Artur Ochojski, Ricard Esparza Masana (eds)

Handbook on **digital skills** and cross-domain **entrepreneurial competences** for **societal challenges**

Bogucki
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Prologue

The paradigm of higher education has been in constant evolution in recent years, following a long period under a traditional model. At present, various aspects are increasingly considered central in this paradigm, including elements such as competency-based education, interdisciplinarity, and the consideration of social and economic challenges as the basis for learning development. The European Union seeks to be a pioneer in these areas, and various initiatives, both from European institutions and member states, contribute to advancing models of higher education to address these elements. These initiatives include funding for projects to promote teaching innovation in universities and other higher education institutions.

The DIGI-SOC project, co-funded by the Erasmus+ programme of the European Commission and led by the University of Economics in Katowice (PL), is an example of these initiatives. The project, concluded in 2023, allowed for discussions and the exchange of best practices, as well as the design of pilot actions in the field of digital and entrepreneurial competency education to address societal challenges. Within the framework of the same project, we present this handbook, which aims primarily to contextualise the rationale for these elements and propose and discuss practical initiatives for competency-based education in direct connection with the mentioned societal challenges. However, the reader should not see this book as a project testimony but rather a clear effort to initiate a debate between educators, trainees, and employees on the why's and how's of the cross domain entrepreneurial competences and digital skills while addressed in education and professional careers. Competence in digital skills has become a central element in all fields of higher education in the contemporary digital era. As technology continues to transform the way we live, work, and learn, students who acquire strong skills in using digital tools are better prepared for success in a variety of fields. These skills are essential

for communication and collaboration in an increasingly interconnected world, while also enhancing the employability and adaptability of graduates in an increasingly digitized job market.

When we talk about digital skills, we are not exclusively referring to the use of software and/or computer elements, programming, or digital tool management. Digital skills encompass any activity or process that helps students interact with the digital environment, using digital tools to address problems and develop opportunities, including accessing information, processing, and analysing it, disseminating it, and/or any other process within the virtual framework. Being aware of the significance of this area, we have deliberately placed it at the core of higher education related to and aiming at grand social challenges, and this manual presents the logic behind the understanding of digital skills, as well as examples of practical initiatives on methodologies for introducing this competence into university programmes and/or courses.

Entrepreneurial competence plays a fundamental role in contemporary higher education when we relate it to the need to address the social challenges we have mentioned. In a constantly evolving world with an economy increasingly driven by innovation and creativity, students who develop entrepreneurial skills are better equipped to adapt to changing environments. These skills include the ability to identify opportunities, solve problems innovatively, make informed decisions, and take calculated risks, all of which are highly valued in the workplace. Therefore, entrepreneurial competence is not only understood as the development of skills for starting businesses, but we should consider this concept as students' ability to identify social and/or business needs and challenges and devise possible solutions through projects (of various kinds), with or without profit motives. Higher education programmes have the potential to introduce the development of this entrepreneurial competence linked to the more theoretical aspects of academia, equipping students with a comprehensive theoretical-practical perspective that enables them to understand their environment and propose innovative projects and initiatives. Within the framework of our discussions, entrepreneurial competence has taken a central role, and this manual presents a contextual deliberation of its meaning and relevance, as well as some initiatives to enhance it in higher education.

The development of competencies related to digital skills and entrepreneurial competences is directly aligned with both the interdisciplinary nature of knowledge domains and the consideration of societal challenges. The handbook practically discusses what should be understood by these societal challenges and how to integrate them into higher education, discussing various examples linked to different social domains. The need to develop capabilities and competencies to address these challenges is evident, particularly when we specifically consider the digital skills and entrepreneurial mindset of students. When we consider these challenges in the current context, it is difficult to imagine that they can be addressed from a single thematic area or academic discipline. For this reason, the handbook presents a multidisciplinary perspective, where the discussion and practical cases can be considered from any field of knowledge. This interdisciplinary approach in higher education, coupled with competency and skill development, aims to offer students the opportunity to develop their academic knowledge while acquiring the capacity to excel in their professional development after their university studies.

The handbook also provides a discussion of the institutional implications in the evolution of higher education in the context presented. Not all universities and other institutions of higher education are aligned or have developed the same capacities in the transition towards the paradigm we consider. This is why analysing their role is essential.

The handbook aims to serve as a reference for discussion and assessment of practical cases that consider the points previously mentioned, placing at the forefront the development of digital capability and an entrepreneurial mindset in students to address contemporary societal challenges, inspired by the results achieved through the DIGI-SOC project and the experience coming from other networks we are set in. Higher education institutions are the central element in the development of capabilities for future professionals. The handbook, directed at academic and technical staff of these institutions, intends to provide support in advancing towards a model of higher education where the foundation of education is centred on the development of competencies that see the social context of students, supporting them to be better professionals and citizens.

The editors

PART I – CONTEXTUALISATION: CURRENT TRENDS IN HIGHER EDUCATION

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1. Contextualization

The current context of university higher education, framed in the European Higher Education Area (EHEA) and located in the Bologna and Copenhagen process, which has led to the harmonization of European higher education systems (university and professional training), makes it possible to have a homogeneous system of certifications, of general reference, as well as a set of degrees that are understandable and comparable between countries.

Thus, a whole set of instruments and strategies are articulated that make it possible: supplement to the European degree, credit system (ECTS), common structure (undergraduate and postgraduate), training appropriate to professional profiles and skills, and lifelong learning. In the following figure we collect the main elements of the EHEA (figure I.1).

The most visible part of the EHEA creation process involves, without a doubt, the architecture of the University System (the undergraduate and postgraduate structure and the implementation of the ECTS system). However, we cannot forget that deeper changes are hidden behind this architecture: redefinition of titles and their relationship with the context in which they arise, as well as

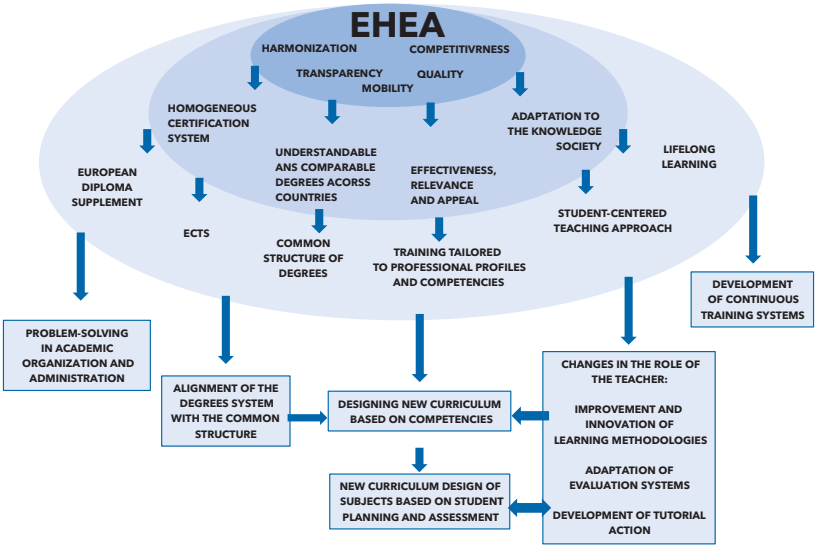

Fig. I.1. The European Space for Higher Education (Tejada et al, 2006: 27)

a thorough review of the teaching-learning process. Therefore, the proposed change is not only structural, although an important part of the change is perceived in the structure of the University. The essence of the change is to focus the actions on the students, on their learning and on the development of the required and possible skills in each case.

This essential change requires a shift in mentality, attitudes, and professional cultures that are deeply rooted in the university context. A change that goes beyond counting teaching hours, study, or work times, three- or four-year titles, etc. It means entering teacher training so that change can take place. There is evidence of recognition of the teaching profession, although the social and institutional value is in research, teaching being a complement to research dedication. Precisely this recognition of the teaching function causes universities to have diversified teacher training programs (initial training and continuous training) from the perspective of training oriented towards professionalization that allows the management of skills from the training process.

To clarify what the EHEA entails, we are going to present the main elements that, in our opinion, should be considered to plan a proposal for challenges to face the university education of the future from the teaching profession. The main lines of action are the following:

1. The profile and skills as a reference for planning, development, and evaluation.
2. The flexibility and polyvalence in the curricular design, which allows a more general formation as well as a more specialized one, transcending the subjects and seeking the integral formation of the students.
3. The student as the centre, since he is the one who learns and the one who needs to adapt to the demands of a professional, social, civic context, etc. In short, a student capable of facing the challenges of our world.
4. The institutional context of operation, since university education occurs in new modalities or emerging university models (Barber et al., 2013) and that transcend the university itself seeking alternation with society and the productive world in the form of internships. professionalizing.
5. Training professionals. That they are a fundamental ingredient in university education, since they must manage competences, learning results, disciplines, teaching-learning activities and learning evaluations from the competence reference.

All the changes and transformations that are taking place in the university context, and taking as a reference what Brunner (2000), Tejada (2002), Armengol, Castro (2004), Marcelo, Estebaranz (2003), Mora (2005), De Miguel (2005), Guardia (2006), Cruz (2008), Mas y Tejada (2013), Fernandez et al., (2019), Castañeda, Selwyn (2019) lead us to consider the following:

- Knowledge is no longer stable, scarce, and slow, which entails the need for constant updating throughout life.
- The new benchmarks for higher education are no longer those of the industrial revolution to have the technological revolution and global opening as benchmarks. Hence the need to develop transversal skills.
- The university institution is no longer considered the only source of knowledge and information.

- Written documents and the teacher's master class are no longer the exclusive means for the training of students.
- The profile of the students has been substantially modified. They have sociocultural characteristics in constant construction and expansion of values. Their relationship with culture has changed, leaving behind the word and the face-to-face social relationship to move on to other forms of relationship through the media and the Internet. Likewise, the variability of the forms of access to the university and the diversity of students from the cultural, geographical point of view, with special educational needs and those who combine work and study make the learning groups even more heterogeneous.
- The work and development of technologies must be an integral part of the curricula, the teaching-learning process and teacher training.
- The introduction and increasing use of digital resources entails changes in the functions and roles of teachers. They become facilitators and managers to know how to use and be in the technologies in the most appropriate way and facilitate and mediate in the teaching-learning processes. The incorporation of technologies makes it possible to extend training actions beyond face-to-face models. Blended and distance modalities, combining synchronous and asynchronous work, as well as work in varied times and spaces, become new training approaches.
- Decentralization in university institutions, with the increase in institutional and teaching autonomy that this implies, and the curricular change, make it necessary for teachers to work as a team, creating teaching teams that plan, develop, and evaluate training, considering the heterogeneity of the students in a diversified learning environment. All these changes entail new roles and a role to be played by the university professor in another, more constructivist line, as a mediator of learning and a researcher and innovator of his own teaching action.
- Implementation of new degrees to adapt to new challenges, which means incorporating into the degree architecture elements that favour curricula flexibility: open

degrees, minors that combine different fields of knowledge (Science minors for Humanities students or Humanities for Science students, interdisciplinary minors, etc.). In short, degrees that offer other training and transfer opportunities, such as challenges, micro-modules and other activities that may give rise to micro-credentials or partial credentials.

- Recognition at the university of the value of basic general training (which allows learning throughout life) to subsequently opt for specialization.
- Existence of other possible training scenarios, based on that of the university institution itself, in the non-formal sphere (associations, business organizations, non-governmental organizations, corporate universities, etc.) and other pedagogical agents (internship tutors, guest lecturers, colleagues, etc.).
- A demand for continuous higher professional training of professionals, but also cultural by all sectors of the population, ceasing to be the university a scenario of almost exclusive use of young people to become an institution that offers training to the citizen in the different stages of his life.
- The need to establish a unified model at a European level for the certification of qualifications and skills, facilitating labour and training mobility and the establishment of training policies and itineraries under the concept of lifelong learning.

On the other hand, and in this idea of analysis of the transformations in the university institutions, Zabalza (2002) raises some dichotomies in relation to these changes. These dichotomies are referred to:

- Personal or individual orientation versus contextual or social orientation: The formative approaches derive from the adaptation to individual and social needs. There are moments in which there is a predominance of the individual over the social and vice versa.
- Specialization versus general basic training: This already traditional discussion of carrying out a specialized training is present in the university environment, on many

occasions, unresolved. What is certain is that the new approaches advocate solid basic training, which promotes personal, social, and professional development throughout life in undergraduate degrees, and greater specialization in postgraduates.

- The local versus the global: Globalization, as one of the current engines of change in the university, leads us to promote student and faculty mobility, to organize inter-university and transnational studies, in different modalities, face-to-face and virtual.

All these elements that make up the new scenario of the university impose the reorganization and design of a new methodological approach in teaching, where permanent, deep, and situated learning, collaboration and the use of digital resources as means for blended work already distance, become the main axes of discussion and work in university education.

Specifically, the changes that affect teaching have to do with the demand for greater clarity in the definition of learning outcomes based on competencies, since training will be based on these, on the change in the organization of learning and training, in a new role of teaching media and resources and teachers.

The role of the actors in university teaching and learning, student, and professor, takes an important turn, so the change of attitudes and mentality of both is crucial for the implementation and development of this new educational approach that focuses on the competitions:

- Teaching will be centred on the student, preparing them, above all, for autonomous learning.
- The role of the teacher changes completely since, from being focused on the mere transmission of content, it becomes the manager of the learning process of the students. One that helps mobilize resources to achieve competent performances.
- Changes in the organization of learning, in a curricular perspective that reinforces continuity, modularity, interdisciplinarity and the coordinated work of teaching teams.
- A new definition of the educational role of the University, within the framework of training throughout life.

- New role of didactic materials now understood as resources capable of generating high-level knowledge and facilitating deep and autonomous learning. Updated resources that incorporate the new potential of digital technologies.
- A greater importance of managing learning tools compared to the mere accumulation of knowledge.

At present, the professional profile has acquired a strong role in the training of professionals. This reference becomes a mirror where to focus the gaze, in a context where change and need have become the priority reasons for analysis and evaluation when thinking about valid training, relevant to guarantee regional development. and the economic and technological progress of a country. Only in this way is it possible to specify the model in a repertoire of professional profiles, subject to change, but at the same time overcoming the challenges of training and work: transparency, coherence, mobility, versatility, flexibility, convergence, correspondence, homologation, recognition, would be some relevant exponents today.

Hence, for example, the ECTS credit system emphasizes student learning and learning outcomes in terms of competencies. This fact, which can be considered obvious, requires a great change in the teaching conception of university professors and a new conception of qualifications, reviewing the competencies, objectives, learning outcomes and knowledge required in each profession, reviewing and adapt the teaching methodology, restructure the contents of the titles, etc.

For this, universities must work on the definition and construction of a new, more current and innovative teaching model, which is capable of responding to current social, cultural and educational challenges. A teaching model that is characterized by the promotion of significant, deep and situated learning, by the development of citizens with skills such as digital and entrepreneurship, which is committed to flexible training modalities, with collaborative planning and a methodological approach based on the design of active, personalized and cooperative methodological strategies that promote the autonomy and self-regulation of students, with a tutorial action and accompaniment to students so that they can develop their skills.

2. Competences and their meaning in the higher education context

Currently, the logic of competencies takes centre stage when approaching teaching, in terms of planning, development and evaluation. Specific competencies are central to the training of excellent professionals, but so are all those basic, generic, and transversal competencies that contribute to training active, critical, committed, and transforming people and citizens that society demands today.

