development of three comprehensive lab programs, each aligned with a core thematic area (entrepreneurship, green, digital), ensuring a targeted and impactful learning experience. Two particularly suitable options are open innovation and hackathons.

c. Unpacking the characteristics of science shops

Open innovation refers to "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively" (Chesbrough, 2003). In other words, open innovation involves organisations collaborating with external stakeholders by sharing knowledge, resources, and technology. Open innovation can take various forms, such as R&D projects or partnerships between companies and research institutions (e.g., the IBM Q Network), which can be considered examples of UBC. Additionally, some studies have focused specifically on cases of open innovation involving HEIs (de las Heras-Rosas & Herrera, 2021; Johnston et al., 2010; Padilla-Meléndez & Garrido-Moreno, 2012). In line with their promotion of UBC, European countries and the European Commission also support open innovation initiatives (Staring et al., 2019)

The Alliance for Skills and Knowledge to Widen Food Sector-related Open Innovation, Optimization, and Development (ASKFOOD) project is pioneering efforts to enhance the European food sector. This initiative is creating cross-industry knowledge platforms to foster innovative multi-actor food clusters, developing an Open Innovation framework to modernise higher education in food studies, and establishing an interactive repository to identify and forecast emerging skills and professional profiles needed for the future.

Regarding ETI labs, compared to science shops, open innovation projects more frequently involve companies, including SMEs and ETIs, and are therefore more open to commercial opportunities. Additionally, numerous open innovation initiatives utilise online hubs to gather ideas and suggestions from employees (e.g., Google's internal crowdsourcing initiatives) or clients (e.g., LEGO Ideas), which may then be developed by the company, or to connect external stakeholders (individuals, companies, etc.) to work on a common project. The three examples below illustrate cases of such connecting platforms:

- **Procter & Gamble Connect + Develop Programme:** This programme aims to develop partnerships with external inventors, startups, and suppliers to create new products and technologies.

- **General Electric Appliances' FirstBuild Initiative:** An open innovation platform that engages makers, designers, and engineers to co-create innovative home appliances. Community members can submit ideas, collaborate on projects, and provide feedback, leading to the development of new products.
- **InnoCentive:** Created to connect organisations with a global network of over 500,000 solvers across 200 countries, achieving an 85% solution rate for posted challenges.

d. Opening perspectives: Hackathons

Hackathons are time-limited events during which voluntary participants gather to hack or improve existing software or create new prototypes (Lifshitz-Assaf et al., 2020). These events can therefore contribute to fostering innovation. Initially emerging as a niche phenomenon, hackathons have been democratised through their adoption by corporations, government agencies, and HEIs (Schulten & Chounta, 2024).

In line with the objective of ETI Labs to enhance students' DigComp, EntreComp, and GreenComp, hackathons are particularly used to explore possible futures with and through technology (Söderberg & Delfanti, 2015; Irani, 2015). A recent study has empirically demonstrated the positive impact of hackathons on enhancing entrepreneurship competencies as outlined in the EntreComp framework (Jussila et al., 2020).

At the operational level, hackathons are organised as intensive events lasting 24 to 48 hours. Based on principles of participation and peer-to-peer approaches, they generally take place outside formal organisational spaces to create a unique atmosphere, blurring the lines between enjoyment and work, fun and seriousness (Irani, 2015; Söderberg & Delfanti, 2015). In terms of infrastructure, organising a hackathon requires providing information and communication networks, as well as open access to project data (if available), while participants should bring their own computers. Consequently, hackathons can be held in both virtual and physical spaces.

Hackathons are also supported by the European Union:

- The European Commission's Digital Education Action Plan (2021-2027) identifies hackathons as vehicles to "support grassroots innovation" and strengthen the Digital Education Hub.

- A multi-year partnership (2023-2025) has been signed with a Spanish consultancy firm called CARSA to design, implement, and evaluate a Digital Education Hackathon series. The year 2024 marked the fifth edition of DigiEduHack.
- The EUDIS Defence Hackathon 2025, with €2.1 million allocated, integrates educational components to improve cybersecurity skills.

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8

Conclusive research insights

Conclusive research insights

University-Business Cooperation (UBC) is a complex issue, shaped by many different factors such as disciplinary differences, the type of higher education institutions, regional contexts, and changing labour market needs. Given this complexity, it is important to note that this overview does not aim to cover all aspects of UBC, but rather to highlight key findings, challenges, and opportunities identified through the desk research.

The observations summarised in this overview show that, despite the growing recognition of UBC's value, significant barriers remain. Context matters greatly—economic specialisation, regional priorities, and the public or private status of institutions, and their character (Comprehensive, applied, professional, vocational) strongly influence how UBC develops. As a result, cooperation is uneven, and some areas, particularly the humanities, are less engaged. However, it is important to note that in recent years, the growing emphasis on human-centred skills, ethics, digital transformation, and sustainability has created new opportunities for the humanities to play a more active role in UBC activities. In practice, the most common forms of UBC identified include:

- Student mobility through internships, apprenticeships, and placements (5.6%),
- Joint research and development (R&D) projects (5.4%),
- Service contracts for consulting and expertise (4.8%),
- Dual education programmes and co-designed curricula (3.6%),
- Creation of spin-offs and start-ups (around 3%),
- Company participation in HEI governance (3.1%).

While student mobility is the most frequent form of UBC, it does not always prepare students well enough for the realities of work. Many students report that internships often fail to bridge the gap between theory and practice, highlighting the need for more integrated and high-quality cooperation models.

In recent years, the role of UBC has expanded beyond employability and innovation to include contributions to broader societal goals. UBC is now expected to help deliver on Environmental, Social, and Governance (ESG) priorities and to support the New Skills Agenda for Europe. Developing digital, entrepreneurial, and sustainability skills—through frameworks like DigComp, EntreComp, and GreenComp—is increasingly important, but their full integration into UBC activities remains a challenge.

Another persistent issue is that UBC often depends on individual initiatives rather than strong institutional strategies. This reliance makes many cooperation projects fragile and limits their potential to create lasting change. Building more systematic support and long-term commitment within universities is necessary.

Creating intermediary structures like science shops, living labs, and open innovation hubs offers a promising way forward. These structures help broaden access to UBC by involving SMEs, civil society organisations, and regional actors, not just large companies. They can also help foster socially responsible innovation and local development.

However, to fully tap into UBC's potential, better ways of measuring impact are needed. Future evaluations should focus not only on how many partnerships exist but also on how they improve graduate employability, curriculum quality, ESG engagement, and regional innovation.

Recognising these needs, the Erasmus Talent & Innovation Labs (ETI Labs) project was launched to support and strengthen UBC. Backed by the Erasmus+ Programme, ETI Labs brings together universities, businesses, and policymakers to create a connected learning ecosystem. By aligning academic training with real-world industry needs, ETI Labs aims to equip students and graduates with the skills and experiences they need to succeed in today's fast-changing economy.

Through innovative forms of cooperation, a stronger focus on key competences, and the creation of new engagement models, ETI Labs aspires to contribute meaningfully to the future of UBC and to help build a more inclusive, resilient, and forward-looking education system.

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