Specifically, we understand the concept of competence as a set of conceptual, procedural, and attitudinal knowledge that, integrated and mobilized in action and in real situations of the professional and cultural context, allow us to create solutions to current problems, needs and challenges. From this point of view, competency-based training should facilitate the integration of this knowledge and create authentic and real learning situations to transfer and mobilize these competencies in action and in the professional contexts of the professional profile, as well as sociocultural contexts, economic and environmental.

The competency-based training approach has meant progress in the sense of placing more emphasis on the globality of the person's capabilities and rebuilding the training contents in a more contextual and situated logic, less academic and more oriented to possible solutions to challenges posed by social, cultural, economic, environmental contexts and professional settings. The identification of needs, opportunities and challenges will become the starting point for designing and developing training.

In line with Tejada (2005, 2007) and Tejada, Ruiz (2013), the competency-based training approach cannot be reduced to more practical training, as a direct counterpoint to the theorization of university training approaches, but rather involves training people incorporating the experience into the training process itself, without which the competence is not acquired. Opening the training spaces and scenarios (external practices, real situations, challenges, and challenges of the close context) so that people can develop their skills is an essential requirement.

On the other hand, it must be said that one of the most significant implications of the university context is the change produced

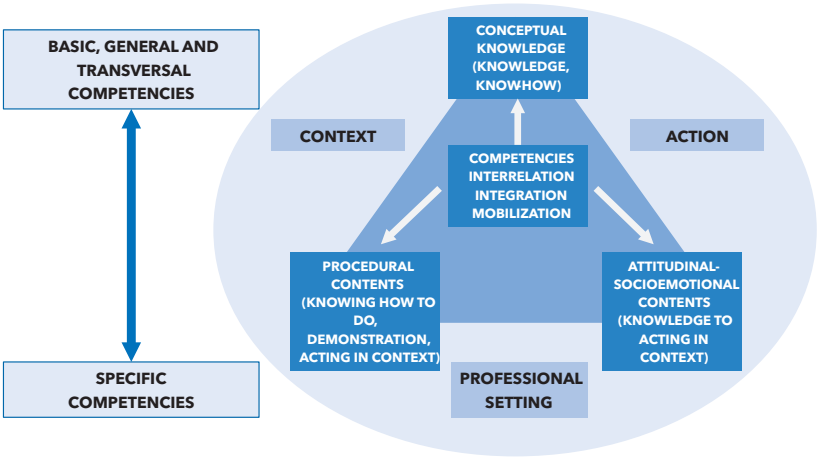

Fig. I.2. Defining elements of competence in the university context.

in the conception of students, teachers, teaching staff and the university itself. The active and responsible role of students in their learning process, the mediating, reflective and critical role of teachers, teaching oriented towards the development of competences (general/transversal and specific), the significant and deep construction of learning and a university committed to the values of justice, freedom, equality, and sustainable development, like ours, become some of the significant changes that justify the importance of innovating in and for university practice.

University education should not only represent a scenario for the training of professionals, researchers, and intellectuals, but a training space that generates critical awareness of reality and that provides tools for participation and social transformation, as well as the development of all those both specific and generic and transversal competences that will allow students to improve their employability (González et al., 2018).

The university must assume its commitment to the sustainable development goals (SDGs) (UN, 2015), actively committing to integrate the principles and values of sustainable development into the curriculum and university teaching practice (Murga, 2015). For this, they must be incorporated into the strategic policies of the university, but also in the teaching-learning processes of university

education. It is in this learning process where teachers are committed to integrating in specific subjects, in a transversal way, skills that promote values based on human rights and sustainable development, proactive attitudes to identify problems and social, cultural, economic impacts, environmental, health, etc. (Portillo et al. 2020), as well as ethical, critical reasoning, entrepreneurship, and digital skills.

These referents of sustainable development guide us to teach and learn to: formulate critical questions, self-reflect on one's own values, to propose more positive and sustainable challenges for the future, to analyse the social, health, environmental, economic, cultural impacts, etc., of our decisions and actions, to consider ethics as the engine of our actions and to collaborate and dialogue in diverse sociocultural contexts with intercultural perspectives.

In summary, we are pointing to a professional teaching profile (Sangrà, 2001) along the lines of a teaching staff: a) more collaborative than solitary, b) who must encourage and promote participation, c) who must recognize and accept the fact that who no longer have possession of knowledge, d) with important organizational skills, e) open to experimentation, and f) with the capacity and ability to modify their methodology. In short, rethink their teaching skills.

3. Planning university teaching

In line with some studies on curricular design for the development of more reflective, deep, self-regulated and situated skills and learning (Correa, 2013; Jonnaert et al., 2008; Moya, Luengo, 2009; Tardif, 2008; Tejada, Ruiz, 2013, Paricio et al., 2019), training designs should focus on adopting globalized and interdisciplinary proposals when organizing content, methodology and evaluation in a different way. Logically, the role and functions of teachers and organizational frameworks are also affected by this design of training actions from a competence logic and the development of reflective, critical, and self-regulated learning.

Coll (2014) points out the need to work on this formative design approach, from a constructivist, sociocultural and contextualized perspective that requires establishing a curriculum that

differentiates what is essential from what is accessory, so that learning focuses on promoting critical reflection on and from action, integrating content, social and cultural experiences that facilitate empowerment and transformation. From this approach, the involvement of learning situations in which the student poses challenges, investigates, inquires, and resolves complex situations connected to the current social world, where said resolution is the result of the mobilization of competencies, of the contrast, must be guaranteed. of knowledge and resources based on reflection and the creation of knowledge in cooperative groups. At the methodological level, these ideas pose new challenges when designing teaching strategies and assessment systems that allow adequate monitoring of the learning process focused on competencies.

As regards the role and functions of teachers, they must work as a team to be able to establish interdisciplinary proposals for the organization of content, methodologies and strategies materialized in cooperative practices, with practical cases, simulated or real, that refer to current problems of the social and cultural context. In addition, with the use of strategies that place the student in the face of self-evaluation and critical reflection on their own learning process, but above all the creation and construction of new knowledge from shared and mediated action between teachers and peers.

More flexible training designs must be assumed, integrating social and cultural experiences, and everything that involves the integration of formal, non-formal and informal teaching and learning. From the organizational point of view, greater flexibility is required in the groupings and configuration of the working groups that allow the development and implementation of cooperative and personalized strategies, of individualized projects and itineraries, of a requirement in the relative to the opening of university educational institutions to the environment (economic, social, cultural and environmental), of the shared construction of the curriculum, thanks to the cooperation and integration of scenarios (university, companies, institutions and community). The following figure presents the elements that must be considered in planning the teaching-learning process based on competencies.

In summary, the keys to planning and designing competency-based teaching (Paricio et al., 2019) would be included in the following ideas:

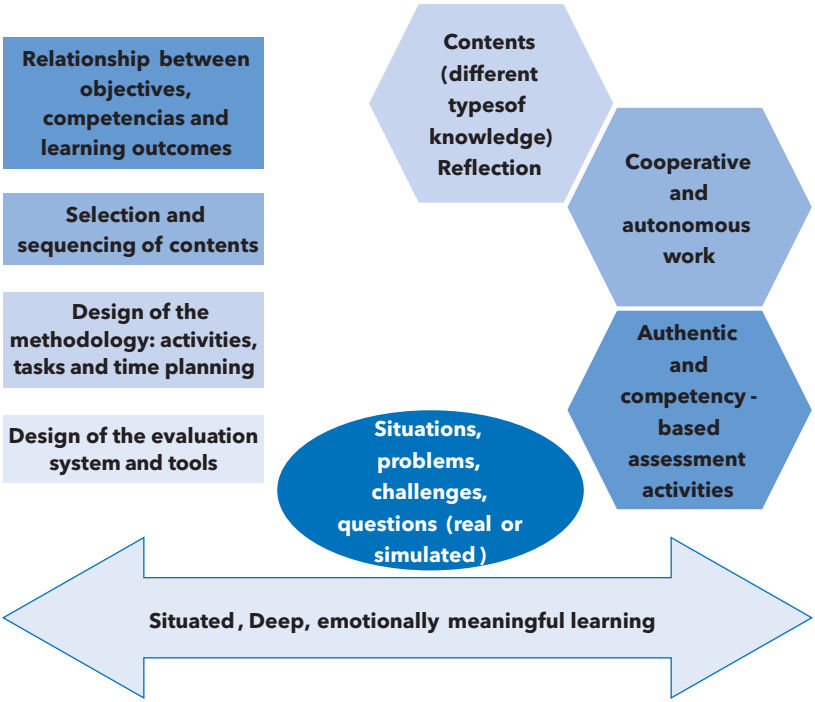

Fig. I.3. Design elements of competency-based teaching.

Updated, explicit and coherent curriculum in its elements (skills and learning results, selection and sequencing of contents, design of the methodology and teaching-learning activities and evaluation system)

Strategic selection of the learning outcomes of the course based on their contribution and relevance with respect to the graduation profiles and the professional, general, and transversal competencies of the profile and the professional family.

Curriculum as a complex system, aligned from the learning results and oriented to training by competencies.

4. Methodologies in the teaching-learning process

When we approach the issue of teaching-learning methodologies in the university context, we must allude to the principle of multivariate methodological strategies. This principle maintains that, for learning to occur, there must be a multiple and varied approach to methodological strategies; that is to say, that the different elements that make up a methodology (activities, resources and means, organization of time and space, contexts, scenarios and environments) are balanced and that they are not repeated in the search for the method, but in the pertinent adaptation to needs, experiences and interests of the student body, according to the proposed learning results, the skills to be developed, according to the contents to be developed and the contexts, scenarios and real or simulated situations. This combination of elements enables us to create multiple actions, a wide variety of methodological proposals.

As illustrated in the following figure, when designing the teaching-learning methodology, it is necessary to reflect on the most opportune combination of time and space, proposing synchronous, asynchronous, face-to-face, or remote activities, in groups, in cooperation or individualized activities and / or autonomous. You must think about the most appropriate resources and means to develop and carry out the activity, the resources that must be varied, taking advantage of the possibilities offered by digital resources (for which the student body must have digital competence). All these activities, times, spaces, and resources must be adequately combined to design and develop projects, solve problems, analyse, and solve challenges, share, and collaborate with others, and develop actions with the community, through service learning.

Competence-based training is key to comprehensive training. Already in the very definitions of competence, reference is made to the integration and combination of knowledge (to know, to know how to do, to know how to be/be), of mobilization and implementation, of action, of experience and of the context of action. Hence, the methodological approach for the development and acquisition of competencies must start from and be supported by experience, analysis, and reflection in and from practice, social interaction with

colleagues and the search for creative solutions to social challenges. cultural, economic, environmental, etc.

Following the approaches of Tejada (2007), it is worth highlighting some psycho-pedagogical principles to consider when designing and developing methodological strategies:

- Starting from the closest reality, integrating experience, action, and context – global and integrated approach.
- The student as the centre of action.
- Degree of responsibility-autonomy and self-regulation
- Reflection in and from action as a motor and improvement "in" and "before" teaching-learning situations.
- Develop observation and analysis and the practical-theory relationship.
- Expansion of meanings and interests, knowledge in action.
- Learning as a socio-cognitive process.
- Teamwork.
- Inquiry Learning.
- Engaged and emotionally significant learning.

The assumption of these principles places us directly in socio-constructivism, in line with what was previously noted. These principles implicit interdisciplinarity and globality, reflection and research, construction, alternation, application, distinction, meaning, coherence, and integration in line with what was proposed by Lasnier (2000).

In the same way, it will be necessary to opt for a global and integrated approach, based on methodological strategies that take the student body as the protagonist, in addition to the importance of the context, action and experience as we have been maintaining.

We cannot forget the methodologies based on the relationship between experience-action-context and on the resolution of problems, situations, or challenges, such as case studies, problem-based learning (ABP) or challenge-based learning (ABR) and cooperative learning. (García et al., 2017; Olivares, Heredia, 2012; Tejada, 2021), where students investigate, investigate, apply, analyse, discuss, reflect, make decisions about the solution(s) or alternatives based on group discussions and previous readings and during the resolution of problems and/or situations, challenges or ethical dilemmas posed, of interest and need in the social, economic, cultural

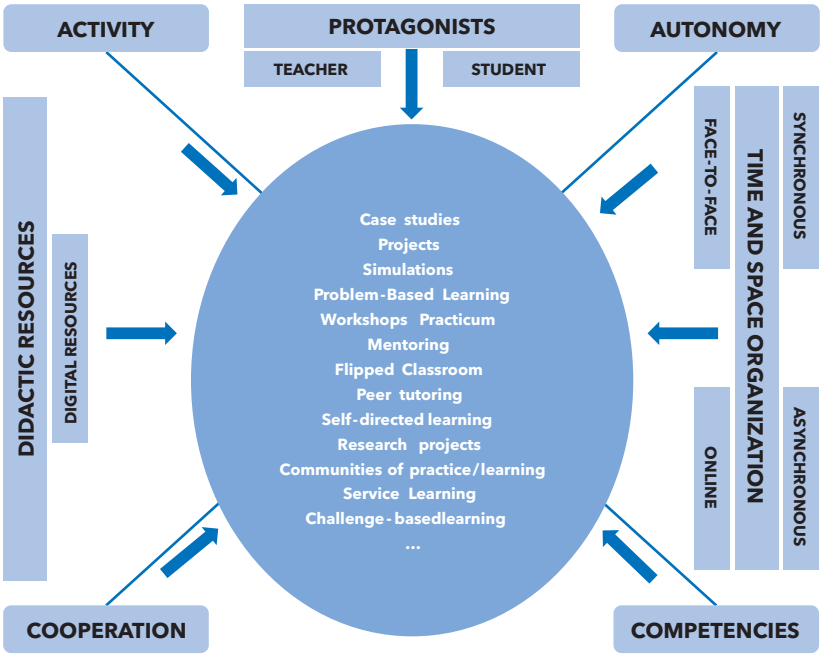

Fig. I.4. Multi-variety of methodological strategies.

or environmental context (Fidalgo et al., 2017). In addition to the implication of the Service-Learning methodology (Ruiz-Corbella, Garcia-Gutierrez, 2019; Mayor Paredes, 2020; Tejada, Ruiz, 2013), as a core strategy for promoting skills related to commitment and social responsibility.

5. The evaluation of learning and skills

As has been shown, in the university context the student is responsible for their learning, among other reasons, because competencies are the guiding axis of the training process. This responsibility implies that the evaluation must undergo substantial changes in its approach. As Falcó (2023) openly states, it is about moving from qualification to evaluation. This evolution has several implications in the university environment that we will see below.

First, we need to consider different functions of evaluation. Thus, we must distinguish between assessment of learning, assessment for learning and assessment as learning. The evaluation in the context of university higher education has focused on the evaluation of learning, understanding this as a summative evaluation, carried out at the end of the teaching-learning process, whose purpose is to verify the achievement of the objectives, competences and/or results. intended learning outcomes and for the ultimate purpose of grading or assigning a score. However, when the competences are the referent of the formative process and the student is in the centre, the evaluation of the learning is insufficient, being necessary an evaluation for the learning.

When we activate the evaluation for learning, as a complement to the evaluation of learning, we are giving prominence to the student who, assuming his active role, must participate openly in said process. This participation in the evaluation, necessary when our referent is in the competences, allows us to propose different evaluation modalities: teacher evaluation, peer evaluation, self-evaluation, and peer evaluation (Rodríguez et al., 2013).

Evaluation as learning emphasizes, as Falcó (2023) emphasizes, on feedback, it is its formative value, promoter of learning. Thus, when learning is competency-based, this evaluation as learning is more than necessary and becomes mandatory, with feedback being one of the most important tasks that teachers must promote in the evaluation process. Table I.1 can be consulted to illustrate the importance and possibilities of feedback. It is with feedback that the learning result (demonstration of competence) becomes significant and allows the student to reflect on his acquisition process and establish lines of action. improvement and future development from a competence perspective.

Table I.1. Participated feedback strategies (Cano, 2020: 183–184).

What does teacher do	What the student or group of students does	Feedback
Review the set of exercises and determine the most frequent mistakes. Discuss them orally in class.	They check how they did the exercise and if they made a mistake.	oral and collective

What does teacher do	What the student or group of students does	Feedback
Review the student's homework by commenting on the electronic file directly.	Read the comments and must respond by attaching to the final work an explanatory document of the modifications made considering the teacher's comments.	Written and electronic.
Review the first version and give oral feedback to the group of students in tutorials	They take notes of what is good, what is not so good and the agreements they reach to incorporate them into a second version.	Oral by the teacher, but students write it down on an ad hoc form.
Returns the correct results of a problem	Narrates in writing the difference between how he had solved the problem and how it should have been solved	Written self-assessment by comparison with the solution (examples)
Provides various jobs solved in different ways	Compare how you have solved the job and how others have done it. Take note of resolution strategies different from yours. From there, criteria for good performance can be inferred individually or collectively.	Self-assessment by comparative judgment
It offers scripts or guidance bases that indicate the steps to be taken in a process and help plan the task.	The students plan their work process based on the script, they monitor their work according to whether they conform to the established phases and at the end they assess the degree of follow-up of the indicated process and the usefulness it has for future learning processes.	Individual self-assessment or as a working group

What does teacher do	What the student or group of students does	Feedback
Provide the questions to answer in the form of one-minute papers or as learning protocols.	The student reflects on what has been learned and writes what has been the most significant, what has been understood and what remains to be understood, what has been learned and how has it been learned.	Self-appraisal
Organize the pairs and give the evaluation criteria for the task (and the characteristics of what good feedback is).	Students evaluate each other by applying the criteria. Optionally, students explain in some way what changes they have made because of the contributions of their peers.	Peer evaluation. Sometimes there can be co-evaluation processes that combine peer evaluation with evaluation by teachers, following the same criteria (for example, established in a rubric).

Another important aspect in the evaluation of competences is in the planning of the process, since the evaluation of these based on the learning results supposes to propose evaluation tasks, evaluation instruments, contexts and decision making. These decisions are relevant when the feedback allows us to go beyond the simple rating. The following figure shows the planning flow of the learning assessment from the learning perspective.

As a complement to this evaluation process shown in the figure, it is recommended that the different evaluation activities be planned in the development of the subjects. A planning that should make the evaluation instruments and/or devices visible, the distribution of the leading roles in the evaluation process and the clarification of the necessary and inevitable feedback that transforms the evaluation into a genuine learning process and not only in information from the achievements or qualifications (Navío, 2022).

6. Summary

All these ideas raised, on how the teaching-learning processes should be characterized in the current university context, require

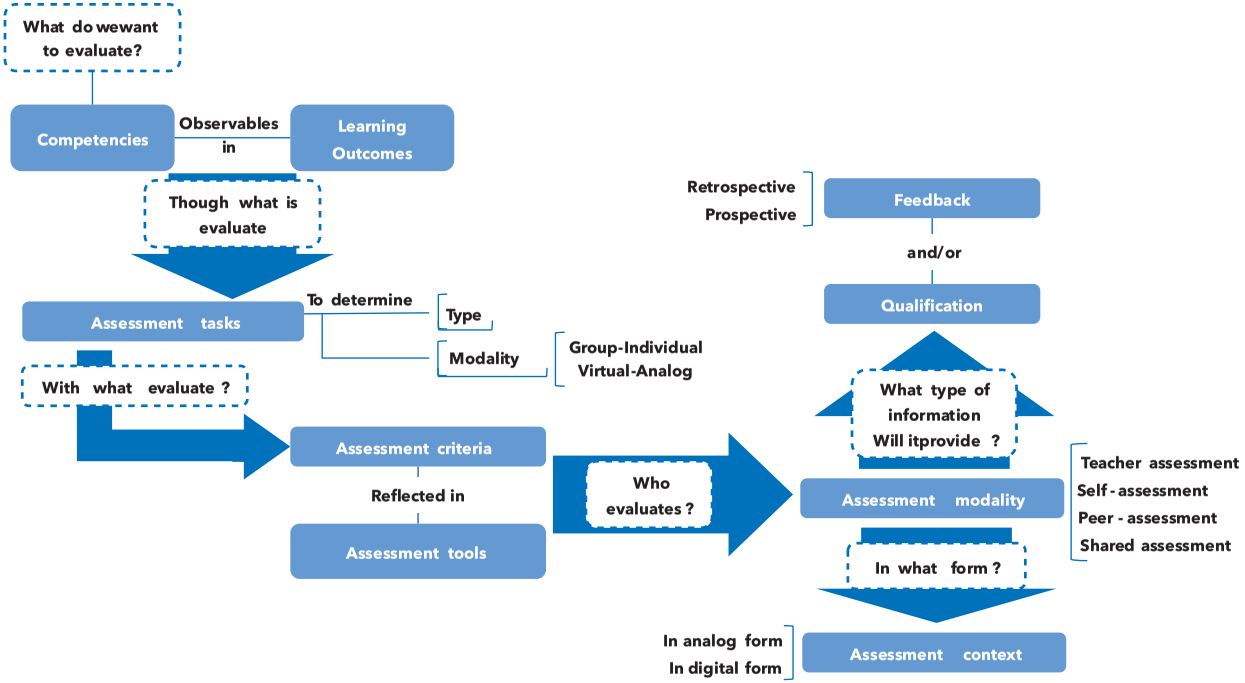

Fig. I.5. Elements to consider when planning the evaluation (Quesada, Rodríguez and Ibarra, 2017: 56).

that the student body develop, acquire, and apply digital competence to make the most of the training and educational possibilities of the environment. For this they must be trained in digital skills.

In the same way, it will be necessary to design learning environments that help students to identify and detect needs, opportunities, and challenges, who know how to analyse them to propose creative and critical projects and solutions. All this will not be possible if the student body does not develop and acquire skills related to entrepreneurship such as autonomy, responsibility, initiative, self-motivation, collaborative, cooperative and network work, the ability to create a project that provides creative solutions to the opportunities or challenges detected and analysed in the environment.

The changes taking place within university education go beyond just the structure of university degrees, and some key elements, discussed throughout the chapter must be underlined. The transformation occurring in university education extends beyond mere alterations to degree structures; it encompasses a shift towards student-centred learning with a focus on cultivating competencies and skills. This necessitates changes in teaching methodologies and instructor training. Central to this shift is the emphasis on competencies, which entails integrating conceptual, procedural, and attitudinal knowledge to tackle real-world problems, fostering a more contextual and situated training approach.

Effective planning of teaching involves universities establishing clear learning outcomes rooted in competencies, necessitating flexible curricular designs that incorporate social and cultural experiences. Collaboration among teachers is crucial to developing interdisciplinary proposals that align with this approach. To foster competencies, a diverse array of teaching methods, such as case studies, problem-based learning, and service learning, is required. Actively engaging students in self-evaluation and reflective practices on their learning process is paramount. This competency-focused paradigm prompts a re-evaluation of assessment methods, transitioning from traditional grading to comprehensive evaluation encompassing, for instance, peer evaluation, self-evaluation, and constructive feedback. Evaluation tasks must be designed to assess students' competencies and decision-making abilities.

In conclusion, the pursuit of developing competencies and skills necessitates a holistic reimagining of teaching approaches, methodologies, and evaluation processes within universities. This transformation aims to equip students with the aptitude required to meet the evolving demands of the 21st century, emphasizing student-centred, contextual, reflective, and competency-driven learning.

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PART II – SOCIETAL CHALLENGES AS DRIVERS FOR INFORMED EDUCATION

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1. Grand societal challenges

Grand societal challenges (GSCs) are big social, economic, and environmental issues that have potential or actual negative impact on well-being of large population and extend beyond national borders. Responses to GSCs need to be based on collaborative efforts a wide range of public and private stakeholders (Ferraro et al., 2015, p. 365; Voegtlin et al. 2022, p. 1–2).

GSCs are usually recognized by academics and practitioners and then become the concern of policymakers representing international organizations. United Nations has adopted a set of 17 Sustainable Development Goals (SDGs) to end poverty, reduce inequalities, combat climate change, protect ecosystems, ensure access to renewable energy etc. (UN 2015). Meanwhile The Commission of European Union launched five EU Mission that will aim to deliver solutions to key global challenges by 2030:

1. Adaptation to Climate Change: support at least 150 European regions and communities to become climate resilient by 2030.
2. Cancer: working with Europe's Beating Cancer Plan to improve the lives of more than 3 million people by 2030 through prevention, cure, and solutions to live longer and better.
3. Restore our Ocean and Waters by 2030.
4. 100 Climate-Neutral and Smart Cities by 2030.
5. A Soil Deal for Europe: 100 living labs and lighthouses to lead the transition towards healthy soils by 2030.

To tackle this challenges EU established Horizon Europe – research and innovation funding programme that strengthen international cooperation and create more impact through mission orientation and citizens' involvement.

A review of the tasks defined by international organizations shows that the key challenges are related to climate change, which may cause problems related to the protection of life on earth, in the seas and oceans, food security, and access to clean water. Some challenges appear suddenly and require a quick response. An example of this type of challenge is the COVID-19 pandemic. Another group of challenges is related to the development of new technologies such as artificial intelligence (AI). We are unable to predict what impact AI development will have on the labour market, human security and privacy, property rights system or freedom and democracy.

There are three analytical facets of GSCs:

1. complexity,
2. uncertainty,
3. value-laden (evaluative) character (Ferraro et al., 2015, p. 365–367; Voegtlin et al. 2022, p. 4–7).

Complexity means that challenges are characterized by many interactions and nonlinear dynamics, and they include feedback loops and rebound effects. It exceeds any comprehensive analysis and cannot be fully understood and are thus difficult to address.

Uncertainty means that challenges and their evolution are difficult to forecast for the actors, who cannot properly predict possible future states relying on unstable preferences of people involved.

Value-laden (or evaluative) means that challenges can be approached and understood in multiple ways depending on the value system or level of awareness the significance of GSCs.

2. Population aging as the societal challenge.

Population aging[1] is a shift in the distribution of population towards older ages. It is reflected in an increase in the population's mean ages, and a rise in the proportion of the population composed of elderly people. Population aging process may proceed at a different pace depending on country, region, or city, but it is the global issue because the world's population is aging rapidly, and older adults compose a large proportion of the globe population than before. For the first time in history, and probably for the rest of human history, people aged 65 and over will outnumber children under age 5 (National Institute of Aging 2007, p. 3). According to World Health Organization (WHO) between 2015 and 2050, the proportion of the world's population over 60 years will nearly double from 12% to 22% and reach 2.1 billion people. The number of persons aged 80 years or older is expected to triple between 2020 and 2050 to reach 426 million[2].

Three major factors are driving this transition: decreasing fertility, increasing longevity, and the aging the large population cohorts (Bloom et al., 2015, p. 80). Birth rate have dropped because of effective birth control, increased child survival, and cultural changes. In many countries birth rate is below the long-term replacement rate of just over two children per woman. Improvements in older age mortality were mainly attributed to decreases in tobacco use and in cardiovascular disease mortality (Mathers et al., 2014). In the United States and Europe post-war baby boom generation are moving from middle into older ages (Bloom et al., 2015, p. 81). While population aging started in high-income countries such as Japan where 30% of the population is over 60 years old, the aging of societies is now being observed in all countries. In 2050, 80% of older people will be living in low- and middle-income countries.

Population aging has implications for nearly all sectors of society, including labour and financial markets, the demand for goods

[1] Both aging and ageing is correct. The first one is much more acceptable to American English use, the second one in British English. Undertaking studies on population aging, we should remember that some scientific journals, institutions, and reports will have the word aging in the titles, while others ageing.

[2] https://www.who.int/news-room/fact-sheets/detail/ageing-and-health

and services, such as housing, transportation, and social protection, as well as family structures and intergenerational ties. Population aging is accompanied by several challenges (Bloom et al., 2015; National Institute of Aging, 2007):

- growing diseases burden and the issue of multimorbidity especially in the case of noncommunicable diseases such as heart disease, cancer, hearing loss, cataracts, osteoarthritis, diabetes, Alzheimer's, dementia, and complex health states commonly called geriatric syndromes,
- the structure of households is changing. As people live longer and have fewer children, 1–2-person households begin to dominate the structure. There may be a reduced capacity for informal caregiving within families. This can lead to increased demand for formal caregiving services and potential social isolation among older adults,
- patterns of work and retirement are shifting. Shrinking ratios of workers to pensioners and people spending a larger portion of their lives in retirement increasingly strain existing health and pension systems,
- slowing economic growth because of higher public spending on health care, expanses for nursing homes etc. Maestas et al. (2023) estimated the impact of population aging on growth in GDP per capita for 1980–2010 in the United States. They found that each 10% increase in the fraction of the population ages 60+ decreased per-capita GDP by 5.5%. One-third of the reduction arose from slower employment growth; two-thirds was due to slower labour productivity growth. Labour compensation and wages also declined in response. Their estimate implied population aging reduced the growth rate in GDP per capita by 0.3 percentage points per year during 1980–2010,
- falling labour supply and straining existing pension and health care systems and weigh down younger generation in the process (many government pension systems promise pensions based on future tax receipts. In that case the increasing money transfers to the elderly people must be financed through the tax burden on young workers),
- lower saving rates because older generations do not work and save as much as younger adults do. Economies must

pay "dividend" back to finance the elderly people consumption in old age,

- digital exclusion poses a significant challenge for older people. As technology continues to advance at a rapid pace, many seniors find themselves struggling to keep up with the digital revolution. This exclusionary gap not only limits their access to essential services and information but also hinders their ability to participate fully in society.

Population aging is a challenge characterized by complexity and interdisciplinarity. It deals with medical issues related to the development of geriatrics and care for the elderly. Aging does not only concern older people, but also younger generations, who either take up the challenge of taking care of the elderly directly or indirectly bear the costs of aging society. Caring for elderly family members requires medical knowledge and practical skills. In addition, mental preparation is important. People caring for the elderly need to have time to rest and live their own lives. Therefore, systemic support from the state is required. Without this support people caring for the elderly may experience depression and occupational burnout. In this case, an analysis of the impact of aging on households and society cannot be overlooked. Population aging changes the demographic structure of a country, region, or city. One effect may be to increase the bargaining power of older people as voters. Political parties can start to treat retired older people as their main voters and prepare program proposals in such a way as to win their votes. An important argument is also the higher level of participation of older people in elections (Goerres, 2007). All this means that in an aging society, older people have an increasing influence on the results of elections and the directions of development of individual countries. It means that population aging raises questions of fairness and intergenerational equity.

Population aging is also associated with uncertainty. It mainly concerns the impact of population aging on the economy. The progressing change in the proportion between retirees and working people makes it impossible for us to predict how pension systems will function in individual countries. Undoubtedly, one of the greatest tasks for public authorities is to change pension systems in such a way as to ensure a safe and dignified life for the elderly, and at the same time limit the negative effects in the form of excessive fiscal

burdens on young people. Policy responses include increasing the size of the labour force, mainly by raising the retirement age; investing more in children to increase the quality and productivity of the future labour force; and public programs that promote fertility by facilitating market work for women with children (Lee, 2016). Anticipating the impact of future technological advancements on population aging is difficult. Breakthroughs in medical treatments, disease prevention, and health interventions may lead to changes in mortality rates and the health status of older adults.

Population aging is also value-laden that means it can be approached and understood in different ways depending on the value system. Cultural aspects may be relevant in this context. Depending on the culture, different communities treat the elderly differently. There are countries where multi-generational families are the dominant form, in which children live with their parents and take care of them in old age. In other countries, older people mostly live in one-person households, having looser relationships with their children. In relation to the elderly, we can also encounter a behaviour called ageism. Ageism is a form of prejudice or discrimination based on a person's age, typically directed towards older adults. It involves stereotyping, stigmatizing, or marginalizing individuals or groups based on their age, leading to unfair treatment, limited opportunities, or exclusion from certain activities or roles (Lytle, Levy, 2019; World Health Organization, 2021). Another reason why population aging should be considered value-laden is the right to dignity and autonomy of aging individuals. Different values and cultural perspectives can shape attitudes towards end-of-life care, assisted living, and healthcare decisions for older adults.

Global aging is a success story and people today are living longer and generally healthier lives (National Institute of Aging, 2007, p. 4). Older people contribute in many ways to their families and communities. Older people can help raise their grandchildren, share their knowledge and experience with young employees, undertake social activities that develop long-neglected passion and at the same time build and integrate the local community. There is no typical older person. Some people in their 80s have the mental and physical abilities of 40–50-year-olds, while others age much earlier. It means that a comprehensive public health response must address this wide range of older people's experiences and needs.

This includes increasing access to geriatric care, specialized medical services, and preventive healthcare. Another important element is to promote social inclusion and community engagement in creating a support network for older people. Examples of such activities are Universities of the Third Age Movement, which are aimed at continuing of enjoyment of learning subjects of interest to the elderly people (Formosa M. (Ed.), 2019). The same intergenerational programs, which helps bring seniors and young people together such as mentoring programs, volunteering at a school library, community gardens etc. Intergenerational programs could serve as key health promoters among elderly people by decreasing the risk of social isolation and loneliness (Murayama et al., 2015). An important aspect is the use of technological innovations in improving the quality of life of the elderly people. For instance, smart homes can be used to support older people to perform daily activities and help them maintain their social relationships (Turjamaa et al., 2019). Another example is the adaptation of urban infrastructure to the needs of older people. This involves improving transport accessibility by curbs cuts, installing wheelchair ramps, and building lifts etc. The creation of age-friendly environments worldwide has been promoted by The WHO Global Network of Age-Friendly Cities and Communities.[3] Among characteristics that contribute towards an age-friendly cities are multi-stakeholder collaborations, government commitment, inclusion of older persons and policies that tackled both the physical and social environments (Fitzgerald, Caro, 2014; Steels, 2015).

[3] https://extranet.who.int/agefriendlyworld/

Take-aways:

- Population aging process may proceed at a different pace depending on country, region or city, but it is the global issue because the world's population is aging rapidly, and older adults compose a large proportion of the globe population than before.
- Three major factors are driving population aging: decreasing fertility, increasing longevity, and the aging the large population cohorts.
- Population aging is accompanied by several challenges such as growing diseases burden, slowing economic growth, lower labour supply and straining existing pension and health care systems, ageism.
- Despite the challenges related to the aging of the society, this process should be treated in terms of opportunities. Older people can add a lot of value to social and economic development. The state should implement a policy modifying the health care system and the pension system and prevent the process of exclusion of the elderly people.

Your key reading:

- Global population aging: Facts, challenges, solutions & perspectives by Bloom D.E., Canning D., Lubet A. 2015. Daedalus, 144(2): 80–92.
- Macroeconomics, aging, and growth by Lee R. (In: Handbook of the economics of population aging. North-Holland, Vol. 1, p. 59–118, 2016).
- Why Population Aging Matters. A Global Perspective by National Institute of Aging (Publication No. 07-6134, March 2007, 1–32, 2007).

3. Poverty as the societal challenge

The first Sustainable Development Goal defined by the United Nations in Agenda 2030 aims to End poverty in all its forms everywhere[4]. Some other Sustainable Development Goals are also related to poverty: zero hunger, Quality education, Gender quality, Affordable and clean energy, Reduced inequalities. This shows that the problem of poverty is complex and involves issues such as: inequality and social exclusion, lack of accessibility, discrimination and segregation, gender disparities.

In the past, poverty was mainly defined as insufficient income to buy a minimum basket of goods and services. Nowadays, the term is usually understood as the lack of basic capabilities to live in

[4] https://sdgs.un.org/2030agenda

dignity. This broader definition considers a wide range of poverty dimensions such as hunger, poor education, discrimination, vulnerability, and social exclusion. Poverty may be also defined as a human condition characterized by sustained or chronic deprivation of the resources, capabilities, choices, security, and power necessary for the enjoyment of an adequate standard of living and other civil, cultural, economic, political, and social rights. (UN. Committee on Economic, Social and Cultural Rights, 2001). Poverty is usually measured as either absolute or relative poverty. In both cases, a poverty threshold, or poverty line, is defined, and people falling under this line are considered poor.

Absolute poverty means poverty defined using a universal baseline with no reference to other people's income or access to goods. The failure of meeting this baseline thus means that the individual is poor. Absolute poverty can be defined as the state in which a subject lacks the means to meet his or her basic needs including food, water, shelter, basic education, and basic medical care. Extreme poverty is typically defined as a state in which a person lacks access to all, or several, of the goods needed for meeting these basic needs (Eskelinen, 2011). According to The World Bank the international poverty line is set at $2.15 per person per day using 2017 prices. This means that anyone living on less than $2.15 a day is in extreme poverty. The World Bank also produces statistics on the number of the people in the world living below these poverty lines. In 2020 the global extreme poverty rate reached 9.3 percent of global population that means that in extreme poverty live more than 700 million people[5]. The Poverty and Inequality Platform (PIP) is an interactive computational tool that offers users quick access to the World Bank's estimates of poverty, inequality, and shared prosperity. PIP provides a comprehensive view of global, regional, and country-level trends for more than 160 economies around the world (World Bank, 2023)[6]. Relative poverty is a situation in which a person or a household is poor when their income and resources are worse than what is thought to be adequate or socially acceptable in the society in which they live. According to Habitat for Humanity relative poverty is when households receive 50% less than

[5] https://www.worldbank.org/en/topic/poverty/overview#1

[6] https://pip.worldbank.org/home

average household incomes. Both absolute and relative poverty means social exclusion. Poor people are not able to participate in economic, social, and cultural activities that are considered as the norm in the society, and their enjoyment of fundamental rights may be restricted[7]. In more developed countries, it's being excluded from what constitutes normal daily life: Internet to access jobs or public services, the proper clothes to find that job, paying for education and access to decent housing (respiratory diseases is one of the most common symptoms of poor housing)[8].

Poverty is a very complex problem which it is characterized by many interactions. Individuals always suffer because of poverty, but the problem affects households, social groups and in the case of the poorest places in the world, entire nations. In the absence of the means of subsistence in the household, children suffer a great loss. They have limited chances to get education, develop passion and personal development. In this case, children often do not have proper behaviour patterns and unequal opportunities from the very beginning mean that they often inherit poverty. Marginalized groups in particular experience poverty. These are groups or communities excluded from mainstream social, economic, educational, and/or cultural life. Examples of marginalized populations include, groups excluded due to race, gender identity, sexual orientation, age, physical ability, language, and/or immigration status. Marginalization occurs due to unequal power relationships between social groups (Sevelius et al., 2020). The problem of marginalized groups often has a spatial dimension taking the form of districts with a large percentage of poor households. An example of this are slums (Davis, 2006). The complexity of poverty manifests itself in the combination and accumulation of many problems.

Poverty affects the health of children and adults (Falkingham, Namazie, 2002). Poverty affects the housing conditions. Poor households are unable to meet their housing needs based on the market mechanism. This can lead to homelessness, the threat of eviction or energy poverty (Stephens, Leishman, 2017; González-Eguino, 2015).

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7 https://www.coe.int/en/web/compass/poverty#5

8 https://www.habitatforhumanity.org.uk/blog/2018/09/relative-absolute-poverty/

Poverty can be uncertain in several ways. Poverty levels can fluctuate due to changes in income. People may experience periods of poverty due to job loss, illness, natural disasters, or other unexpected circumstances that affect their ability to earn a sufficient income. Poverty can also be uncertain in terms of its transmission from one generation to the next. While poverty tends to have a cumulative effect, meaning that individuals who grow up in poverty are more likely to experience poverty as adults, this pattern is not deterministic. Some individuals and families can break the cycle of poverty through education, access to opportunities, and other factors, introducing an element of uncertainty in determining whether someone will remain in poverty or not. Poverty is not a static phenomenon and can vary significantly across countries, regions, and communities. Factors such as natural disasters, conflicts, and political instability can exacerbate poverty levels in specific areas, leading to increased uncertainty.

Discussions around poverty often involve value judgments, which can introduce value-laden elements into the discourse. Judgments about poverty often involve subjective assessments of what constitutes a decent standard of living. Different societies and individuals may have varying opinions on what level of material well-being is considered acceptable or sufficient to meet basic needs. Furthermore, societal attitudes and cultural norms can influence the interpretation of poverty. There may be differing views on the causes of poverty, the responsibilities of individuals and governments in addressing it, and the best strategies for poverty alleviation. These perspectives can be influenced by moral, ethical, and political values.

Poverty is such an important and current topic that academics, politicians, and social activists deal with it. It is impossible to discuss the entire scientific achievements in the field of poverty research here, therefore the achievements of only a few scientists are discussed. It is worth focusing on the work of people who have won Nobel Prizes for their research on poverty. There have been the following Nobel Laureates who have addressed the issue of poverty:

- The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 1998 was awarded to Amartya Sen "for his contributions to welfare economics".

- The Nobel Peace Prize 2006 was awarded jointly to Muhammad Yunus and Grameen Bank "for their efforts to create economic and social development from below".
- The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2015 was awarded to Angus Deaton "for his analysis of consumption, poverty, and welfare".
- The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2019 was awarded jointly to Abhijit Banerjee, Esther Duflo and Michael Kremer "for their experimental approach to alleviating global poverty".
- One of Amartya Sen's most influential contributions is the development of the capability approach. This approach focuses on people's capabilities and freedoms to live the lives they value. Sen argues that poverty should be understood not just in terms of lack of income or resources but also in terms of the opportunities and capabilities individuals must achieve well-being. Sen has also made contributions to social choice theory. He has highlighted the importance of individual rights, freedoms, and social justice in the assessment of social welfare and poverty reduction policies. His efforts stem from his interest in questions of distribution and a lot of society's poorest members. Sen's studies have included famines, to create a deeper understanding of the economic reasons behind famine and poverty.
- Muhammad Yunus, an economist, and social entrepreneur is widely known for his pioneering work in the field of microfinance and poverty alleviation. His main contribution lies in the development and popularization of microcredit and the establishment of the Grameen Bank. Yunus is credited with developing the concept of microcredit, which involves providing small loans to individuals, particularly those living in poverty or without access to traditional banking services. He recognized that many people, especially women, were trapped in poverty due to their lack of access to credit. Yunus believed that providing small loans without collateral and at affordable interest rates could empower individuals to start or expand small

businesses, generate income, and improve their living conditions.

- Angus Deaton's greatest contribution is to integrate statistics, sociology, and economics. Deaton has developed novel methods for measuring and analysing consumption patterns and their relationship to welfare. He emphasized the importance of accurately measuring household consumption to assess living standards and poverty levels. His work on consumption data has improved our understanding of poverty dynamics, inequality, and economic development. Deaton has also explored the intersection of health and economic development. He has investigated the relationship between health outcomes, income, and poverty, highlighting the importance of good health as a crucial component of well-being. His research has contributed to understanding the complex interplay between health, poverty, and economic development. Deaton's focus on household surveys has helped transform development economics from a theoretical field based on aggregate data to an empirical field based on detailed individual data.
- Abhijit Banerjee, Esther Duflo, and Michael Kremer have introduced a new approach to obtaining reliable answers about the best ways to fight global poverty. Their research and contributions have focused on applying rigorous experimental methods to understand the causes of poverty and evaluate the effectiveness of poverty reduction interventions. Banerjee, Duflo, and Kremer have extensively used randomized controlled trials to study poverty-related issues. RCTs involve randomly assigning individuals or communities to different treatment groups, allowing researchers to isolate the causal impact of specific interventions or policies. It involves dividing this issue into smaller, more manageable, questions. As Duflo wrote in her Prize Lecture: "It is useful to start with the strawman: what the process of policy influence does not look like for researchers conducting randomized controlled trials. The strawman views the researcher as running a small, well-designed, and tightly controlled experiment (say,

with 100 treatment schools, 100 control schools), implemented by excellent partners. She uncovers some results. If they are negative, she shelves the paper. If they are positive, she prepares a shiny policy brief and peddles it to policymakers, who adopt and scale up the policy." (Duflo, 2019, p. 441).

All the Nobel Laureates mentioned above have a very valuable advantage in the context of poverty studies. They are the authors of books that explain the causes and effects of poverty in an accessible form and give tips on how to deal with this challenge in practice.

Take-aways:

- There are several definitions of poverty depending on how broadly we look at this concept. Poverty could be defined as insufficient income to buy a minimum basket of goods and services. The term could be also understood as the lack of basic capabilities to live in dignity. Poverty may be also defined as a human condition characterized by sustained or chronic deprivation of the resources, capabilities, choices, security, and power necessary for the enjoyment of an adequate standard of living and other civil, cultural, economic, political, and social rights.
- Poverty is usually measured as either absolute or relative poverty. In both cases, a poverty threshold, or poverty line, is defined, and people falling under this line are considered poor.

Your key reading:

- Poor Economics. A Radical Rethinking of the Way to Fight Global Poverty by Banerjee & Duflo (New York, NY, PublicAffairs, 2011).
- Good Economics for Hard Times by Banerjee & Duflo (New York, NY, PublicAffairs, 2019).
- The great escape. Health, Wealth, and the Origins of Inequality by Deaton (Princeton University Press, 2013).
- Measuring health and poverty: a review of approaches to identifying the poor by Falkingham & Namazie (London, DFID health systems resource Centre, 7(1), 1–70.2002).
- Banker to the Poor. The Story of the Grameen Bank by Yunus (Aurum Press, 2003).
- Development as Freedom by Sen (New York, Oxford University Press, 1999).

4. Industry 4.0 as the societal challenge

Industry 4.0 as a concept was initially presented in Germany (in 2011) as an idea promoted by the country's industrial and manufacturing sector. However, it was coined to be a part of the German government's policy for high-tech and advanced manufacturing, based on the digitization of industrial production. Obviously, the number "4.0" can be traced back to the idea of industrial revolutions which build one upon another (the first: mechanization of production through water and steam power; the second: electricity, mass production, and the assembly line; the third: computers, automation, and information technology). Thus, Industry 4.0 represents the next phase in the evolution of industrial production, characterized by the integration of digital technologies and data exchange. It stands for: smart machines, interconnected systems, and real-time data analytics enabling more efficient and flexible manufacturing processes.

Politically, the idea gained not only the German, but a worldwide recognition. With public research agendas, taxation schemes and other policy instruments or strategic frameworks aimed at boosting digitalization, automation, and connectivity in business. Also, the corporate sector reacted with own investments and capacity building programs. One might even consider that a new business sector emerged from IT and engineering companies, known as Industry 4.0 digital entrepreneurs (Gwosdz et al., 2022) or as Industry 4.0 supply chain integration (Tiwari, 2021). Industry 4.0 has also became an important area of support within the European Union's concept of the European Digital Innovation Hubs (European Digital Innovation Hubs, n.d.).

There are a few perspectives due to which Industry 4.0 is considered as a societal challenge worth tackling in various forms of education. One of them is its relation to the technological disruption. Industry 4.0 involves the convergence of technologies like artificial intelligence (AI), robotics, Internet of Things (IoT), big data analytics, and automation. This rapid technological advancement further disrupts existing industries and job markets, leading to new market dynamics, significant socioeconomic changes, and the potential displacement of certain jobs (Iansiti, Lakhani, 2020; Koh et al., 2019; Schwab, 2016).

Consequently, this raises a perspective of skills gap and workforce adaptation: The implementation of Industry 4.0 technologies requires a highly skilled workforce proficient in digital literacy, data analytics, programming, and other emerging fields. However, there is a concern that the current employees may not possess the necessary skills to adapt to the changing demands of the industry, resulting in a skills gap and unemployment (World Economic Forum, 2020). Thus, emerging technologies carry on the need for organizations and individuals to develop new skills to thrive in the digital age (Tidd, Bessant, 2018). And it is not only about technological skills, but about a whole range of soft skills as well. Sony and Mekoth (Sony, Mekoth, 2022) list the latter as: interpersonal adaptability; dealing with crises and unforeseen circumstances adaptability; adaptability to creative problem-solving; adaptability with continuous learning, training, and education; adaptability with managing stress; and team adaptability.

Some experts argue that without proper measures, Industry 4.0 could exacerbate inequality, as certain regions or individuals may struggle to adapt to the new technological landscape. On the other hand, they can also perceive Industry 4.0 as a source of new opportunities to chase the better performing territories (Bailey, De Propris, 2019; Forgione, Migliardo, 2023). The same refers to the digital divide. It is discussed whether different locations and industries might experience further lagging or alternatively accelerate in the interconnected business world.

Because of fact that Industry 4.0 heavily relies on interconnected devices, data sharing, and cloud computing, this interconnectedness raises concerns about data privacy and security. The increased collection and analysis of business data, along with potential vulnerabilities in interconnected systems, can lead to disclosures, cyberattacks, and misuse of maintenance information (Bracho et al., 2018; Williams et al., 2023; Zarreh et al., 2019). The taxonomy of issues and potential threats is widespread and needs various managerial responses in a form of organizational guidelines or technological solutions (Lezzi et al., 2018; Thames, Schaefer, 2017). Mitigation of the risks posed by the integration of advanced technologies in industrial settings is seen crucial for businesses to remain functional and thrive with the competition (Shukla et al., 2022).

The adoption of Industry 4.0 technologies also highlights some ethical and legal challenges. For example, the use of AI and automation raises questions about the responsibility and accountability of autonomous systems. Addressing these issues in industrial applications is much older than Industry 4.0 itself. Let us take the influential works by Wallach as an example (Allen et al., 2006; Wallach, 2008). Currently, as autonomous robots become reality, there is an emerging need for governing AI safety, e.g., using the three "AAA" governance principles (prospective risk Assessments, operation Audit trails and system Adherence to jurisdictional requirements) (Falco et al., 2021), or – even further – including standards for transparency of autonomous systems (Winfield et al., 2022). All this happens in a legal environment that faces novel questions of ownership and control in the world of robots (Calo, 2015).

Finally, Industry 4.0 must also be seen in a perspective of environmental sustainability. While it offers resource optimization and energy efficiency, it also poses doubts concerning making pressures on increased production and consumption, as well as boosting electronic waste, overall energy consumption and carbon footprint of digital operations (Ghobakhloo, 2020). For this reason, the important emerging notions concern Industry 4.0 and: sustainable innovations (Ghobakhloo et al., 2021), sustainable manufacturing (Ching et al., 2022), sustainable supply chains (Mastos et al., 2020). The potential of digital technologies, data analytics, and automation in industry is seen as an evidence-based driver for environmental improvements and circular economy practices. Piccarozzi and co-authors even call the relationship between Industry 4.0 and sustainability "a new story of the 'Two Giants'" (Piccarozzi et al., 2022).

The complexity of Industry 4.0 can be seen in its reliance on the interconnectedness of various components, such as machines, sensors, and systems, through IoT and cyber-physical systems. The number of interactions and dependencies between different elements grows. Managing and coordinating these systems calls for new competencies across businesses. Especially though, Industry 4.0 generates vast amounts of data. This data often includes heterogeneous and unstructured information from diverse sources. Dealing with this data abundance and complexity requires advanced data analytics techniques, including artificial intelligence and

machine learning, to extract valuable insights, optimize processes, and support decision-making. They are also a way to achieve adaptability and flexibility of production systems. Another dimension of Industry 4.0 complexity lies in its ecosystem nature i.e., in involving multiple stakeholders, including suppliers, manufacturers, customers, and service providers. This calls for aligning different organizations, technologies, and business models. Effective partnerships and interoperability become critical for the whole value chain. Altogether the above-mentioned characteristics very often trigger changes in organizational structures and roles, leading to the need for reskilling, upskilling, and improved innovation culture.

The adoption and implementation of Industry 4.0 technologies is related to significant investments and strategic decisions for businesses. While taking decisions, they need to embrace uncertainty. The market's acceptance of new products and services enabled by Industry 4.0 technologies may not always be predictable, and the pace of technological advancements and related legal changes is never known nowadays. Remaining compatible with the competitive landscape is a challenge, unless a certain company is willing to sail the Blue Ocean (Kim, Mauborgne, 2005).

Despite the automation and digitization enabled by Industry 4.0, the role of humans remains or at least should remain crucial. This makes Industry 4.0 value laden. In an organizational perspective it refers to the well-being, safety, and empowerment of workers within the digitalized industrial environment. Businesses can prioritize values such as worker health and safety, job satisfaction, and opportunities for skills development and meaningful work. The widely addressed issue of whether the automation leads to job reduction is one of the main narrations here. After the other – already mentioned – value-laden notions like ethics, sustainability, equality, and digital divide are added, one enters the pathway of discussing the emerging Industry 5.0 concept which "blows the whistle on global industrial transformation" as "it aims to place humans' well-being at the center of manufacturing systems, thereby achieving social goals beyond employment and growth to provide prosperity robustly for the sustainable development of all humanity" (Leng et al., 2022). Industry 5.0 is expected to leverage the creativity of human experts in collaboration with efficient, intelligent, and accurate machines, to obtain resource-efficient and user-preferred manufacturing

solutions (Maddikunta et al., 2022). Within this concept the power of industry is recognized to achieve societal goals beyond jobs and growth and become a resilient provider of prosperity (Huang et al., 2022).

Industry 4.0 shall be considered both global and local challenge. Globally, it disrupts traditional industries and business models, leading to shifts in production processes, supply chains, and job markets. Countries and corporates must invest in technological infrastructure, foster innovation, and develop skilled workforces to remain economically competitive in the digital era. Regulatory frameworks and standardization processes should be compliant across borders. However, the pace of this another industrial revolution links the global dimension with the local one. Bridging the technology gap and enabling technology transfer to less-developed regions is, as always, one of the fundamental issues. While Industry 4.0 presents global challenges, it is also a significant local challenge for specific regions, communities, and organizations. Many regions or localities have limited resources, infrastructure, or access to advanced technologies. And this is not only about global disparities but also about differences within well-developed countries. Mainly the metropolitan areas can have vivid Industry 4.0 ecosystems due to their advantageous dynamics, connectivity, infrastructure, industrial mix and related pool of skilled workers. This creates local challenges in terms of economic development, job opportunities, and attracting investments.

Those issues lead many countries to establishing policies on Industry 4.0. They usually encompass the issues of infrastructure development, research and development, skills and education, innovation, and entrepreneurship, as well as internationalization. An array of proposed policy instruments usually starts with advisory and consultancy. Further enabling networking and education and offering financial support as grants or taxation schemes. Also, many regions and cities prepared their strategies or action plans towards Industry 4.0 readiness and future highly competitive position. Soft policy instruments are mainly used in these cases and clustering is encouraged or facilitated.

Industry 4.0 has quite significant implications for higher education, especially concerning some engineering programs (industrial engineering, manufacturing, automation and robotics,

cybersecurity etc.), data science programs, and management programs. Schools are revising their curricula to align with the skills and knowledge needed in the era of Industry 4.0. They put more attention to subjects such as data analytics, artificial intelligence, Internet of Things (IoT), or digital economy. Delivering competencies related to digital literacy becomes a part of almost all curricula. The growing number of schools promote interdisciplinary programs that blend engineering, data science and managerial knowledge. Higher education institutions are emphasizing experiential learning opportunities, such as internships, cooperative education, and industry projects. This allows students to gain hands-on experience and develop real-world skills by working directly with industry partners. Collaboration with industry also helps universities stay in touch with the latest technological advancements and adapt their curriculum accordingly. The need for upskilling and reskilling related to Industry 4.0 is a market opportunity for many schools which open (commercially or as a part of public support schemes) lifelong learning programs, professional development courses, and micro-credentials projects.

Take-aways:

- Industry 4.0 means evolution of industrial production, characterized by the integration of digital technologies and data exchange. It stands for: smart machines, interconnected systems, and real-time data analytics. A more human-centric approach to Industry 4.0 is emerging and is known as Industry 5.0.
- Industry 4.0 is mainly seen in a perspective of technological disruption. Anyway, it has a strong impact on employment, equality, sustainability, regulations and even ethics.
- Countries and regions support their businesses on Industry 4.0 readiness.
- Universities promote more and more interdisciplinary programs that blend engineering, data science and managerial knowledge for Industry 4.0 applications.

Your key reading:

- The Fourth Industrial Revolution by Schwab (www.weforum.org, 2016)
- Exponential Disruptive Technologies and the Required Skills of Industry 4.0 by Bongomin et al. (Journal of Engineering, 2020)
- Industry 4.0, Regional Disparities and Transformative Industrial Policy by Bailey & De Propris (Regional Studies Policy Impact Books, 1(2), 67–78, 2019)
- Industry 5.0 and Society 5.0—Comparison, complementation and co-evolution by Huang et al. (Journal of Manufacturing Systems, 64, 424–428, 2022)

5. Circular economy as the societal challenge

The circular economy is a concept that redefines the traditional linear model of production and consumption, where resources are extracted, used, and disposed of. Instead, it focuses on creating a closed-loop system where materials and products are reused, recycled, and regenerated, minimizing waste, and maximizing resource efficiency.

The origins of the current understanding of circular economy should be traced to the 1980s' – when the notion of industrial ecology was introduced (Saavedra et al., 2018), and to McDonough and Braungart's concept of Cradle to Cradle (McDonough, Braungart, 2002). Industrial ecology is about humanity that can deliberately and rationally approach and maintain a desirable carrying capacity, given continued economic, cultural, and technological evolution. The approach seeks to optimize the total materials cycle from virgin material, to finished material, to component, to product, to obsolete product, and to ultimate disposal (Graedel, 1996). Cradle to Cradle is "characterized by three principles derived from nature Everything is a resource for something else. In nature, the "waste" of one system becomes food for another. Everything can be designed to be disassembled and safely returned to the soil as biological nutrients or re-utilized as high-quality materials for new products as technical nutrients without contamination." (https://mcdonough.com/cradle-to-cradle/). In other words, it is an agenda for innovation concerning making, using, and re-using of products (Meyer, Schneider, 2019).

Like the most societal challenges, this one can also be seen in various perspectives. From an environmental standpoint, which is fundamental here, the circular economy is seen as a response to the challenges posed by resource depletion, pollution, and climate change. The need to reduce the extraction of finite resources, decrease energy consumption, and minimize waste generation is advocated (Colorado et al., 2020; Londoño, Cabezas, 2021). So, waste management and material flow are given attention due to the possible detrimental impacts of the linear economy on ecosystems (Haupt, Hellweg, 2019). However, some opinions emerge that the mere fact that materials are circulated does not necessarily equate to greater sustainability (Blum et al., 2020). This dilemma might be quite easily answered if circular economy is properly seen and balanced within the biophysical environment and the production-consumption system (Velenturf et al., 2019).

From an economic perspective, the circular economy might raise crucial questions on ethical premises of natural resources and raw materials pricing, the real costs of the use of the environment as a sink for residuals or the burdensome nature of recycling. The discussions concerning these issues are older than the concept of circular economy itself (Andersen, 2007). Being different from the traditional linear economy, the circular one follows the same guiding rules as: property rights, rule of law and price signals. Consequently, if some of the essential parts of a market are lacking, a weaker circular economy than otherwise possible will materialize (Grafström, Aasma, 2021). Apart from the principles of economy, the circular economy is often framed as an opportunity to unlock economic growth and innovation (Suchek et al., 2021). It becomes a canvas for corporate strategies (Blomsma et al., 2019) and a challenge concerning organizational capabilities (Sehnem et al., 2022). The other authors emphasize the potential for job creation, especially the so-called green jobs (Aguilar-Hernandez et al., 2021; Moreno-Mondéjar et al., 2021; Sulich, Sołoducho-Pelc, 2022), and reduced dependence on scarce resources (Gusmerotti et al., 2019).

Social approach to the transition to a circular economy highlights the need for systemic changes and collaboration across sectors, including government, industry, and civil society (Ho et al., 2022; van Langen et al., 2021; Köhler et al., 2022). Aspects such as consumer behavior (Hazen et al., 2017; Parajuly et al., 2020;

Shevchenko et al., 2023), education, and awareness (Andrews, 2015; Bugallo-Rodríguez, Vega-Marcote, 2020; Kirchherr, Piscicelli, 2019; Whalen et al., 2018) are also widely emphasized. On the meta-level the circular economy is seen to achieve more equitable distribution of resources and improved well-being for communities (Ho, Yanagisawa, 2023; Schröder et al., 2020). Again, an impact on labour market is also seen here. For example, the Green Alliance UK claims that "As well as helping to level up the regions, jobs in the circular economy also level up across industries and job roles, including those negatively affected by automation and offshoring. Elementary, process plant and machine operatives, and skilled trades, would be well represented in an efficient circular economy, helping to address declines in employment in these occupations. For instance, this could be collecting, sorting, and grading waste materials, or the disassembly and repair of products and machinery." (Green Alliance, 2021)

In a technological perspective the circular economy relies on technological advancements to enable the efficient and sustainable use of resources. They cover developing and implementing innovative technologies, such as advanced recycling methods, resource tracking systems, and digital platforms to facilitate sharing and reuse. Further, changes are needed in operations (Lieder, Rashid, 2016) as well as in business models (Mendoza et al., 2022) and product design (den Hollander et al., 2017). Circular economy technologies might play a vital role in energy production value chains (Boloy et al., 2021) and are seen as an emerging field for cooperation with advanced digital technologies like blockchain (Khan et al., 2022; Uçar et al., 2020). They are also perceived as focal areas of entrepreneurial and innovation ecosystems (Aarikka-Stenroos et al., 2021).

The complexity of circular economy is mainly related to its systemic nature. It involves interactions and feedback loops between different components of the economy and the environment. Actions taken in one part of the system have effects and consequences elsewhere. On a macro level it is built upon feedback between nature (the use of natural resources) and economic performance. Whereas on a micro level it touches the issues of feasibility, social responsibility, and social acceptance. In the circular economy, the feedback loops can be observed in the closed-loop material flows

and circular supply chains. By designing products and systems with the intention of keeping materials in use, the circular economy triggers changes in policy, business, and social life. The complexity can also be seen through the non-linear dynamics of circular economy processes. Incremental changes and interventions can build momentum and eventually lead to transformative shifts in the way resources are managed in different sectors. Therefore, adaptive management and continuous learning are needed to tackle the new solutions within different value chains and territorial settings.

Entering the world of circular economy means answering many fundamental business questions concerning uncertainty. It is due to fact that the change to be implemented will radically or incrementally redefine many interlinked processes. There may be uncertainties regarding the feasibility, scalability, and cost-effectiveness of new technologies needed for circularity. Additionally, the emergence of disruptive technologies or unforeseen technological developments can introduce further uncertainty. The already mentioned issues of awareness and acceptance of circular products and services are another risk factors, as much as the issues of availability and pricing of recycled or reused materials. Moreover, changes in political landscapes, varying policy priorities, and inconsistent regulatory frameworks might become other bottlenecks in the implementation of circular strategies. On the other hand, geopolitically, circular economy is perceived to reduce dependence on other countries and its related risks (Nygaard, 2022).

Circular economy is one of the most value-laden contemporary concepts. It is deeply rooted in sustainability values, aiming to create a more sustainable and regenerative economy. It emphasizes principles such as resource conservation, waste reduction, and environmental protection. These values reflect a broader societal concern for the planet and future generations, driven by ethical considerations and a desire to mitigate the negative impacts of the linear model. However, the concerns of ensuring that the benefits are shared by all humans, across continents and countries, remain critical and surely will not be easily solved. Especially though not all economies will be capable of switching to circular approach, due to the investments needed, while some of them might even lose their income because of reduced demand for natural resources. Finally, the values of circular economy being human- and user-centred are

highlighted (Lofthouse, Prendeville, 2018), also leading to considerations that design thinking, creativity, and innovation in creating products should not only make them environmentally and economically sustainable but also culturally appealing and aesthetically pleasing.

The perspective of seeing circular economy as a global and local challenge addresses the issues of the depletion of natural resources and the generation of significant waste and pollution. As the global population grows and consumption patterns continue to rise, resource scarcity and environmental degradation become more pressing issues. The circular economy offers a framework to decouple economic growth from resource consumption and environmental impact. Because of the global economy being highly interconnected, the extraction of resources, production of goods, and disposal of waste often involve multiple countries and regions. Resource availability varies across regions, and local contexts play a significant role in shaping the circular economy. Different regions have different resource endowments and capacities for resource recovery, recycling, and reuse. Localizing circular economy practices allows regions to leverage their specific resources, such as renewable energy, water, or specialized industries, to create circular loops and maximize resource efficiency. Thus, implementing circular practices requires collaboration and coordination on various levels – not only to obtain the expected performance of the value chains but also to search for win-win solutions for all stakeholders. This means fostering economic development and inclusive growth by creating new business opportunities, stimulating innovation, and generating jobs in thousands of locations across the globe. Moreover, locally, waste management and infrastructure systems have a direct impact on the implementation of circular practices. Efficient collection, sorting, and recycling systems are crucial for closing material loops and minimizing waste generation. Local governments and communities need to invest in infrastructure development, such as recycling facilities, composting sites, and waste-to-energy plants, tailored to their specific waste management needs.

Hartley et al. offer an extensive review of policies that may accelerate a transition towards a circular economy (Hartley et al., 2020). They listed the ones focusing on waste treatment, including

production process-based approaches to eliminating waste; government purchasing decisions, referenced primarily in the context of sustainable public procurement and quality standards; education, promotion, and upskilling; infrastructure development; financial incentives, and labelling related to the quality of re-used and remanufactured products. In the paper they cite propositions concerning the policy mix to stimulate resource efficiency, emphasizing instruments like materials taxes, extended producer responsibility, and technical requirements. A detailed typology of incentives to boost the circular economy has been recently listed by the European Commission (Couder et al., 2021), encompassing a long selection of financial instruments, non-financial market-based instrument, non-financial non-market-based (normative and informative) instruments, instruments removing the normative obstacles, and other incentives (stimulating value chain collaboration, supporting first movers and empowering consumers to select more circular products). There is a detailed analysis of the twenty incentives annexed to the Commission's report. Moreover, in the EU, one of the so-called Urban Agenda's partnerships is focused on circular economy. The US policy up to now is mainly based on strategy to prevent plastic pollution and the National Recycling Strategy (https://www.epa.gov/circulareconomy). It is worth noting that this approach is supported by a publicly available IT tool – Recycling Infrastructure and Market Opportunities Map – that highlights existing infrastructure, per capita generation and recycling of post-consumer material, and other relevant market factors. The US Environmental Protection Agency believes that the map helps develop and strengthen primary and secondary end markets for materials, support cleaner communities by reducing the amount of plastic and other waste entering landfills, and provide opportunities to address climate change by diverting more materials from landfill (https://www.epa.gov/circulareconomy/recycling-infrastructure-and-market-opportunities-map). The circular economy policies are also present in other large countries like China, Australia, India, or Brazil. Some African countries established The African Circular Economy Alliance.

Circular economy has already gained recognition in higher education as a critical area of focus for sustainability in engineering, environmental and economy or business-related programs. It is also a horizontal subject of choice to the other curricula, contributing

to responsible education. Schools are incorporating circular economy principles into their curricula across various disciplines. They are offering courses, programs, and modules specifically focused on circular economy concepts, including sustainable design, waste management, circular business models, and eco-innovation. This integration ensures that students are equipped with the knowledge and skills necessary to address circular economy challenges in their future careers. Faculty and students engage in interdisciplinary research projects exploring topics such as circular design, sustainable production and consumption, material flow analysis, and circular business strategies. The outputs contribute to the development of practical solutions, best practices, and policy recommendations. These projects are often organized in collaboration with industry, government or local government agencies, and NGOs. Moreover, universities are implementing circular practices within their own operations, as a part of their sustainability agendas. This basically includes implementing waste reduction and recycling measures. But in some cases, also promoting circular building and infrastructure design as well as implementing sustainable procurement policies.

Take-aways:

Circular economy redefines the traditional linear model of production and consumption, where resources are extracted, used, and disposed of. Instead, it focuses on creating a closed-loop system where materials and products are reused, recycled, and regenerated, minimizing waste, and maximizing resource efficiency. Thus, in a human-related aspect, circular economy cares for the planet for us and future generations.

- Circular economy is mainly seen in an environmental engineering perspective. But it has very strong socio-economic linkages. On a macro level it is built upon feedback between the use of natural resources and economic performance. Whereas on a micro level it touches the issues of value chains, feasibility, social responsibility, and social acceptance.
- Countries develop various policy instruments and incentives to boost circular economy.
- Circular economy is a critical area of focus for sustainability in engineering, environmental and economy or business-related programs. Universities add a circular content to many other curricula as a part of their responsibility strategies. Also, operations in campuses might address circularity in action.

Your key reading:

- Cradle to Cradle: Remaking the Way We Make Things by McDonough & Braungart (Macmillan, 2002)
- Theoretical contribution of industrial ecology to circular economy by Saavedra et al. (Journal of Cleaner Production, 170, 1514–1522, 2018)
- Innovation and the circular economy: A systematic literature review by Suchek et al. (Business Strategy and the Environment, 30(8), 3686–3702, 2021)
- Drivers and approaches to the circular economy in manufacturing firms by Gusmerotti et al. (Journal of Cleaner Production, 230, 314–327, 2019)
- Macroeconomic, social and environmental impacts of a circular economy up to 2050: A meta-analysis of prospective studies by Aguilar-Hernandez et al. (Journal of Cleaner Production, 278, 2021)
- Consumer behavior in the circular economy: Developing a product-centric framework by Shevchenko et al. (Journal of Cleaner Production, 384, 1355682023)
- Incentives to boost the circular economy: a guide for public authorities by Couder et al. (European Commission. Directorate-General for Research and Innovation, 2021)

6. Energy and climate change as the societal challenge

Energy and climate change represent a pair of key societal dilemmas in contemporary times. Energy plays a fundamental role in sustaining modern civilization by providing power to residential, industrial, and transportation sectors. Nevertheless, the predominant energy sources, notably fossil fuels, actively contribute to climate change by releasing greenhouse gases, thus engendering a wide array of environmental and socioeconomic repercussions. The combustion of fossil fuels results in the emission of greenhouse gases, which directly contribute to climate change (Houghton, Woodwell, 1989). Consequently, this gives rise to substantial environmental and socioeconomic consequences, exerting an impact on diverse aspects of our planet and the well-being of humanity (Hardy, 2003).

Climate change can be defined as: "…a change of climate which is attributed directly or indirectly to human activity that alters the

composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." (UNFCCC, 1992, art. 1). The UNFCCC distinguishes between climate change that is linked to human activities altering the atmospheric composition, and climate variability attributable to natural causes. Here, we focus on the first one with specific attention given to energy.

Trying to understand the consequences of climate change research shows rising temperatures (Fuso et al., 2023), forest fires (Flannigan et al., 2000), ocean / sea level rise (Mori et al., 2013), water scarcity (Taylor et al., 2013; González-Zeas et al., 2019), glacier shrinkage (Afzal et al., 2023) , impacts on agriculture and food security (Wheeler, von Brown, 2013), changes in ecosystems (Peres, Garcia, 2023) and consequences of societal nature (Stehr, von Stroch, 1995). The increase in greenhouse gases leads to a rise in global temperatures, causing shifts in weather patterns, heatwaves, and more frequent and severe extreme weather events such as hurricanes, droughts, and floods. Warmer temperatures cause glaciers and polar ice caps to melt, leading to an increase in global sea levels.

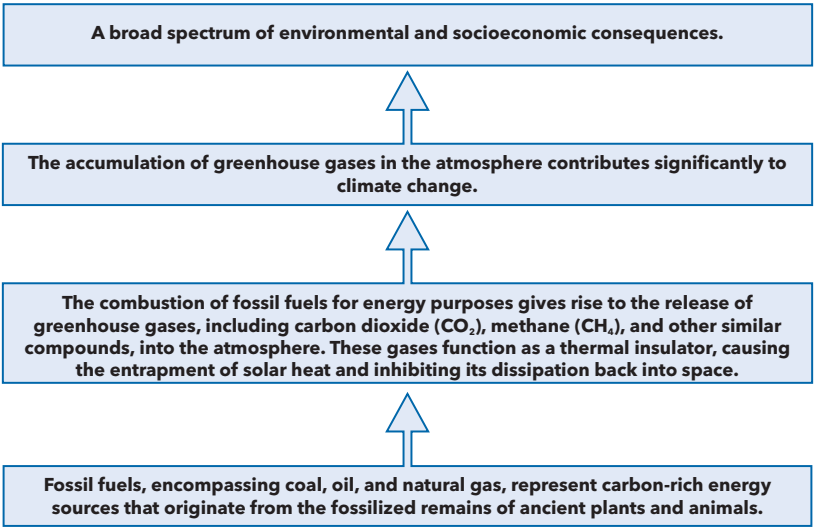

Fig. II.1. Fossil fuels, the release of greenhouse gases with greenhouse effect and climate change. Source: own elaboration.

This can result in coastal erosion, flooding of low-lying areas, and the loss of coastal habitats. Changing climate patterns can affect agricultural productivity, water availability, and crop yields. This, in turn, can impact food production and availability, posing challenges to global food security. Climate change can disrupt ecosystems, affecting plant and animal species. It can lead to shifts in species' geographic ranges, loss of biodiversity, and disruption of ecological processes. Finally, it can have wide-ranging socioeconomic impacts, including damage to infrastructure, increased healthcare costs due to heat-related illnesses, displacement of communities due to sea-level rise or extreme weather events, and economic losses in sectors dependent on climate-sensitive resources.

Climate change covers enduring alterations in global or regional climate patterns, encompassing variations in temperature, precipitation, wind dynamics, and other pertinent factors (Ezas et al., 2022). Primarily pushed by human activities, climate change entails substantial risks to ecosystems, economies, and human well-being. Its consequences extend to the disruption of weather patterns, the occurrence of extreme weather events, the escalation of sea levels, and adverse effects on agriculture and food security. Moreover, climate change exacerbates economic and social inequalities, with vulnerable populations frequently experiencing disproportionate impacts (Cevik, Jalles, 2023).

Climate change presents a complex challenge due to several interrelated factors and considerations. The key reasons contributing to its complexity are those of scientific, multidisciplinary, global scale, uncertainty, equity, economic and political nature. Climate change involves intricate scientific processes, targeting interactions between the atmosphere, oceans, land, and biosphere. Understanding and predicting the behaviour of the Earth's climate system requires comprehensive analysis of these complex dynamics. Its change requires a multidisciplinary approach, involving fields such as atmospheric science, ecology, economics, social sciences, and policy. Addressing its causes, impacts, and mitigation strategies necessitates collaboration and expertise from diverse disciplines. Moreover, climate change is a global challenge with a long-term perspective, transcending national boundaries and requiring international cooperation like with the international law for coastal and marine ecosystems (Zhu, Bai, 2022). The interconnectedness

of emissions, impacts, and adaptation efforts across countries and regions adds complexity to addressing the issue effectively. In fact, it unfolds over extended time scales, making it a challenge to convey the urgency of action and implement long-term solutions. Balancing short-term priorities with the need for sustained efforts to mitigate and adapt to climate change poses complexity in decision-making. Climate change raises issues of equity and ethics, as its impacts disproportionately affect vulnerable populations and future generations. Addressing fairness, justice, and ethical considerations in climate policies adds complexity to finding equitable solutions and despite significant advancements in climate science, inherent uncertainties persist in climate change projections (just to mention two HORIZON projects researching the topics – BOLSTER, DUST). Future climate outcomes are influenced by a range of factors, including human actions, technological developments, natural processes, and policy decisions. Uncertainties in predicting regional climate impacts and the precise magnitude of future changes contribute to the complexity of decision-making and policy formulation. Finally, climate change carries economic implications, affecting industries, energy systems, and global trade. The transition to low-carbon economies necessitates substantial investments, technological innovation, and policy reforms. However, economic considerations, divergent national interests, and political dynamics can influence the speed and extent of climate action, making consensus-building and decisive measures challenging to achieve.

Given these complexities, addressing climate change necessitates a comprehensive and integrated approach that combines scientific understanding, policy frameworks, international cooperation, technological innovation, public engagement, and equitable solutions (Balint et al., 2017). It requires balancing environmental sustainability, economic development, and social well-being to achieve a resilient and sustainable future for all. Addressing climate change requires transitioning from high-carbon to low-carbon energy systems, decarbonizing industries, and adopting sustainable practices (Davine-Wright 2022). These transformations involve technological advancements, infrastructure development, and behavioural changes at both individual and societal levels. Overcoming technological, economic, and logistical challenges and

ensuring coordination among multiple stakeholders add complexity to these transitions.

Climate change is a societal challenge that is difficult to predict due to various factors (Thasneem et al., 2023). Like we said, the Earth's climate system is a highly intricate and interconnected network of components that interact in complex ways. Changes in one part of the system can lead to cascading effects throughout, making it challenging to predict how these interactions will unfold and impact future climate patterns. In fact, predicting future greenhouse gas emissions, which are the main drivers of climate change, is still rather difficult due to uncertainties in factors such as population growth, economic development, technological advancements, and policy decisions. These uncertainties make it challenging to accurately forecast the magnitude and timing of climate change impacts. At the same time, climate change can trigger feedback mechanisms that can either amplify or dampen the initial climate response. The complex interactions between different components of the climate system, such as for instance melting ice and increased water vapor, contribute to uncertainties in predicting the strength and interactions of these feedback mechanisms. Climate change is influenced by human activities and socioeconomic factors, making accurate predictions even more challenging. The intertwined nature of energy production, land use changes, and consumption patterns with social, economic, and political dynamics contributes to uncertainties in emissions trajectories, adaptation capabilities, and societal responses to climate change. Climate change impacts vary across regions due to differences in climate sensitivities, natural variability, and local factors. Predicting how specific regions will be affected by climate change requires detailed regional modelling and understanding of local factors, further adding to the complexity and uncertainty of predictions. Indeed, the future trajectory of climate change can be influenced by technological advancements and policy interventions. However, uncertainties exist regarding the pace and scale of technological advancements, as well as the implementation of effective policies, making it challenging to predict the extent to which these factors will shape future climate outcomes. Given these challenges, climate change predictions involve a degree of uncertainty. The complexity and uncertainties inherent in the climate system make it difficult to make precise and deterministic predictions, emphasizing

the importance of considering a range of possible future outcomes when planning for climate change impacts.

Climate change may be approached and understood through various value systems, each offering a different perspective on the issue. The key value systems possible to apply to deliberate on the climate change could be related to environmental stewardship, sustainable development, equity and justice, efficiency and – finally – cooperation. Environmental stewardship prioritizes the protection and preservation of the natural environment. It recognizes climate change as a threat to ecosystems and biodiversity and promotes the conservation of natural resources, reduction of greenhouse gas emissions, and adoption of sustainable practices. On the other hand, sustainable development as a value system seeks to achieve a balance between economic development, environmental protection, and social well-being. It emphasizes the need for economic growth within ecological limits, considering the long-term consequences of climate change. Approaches rooted in sustainable development aim to reconcile environmental sustainability, social equity, and economic prosperity. Thus, for instance, intergenerational equity may be considered a set of values which emphasizes the rights and needs of future generations. It recognizes that decisions made today to address climate change will impact future populations. Approaches based on intergenerational equity prioritize emission reductions and sustainable practices to ensure a liveable planet for future generations. When describing social justice, one could see this value system as focusing on addressing social inequalities in climate change impacts and responses. It acknowledges that marginalized communities bear a disproportionate burden of climate change due to factors such as poverty and limited resources. Approaches grounded in social justice aim to reduce disparities, promote climate resilience in vulnerable communities, and ensure equitable climate policies. For those primarily discussing and looking for optimizing resource allocation and maximizing economic efficiency in climate change mitigation and adaptation efforts, the value set shifts the focus on market-based mechanisms, cost-benefit analyses, and technological innovations to achieve environmental goals at the lowest cost. As we pointed to its complexity, climate change entails the very global nature and therefore it challenges the need for international collaboration. It

requires multilateral efforts, international agreements, and shared responsibility. Approaches rooted in global cooperation aim to foster collaboration among nations to reduce emissions, adapt to climate impacts, and support developing countries. These value systems represent different perspectives and approaches to addressing climate change and play a crucial role in shaping policies, strategies, and actions at various levels. It's important to note that these value systems are not mutually exclusive and often intersect and influence one another. Different individuals, organizations, and societies may prioritize and emphasize different value systems when approaching climate change. Recognizing and understanding these diverse value systems may truly foster constructive dialogue, facilitate collaboration, and lead to more comprehensive and effective strategies for addressing climate change.

Climate change is a multifaceted challenge with both local and global dimensions. Its impacts are experienced at the local level, but it is inherently a global issue due to its underlying causes, interconnectedness, and shared consequences (Devine-Wright). Local actions cumulatively contribute to global impacts, while global efforts shape local vulnerabilities and opportunities (Biswas, Rahman). Effectively addressing climate change requires integrating local and global perspectives, fostering collaboration among stakeholders at various scales, and recognizing the interconnectedness of climate change impacts and responses.

Taking a more local perspective, we can see that climate change affects different regions in unique ways, influenced by local factors such as geography, topography, and prevailing weather patterns. These regional variations result in diverse challenges, including changes in precipitation, temperature extremes, and impacts on local ecosystems and communities. And, indeed, climate change directly affects local communities and ecosystems, leading to immediate consequences. Extreme events like heatwaves (Ban et al., 2022), droughts (Hosseinzadehtalaei et al., 2023), floods (Kim et al., 2023), and storms (Erikson et al., 2018) can damage infrastructure, disrupt agriculture, deplete water resources, and pose risks to human health. Addressing these localized impacts requires tailored adaptation and resilience strategies specific to the local context. Local action is crucial for both adapting to and mitigating climate change (Marquez-Ballesteros et al., 2023). Local governments, communities,

and individuals can implement measures such as enhancing infrastructure resilience, adopting sustainable land-use practices, promoting energy efficiency, and supporting local renewable energy projects. These localized efforts contribute to global climate goals while addressing local vulnerabilities and priorities.

A more global perspective of "energy fuelled" climate change sees its transboundary effects. Climate change transcends national boundaries, with greenhouse gas emissions and impacts in one region affecting global climate systems and ecosystems. Rising global temperatures, sea-level rise, and changes in oceanic and atmospheric patterns have far-reaching consequences that extend beyond specific geographic regions. Disruptions in global food production, migration patterns, and geopolitical stability exemplify the broader global implications of climate change. And, like we said, climate addressing climate change necessitates collective global action, as reducing emissions and promoting sustainable practices is a shared responsibility (Brechin, 2016). Cooperation and collaboration among nations are vital to mitigate climate change, facilitate technology transfers, and support developing countries in their climate efforts. In fact, climate change that impacts one part of the world, can indirectly affect global systems and populations. Changes in weather patterns and extreme events can disrupt global supply chains, trade, and economies. Therefore, building global resilience to climate change requires a coordinated response to protect shared resources (Tompkins, Adger, 2004), economies (Badau et al., 2016), and vulnerable populations (Handmer et al., 1999).

Addressing energy and climate change challenges necessitates transitioning to sustainable and low-carbon energy sources, enhancing energy efficiency, and adopting cleaner technologies. This transition is imperative for mitigating greenhouse gas emissions, limiting global temperature rise, and fostering resilience to climate change impacts. Additionally, it presents opportunities for innovation, job creation, and sustainable economic growth. Efforts to tackle these challenges involve international cooperation, policy frameworks, technological advancements, and changes in individual and collective behaviours such as those favoured with the implementation of a Just Transition Mechanism in European Union. Of course, addressing climate change as a societal challenge requires a wide range of measures, policies, and programs at various levels, from local to global. Examples of these

approaches include international agreements and frameworks such as the Paris Agreement and the United Nations Framework Convention on Climate Change (UNFCCC – https://unfccc.int/resource/ccsites/zimbab/conven/text/fulltext.htm). National climate action initiatives, local and community-based initiatives are of pivotal meaning due to interrelated (local-global) nature of this societal challenge.

Table II.1. Facing the challenge – range of actions.
Source: own elaboration.

Global measures
• The Paris Agreement, adopted in 2015, is a landmark international treaty aiming to limit global warming to well below 2 degrees Celsius above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5 degrees Celsius. It establishes a framework for countries to set their own emissions reduction targets (Nationally Determined Contributions), enhance climate resilience, and provide financial and technological support to developing countries. • United Nations Framework Convention on Climate Change (UNFCCC): The UNFCCC is an international treaty formed in 1992 to address climate change comprehensively. It serves as the foundation for global climate action, facilitating negotiations, knowledge sharing, and collaboration among nations.
National measures
• Many countries have implemented policies and incentives to promote renewable energy deployment, such as feed-in tariffs, tax incentives, and renewable portfolio standards. These measures aim to accelerate the transition from fossil fuels to renewable energy sources, reducing greenhouse gas emissions from the energy sector. • Carbon pricing mechanisms, including carbon taxes and emissions trading systems (cap-and-trade), put a price on carbon emissions to create economic incentives for reducing greenhouse gas emissions. Several countries and regions have implemented carbon pricing schemes. • Governments and organizations implement energy efficiency programs to reduce energy consumption and associated emissions. These programs may include building energy codes, appliance efficiency standards, energy audits, and financial incentives for energy-efficient technologies and practices. • Countries develop adaptation and resilience strategies to manage the impacts of climate change on various sectors, such as agriculture, water resources, infrastructure, and public health. These strategies involve assessing vulnerabilities, developing adaptation plans, and implementing measures to enhance resilience in the face of climate-related risks. • Investments in research and development drive technological advancements for low-carbon energy technologies, climate modelling, and mitigation and adaptation solutions. Governments, private sectors, and academic institutions support research initiatives to expand knowledge and develop innovative solutions to address climate change challenges.

• Governments provide financial and policy support for the development and deployment of clean technologies, such as renewable energy, energy storage, and carbon capture and storage (CCS), to accelerate the transition to a low-carbon economy.
Local measures
• Local governments and communities promote sustainable transportation options, including the development of public transit systems, cycling infrastructure, carpooling programs, and electric vehicle adoption, to reduce greenhouse gas emissions from the transportation sector. • Cities incorporate climate considerations into urban planning by implementing green building practices, creating green spaces, adopting low-impact development techniques, and investing in sustainable infrastructure, such as renewable energy installations and efficient public transportation systems. • Programs aimed at raising awareness and educating communities about climate change encourage individual actions and behaviour changes. Community engagement initiatives involve public consultations, stakeholder involvement, and grassroots efforts to foster a sense of collective responsibility and empowerment.
Cross-territorial measures
• Climate monitoring systems, satellite observations, and climate modelling contribute to improved understanding and prediction of climate change impacts. Accessible climate data helps inform policy decisions, support adaptation planning, and enhance early warning systems for extreme weather events.

The success of these approaches depends on their implementation, enforcement, and continuous evaluation, as well as the collaboration and engagement of various stakeholders, including governments, businesses, civil society, and individuals. Climate change mitigation and adaptation efforts continue to evolve as new knowledge, technologies, and policy frameworks emerge to tackle this complex societal challenge.

Academic community does a lot to address the societal challenge of energy and climate change (Reyes-Garcia et al., 2019, MIT Climate Grand Challenges). By combining research, education, practical initiatives, and community engagement, universities play a crucial role in advancing our understanding and addressing the multifaceted societal challenge of energy and climate change. HEIs nurture and empower the next generation of leaders, professionals, and innovators who will drive the transition towards a sustainable and low-carbon future. For instance, climate science research conducted by universities is essential for deepening our understanding of climate change, encompassing investigations into its causes, impacts, and potential mitigation strategies. These

studies encompass disciplines such as atmospheric physics, carbon cycling, and climate modelling. Universities and research institutes engage in studies and development activities focused on renewable energy technologies, including solar, wind, geothermal, and bioenergy. These endeavours aim to enhance the efficiency, cost-effectiveness, and scalability of renewable energy sources, driving the transition to a low-carbon energy system. On the other hand, we observe various degree programs, courses, and certificates focused on energy and climate change. These programs cover a range of disciplines, including environmental science, climate studies, renewable energy engineering, sustainable development, policy analysis, and economics. It is worth mentioning that universities encourage interdisciplinary collaboration, fostering knowledge exchange among different fields of study. This approach helps students develop a holistic understanding of the complex interactions between energy, climate change, society, and the environment. With the help of several programmes like ERASMUS+, universities provide students with opportunities to engage in fieldwork, internships, and research projects related to energy and climate change. These experiences equip students with practical skills and knowledge to address real-world challenges.

Indeed, universities play a vital role in addressing the energy and climate change challenge through their education and training initiatives. They offer a diverse range of academic programs, courses, and certificates tailored to energy and climate-related disciplines, including environmental science, renewable energy engineering, policy analysis, and sustainable development. Moreover, taking the role of responsible community stakeholder, they strive to reduce energy consumption and improve energy efficiency in campus operations to promote behaviour change initiatives. Applying sustainable design principles in building construction and renovation, including energy-efficient systems, green roofs, or rainwater harvesting, they build a positive impact while educating or researching this societal challenge.

And finally, universities play a crucial role in disseminating knowledge on energy and climate change (Terrado et al., 2023). Engaged in collaborations with diverse stakeholders, including governments, businesses, NGOs, and community organizations, joint research projects are created to implement sustainable initiatives

as well as to influence policy and decision-making processes. HEIs contribute to real-world solutions and address energy and climate change challenges by actively engaging with local communities through outreach programs, public events, and public lectures to educate and empower them with knowledge about energy conservation, the impacts of climate change, and sustainable practices.

Its teachers who should be actively engaged in helping students in understanding climate change as a societal challenge (Stevenson) while simultaneously addressing their digital skills and entrepreneurial competences (DIGI-SOC). To start with project-based learning, teachers should design activities that require students to explore climate change issues and propose innovative solutions. By utilizing digital tools and resources, students can conduct research, analyse data, collaborate with peers, and create presentations or prototypes of their ideas. This approach promotes critical thinking, problem-solving, creativity, digital literacy, and entrepreneurial thinking. One of a great applied ideas is to make use of virtual simulations and games. Incorporating online simulations and games focused on climate change and sustainability allows students to engage in real-world scenarios, make decisions, and observe the consequences of their actions. These interactive platforms enhance digital skills and entrepreneurial competences by fostering strategic thinking, teamwork, and decision-making within the context of climate change (see for instance https://www.climateinteractive.org/en-roads/). The other option could include encouraging students to develop digital stories, videos, mooks or multimedia presentations that communicate climate change impacts and potential solutions. By utilizing digital media tools to collect and analyse data, visualize information, and present their findings, students can raise awareness and inspire action. This approach cultivates digital literacy, communication skills, and entrepreneurial thinking by promoting innovative methods of conveying messages. At the same time, by organizing entrepreneurship or innovation challenges focused on climate change, teachers may provide students with opportunities to develop business models, products, or services that address climate change-related issues. This approach nurtures entrepreneurial competencies such as problem-solving, creativity, market research, and financial literacy while linking them to climate change solutions. One of a certainly important aspect is to utilise

online collaboration and networking, to address the complexity and global nature of this societal challenge. Thus, one can think of encouraging students to engage in online collaboration and networking platforms focused on climate change and sustainability. It enables them to interact with peers, experts, and organizations in the field. Participating in virtual communities, forums, or social media groups enhances digital communication and networking skills, while providing opportunities for knowledge exchange and learning from others. The other interesting example could be to involve students in citizen science projects related to climate change or environmental campaigns. It allows them to collect and analyse environmental data using digital tools such as sensors, mobile apps, or online platforms. This hands-on approach develops digital literacy, data analysis skills, and encourages entrepreneurial thinking by exploring innovative uses of data. And teachers can encourage students to design and implement digital campaigns or advocacy initiatives to raise awareness about climate change and promote sustainable practices. Through the creation of websites, social media campaigns, or online petitions, students can engage their peers, families, and the wider community, developing digital communication skills, media literacy, and entrepreneurial competences.

All these approaches foster critical thinking, problem-solving, collaboration, creativity, and digital literacy, equipping students with the tools they need to address climate change challenges and drive sustainable solutions.

Take-aways:

Energy and climate change are interconnected and pressing issues that require concerted efforts from governments, businesses, communities, and individuals to ensure a sustainable and secure future for our planet. The key points to remember:

- Climate change is a complex societal challenge that is influenced by multiple factors and has far-reaching impacts on the environment and society.
- Fossil fuels contribute to climate change through the emission of greenhouse gases, which have various environmental and socioeconomic consequences.

- Climate change is difficult to predict due to the complexity of Earth's climate system, the interplay of various factors, and the inherent uncertainty in long-term projections.
- Climate change can be approached and understood through different value systems, such as environmental stewardship, economic sustainability, social justice, and intergenerational equity.
- Climate change has both local and global dimensions. It manifests differently in various regions due to local factors, but its causes and consequences are interconnected globally.
- Local responses to climate change involve measures like sustainable transportation, urban planning, community engagement, and adaptation strategies tailored to specific regional vulnerabilities.
- Climate change has global implications, including transboundary effects, shared responsibility, and the need for global resilience. International agreements facilitate collective action.
- Measures to address climate change include renewable energy policies, carbon pricing, energy efficiency programs, climate adaptation planning, technological innovation, and research on climate science and impacts.
- Universities address the energy and climate change challenge through research, education, campus sustainability, community engagement, and policy advocacy.
- Teachers can involve students in understanding climate change by integrating digital and entrepreneurial competencies through project-based learning, virtual simulations, multimedia projects, entrepreneurship challenges, online collaboration, and environmental campaigns.

Your key readings:

- Global Climatic Change by Houghton & Woodwell (Scientific American, 260(4), 36–47, 1989).
- Think global, act local? The relevance of place attachments and place identities in a climate changed world by Devine-Wright (Global Environmental Change, Volume 23, Issue 1, 2013, Pages 61–69, 2013)
- Climate Change: Causes, Effects, and Solutions by Hardy (Wiley, Chichester, 2003).
- Climate Change Impacts on Global Food Security by Wheeler & von Braun, (Science 341,508–513, 2013)
- What is climate change education? by Stevenson, Nicholls & Whitehouse (Curriculum Perspectives, 37 (1). pp. 67–71, 2017)

7. Urbanisation and technologization in cities as the societal challenge

Urbanisation refers to the progressive concentration of populations in urban areas, resulting in the expansion of cities. This phenomenon is increasingly seen worldwide and presents economic implications (Bertinelli, Strobl, 2007; McGranahan, Satterthwaite, 2014; OECD 2020). The rapid influx of individuals into urban areas gives rise to challenges such as overcrowding, strain on infrastructure, heightened resource demand, and environmental degradation (Pradhan et al., 2021). These obstacles can have adverse effects on the well-being of urban residents and exert pressure on governments to provide essential services, including housing, transportation, healthcare, and education.

Conversely, city technologisation entails the integration of advanced technologies and digital solutions into urban environments. The notion of smart cities, which leverage technology to augment efficiency, sustainability, and liveability, has gained momentum in recent times (Sabri, 2021). While technology offers notable advantages like enhanced urban planning (Geertman, Stillwell, 2020), energy management (Rehman et al., 2023), and transportation systems (Angelidou et al., 2022), it also presents hurdles. Issues pertaining to data privacy (van Zoonen, 2016), security (Rizi, Seno, 2022), people discontent (van Twist et al., 2023) and the digital divide (Graham, 2002) must be addressed to ensure that the benefits of city technologisation are accessible to all citizens and do not exacerbate existing social inequalities.

Moreover, urbanisation and city technologisation are interconnected challenges. As cities become more technologically advanced, the demand for urban services and infrastructure escalates, further straining resources. Additionally, technological advancements can fuel urbanisation by attracting individuals to cities in search of economic opportunities and an improved quality of life. Technological progress often leads to the development and implementation of novel urban services and infrastructure, such as smart transportation systems, efficient energy grids, or digital governance platforms (Mora L. et al., 2023). However, as cities adopt these technologies, the demand for such services and infrastructure

surges, intensifying the strain on resources, including financial resources to maintain them (Gassmann et al., 2019). This necessitates the allocation of funding, materials, and manpower to cater to the expanding needs of a growing urban populace.

Furthermore, technological advancements act as catalysts for urbanisation by enticing more people to migrate to cities. When cities employ innovative technologies, they often create avenues for economic growth, enhanced quality of life, and improved services (Caragliu et al., 2011). These benefits can attract individuals from rural areas or smaller towns to relocate to cities in pursuit of better employment prospects (Nieto-Mengotti et al., 2019), entrepreneurial actions (Marchesani et al., 2023), knowledge and education (Laurini et al., 2021), and other advantages. This influx of people contributes to further urbanisation and population growth, presenting additional challenges for cities to manage.

The intricate relationship between urbanization and city technologization results in a dual effect: technological advancements not only stimulate the demand for urban services and infrastructure but also act as a magnet, attracting more individuals to cities and driving further urbanization. This cyclical process poses a challenge as cities must effectively manage resources, plan for sustainable growth, and ensure equitable access to the benefits of technology-driven urban development (Yigitcanlar, 2015). Consequently, addressing these challenges demands a multidisciplinary approach involving urban planners, policymakers, technologists, and citizens (Andrisano et al., 2018). It is imperative to ensure that urbanization and city technologization are executed in a sustainable, inclusive, and equitable manner, considering the needs and aspirations of all urban dwellers.

The key reasons underlying urbanization and city technologization as societal challenges can be attributed to several factors, including population growth, limited resources, inadequate infrastructure, environmental impact, inequality and social challenges, technological advancements, as well as governance and policy issues. Rapid population growth, fuelled by both natural increase and rural-to-urban migration, serves as a significant driver of urbanization. As more people migrate to cities, there is increased strain on urban infrastructure, services, and resources. Cities may encounter difficulties in providing fundamental services and

infrastructure to a growing population (Cobbinah et al., 2015). Resources such as housing, water, energy, transportation, and healthcare can become strained as urbanization intensifies, placing the onus on governments and urban planners to effectively manage and allocate resources. Urbanization often outpaces the development of necessary infrastructure. Cities may struggle to provide adequate transportation systems, utilities, and public services to meet the needs of a burgeoning population. This can lead to issues like congestion, insufficient housing, inadequate access to clean water and sanitation, and other challenges related to infrastructure. The rapid growth of cities can have detrimental effects on the environment, including deforestation, loss of green spaces, increased pollution, and heightened energy consumption. If not properly addressed, these environmental challenges can adversely affect the quality of life for urban residents and contribute to climate change. Urbanization can exacerbate social inequalities. As cities expand, disparities in access to resources and opportunities may widen, leading to socioeconomic divisions. Certain marginalized communities may face exclusion, limited access to basic services, and inadequate representation in decision-making processes. Addressing these social challenges necessitates an inclusive approach to urban planning and development.

While city technologization offers numerous benefits, it also presents its own set of challenges. The rapid pace of technological innovation can result in a digital divide, where certain segments of the population are left behind in terms of accessing and utilizing technology (Reddick et al., 2020). Issues pertaining to data privacy, cybersecurity, and ethics also arise as cities become more interconnected and reliant on digital infrastructure. Lastly, effectively managing urbanization and city technologization requires robust governance structures and policies. City governments must develop long-term urban planning strategies, enact appropriate regulations, and foster collaboration with various stakeholders to tackle the complex challenges arising from urbanization and technological advancements.

Urbanization and city technologization as societal challenges have wide-ranging consequences, including strain on infrastructure, environmental impact, housing challenges, social inequalities, digital divide, privacy, and security concerns, as well as economic

challenges and opportunities. The rapid influx of people into cities puts significant strain on existing infrastructure and services. Roads, public transportation, water supply, sanitation systems, healthcare facilities, and educational institutions may become overburdened and struggle to keep up with the growing population. This can lead to congestion, inadequate service provision, and increased pressure on resources. Urbanization often leads to increased pollution, deforestation, loss of green spaces, and higher energy consumption. The expansion of urban areas encroaches upon natural habitats, contributing to biodiversity loss. Additionally, increased pollution from industrial activities, transportation, and waste generation can harm air and water quality, impacting the health and well-being of urban residents. Urbanization often results in a shortage of affordable housing. The demand for housing outpaces supply, leading to rising prices, inadequate living conditions, informal settlements, and homelessness. This perpetuates social inequalities and exacerbates the housing crisis, particularly for low-income and marginalized communities. Urbanization can widen existing social inequalities. Disparities in income, access to education, healthcare, and other essential services can become more pronounced in cities. Certain groups, such as marginalized communities or vulnerable populations, may face discrimination, exclusion, and limited opportunities. Addressing social inequalities becomes crucial for creating inclusive and equitable cities. City technologization can create a digital divide, where segments of the population have limited access to and utilization of digital technologies. This divide can result from disparities in internet connectivity, digital skills, and access to digital devices. It further exacerbates existing inequalities and hampers equitable access to the benefits of technology. The integration of advanced technologies in cities raises concerns about data privacy and cybersecurity. Smart city technologies rely on extensive infrastructure, including sensors, networks, and data centres. The rapid urbanization associated with smart city development places strain on existing infrastructure and requires careful management of resources such as energy, water, and transportation systems. Ensuring the scalability and sustainability of infrastructure becomes a challenge. As cities become more connected and collect vast amounts of data, there is a need to ensure that personal information is protected and used responsibly.

Vulnerabilities in digital infrastructure can also pose security risks, potentially leading to data breaches, surveillance, and cyber-attacks. Urbanization can create economic opportunities by concentrating industries, businesses, and innovation hubs in cities. However, it can also lead to economic disparities, unequal distribution of wealth, and job market challenges. The informal economy may flourish alongside formal sectors, resulting in precarious employment and income insecurity for some urban residents. Of course, addressing these consequences requires a comprehensive approach that encompasses urban planning, sustainable development strategies, equitable resource allocation, and inclusive policies. It is crucial to foster resilience, reduce environmental impact, promote social inclusion, bridge the digital divide, and ensure that the benefits of urbanization and city technologization are accessible to all members of society.

The complexity of urbanization and city technologization arises from various factors, with interdisciplinary collaboration being one of them. Dealing with these challenges necessitates the involvement of multiple disciplines and sectors. Urban planning, architecture, transportation, energy, environmental science, sociology, economics, technology, governance, and many other fields need to collaborate to address the multifaceted aspects of these challenges (Schmid et al., 2018). The complexity lies in integrating diverse perspectives and expertise to develop comprehensive solutions. Another aspect of complexity is the scale and diversity of urbanization and city technologization. These processes occur on a large scale and impact diverse urban environments worldwide. Cities vary in terms of size, population density, socioeconomic characteristics, cultural contexts, and infrastructure. Finding adaptable solutions that can be tailored to the specific needs and contexts of different cities, while considering their unique challenges and opportunities, presents a complex challenge. Long-term planning and development also pose complex issues. Addressing urbanization and city technologization requires a long-term vision and planning. The decisions made today can have long-lasting impacts that resonate for decades or even centuries. Balancing short-term needs with long-term sustainability and resilience is a complex task, as urban areas need to adapt to evolving socioeconomic, environmental, and technological changes. Finally, the institutional aspect further adds

to the complexity. Numerous stakeholders, including government bodies, private sector entities, community organizations, residents, and academic institutions, have diverse interests and perspectives regarding urbanization and city technologization. These stakeholders often have different priorities, goals, and levels of influence, leading to complex negotiations, decision-making processes, and coordination challenges.

Urbanization and city technologization occur in dynamic and uncertain environments, adding to the complexity. Factors such as population growth, economic fluctuations, technological advancements, and policy changes can be difficult to predict. This uncertainty complicates planning and decision-making processes, as cities must anticipate and adapt to changing circumstances while maintaining long-term goals (Saurav et al., 2021). If not well managed, there can be trade-offs and unintended consequences. Managing urbanization and city technologization involves making difficult trade-offs and understanding potential unintended consequences. For example, while implementing advanced technologies in cities can enhance efficiency and convenience, it may also raise privacy concerns (van Zoonen, 2016). Balancing different priorities and minimizing negative consequences requires careful consideration and evaluation of potential trade-offs. Furthermore, urbanization and city technologization have the potential to exacerbate social inequalities if not addressed properly. Ensuring equitable access to resources, opportunities, and benefits for all residents is a complex task that involves addressing systemic barriers, promoting inclusivity, and tackling socioeconomic disparities. Indeed, cities are dynamic and complex systems influenced by numerous interconnected factors, making it difficult to predict their future outcomes with certainty. Additionally, each city has its own unique characteristics, challenges, and opportunities based on its geographic, social, economic, and cultural context. The local dynamics and context vary across different cities and regions, making it challenging to predict the trajectory of urbanization and city technologization in a generalized manner. The interconnected nature of urbanization and city technologization further complicates the prediction process. Moreover, urbanization and city technologization exhibit emergent properties, meaning that the overall behaviour and outcomes of these processes are not simply a linear sum of the individual factors

involved. They arise from the interactions, feedback loops, and self-organizing mechanisms within the urban system, which can result in unexpected patterns or nonlinear responses. The presence of wicked problems further adds to the complexity (Goodspeed, 2015). Urban development involves multiple stakeholders with diverse interests and decision-making power. The varied priorities, competing interests, and decentralized decision-making processes make it challenging to predict future outcomes accurately. Cities are also vulnerable to unforeseen events and disruptions such as natural disasters, economic crises, technological disruptions, or social upheavals. These events can significantly alter the course of urbanization and city technologization, introducing new challenges or opportunities that may not have been anticipated. Finally, urban development is a gradual process that unfolds over time. Changes in infrastructure, policies, and technology often require significant lead time and may face resistance or inertia in implementation.

Understanding the value-laden nature of urbanisation and city technologisation is of utmost importance as it highlights the subjective and normative aspects inherent in these processes. These phenomena encompass various visions and values of development, and the choices made in urban planning, infrastructure development, and technology adoption reflect societal priorities, goals, and values (Dameri, Rosenthal-Sabroux). These values can encompass economic growth, environmental sustainability, social equity, cultural preservation, public participation, and more. Recognising the value-laden nature of urbanisation and city technologisation helps us comprehend that different stakeholders may hold divergent perspectives on what constitutes desirable urban development. Urbanisation and city technologisation often give rise to conflicts between competing values and interests. For instance, the expansion of urban areas may encroach upon natural habitats, raising questions about environmental conservation and the preservation of biodiversity. Technological advancements may enhance efficiency but also raise concerns about privacy and surveillance. Acknowledging the value-laden nature of these processes enables a more nuanced understanding of the trade-offs involved and the necessity of balancing multiple values and interests. Moreover, urbanisation and city technologisation have profound social and cultural impacts, shaping the way people live, work, interact, and

experience the urban environment. The design of urban spaces, transportation systems, housing policies, and technology applications can influence social dynamics, inclusivity, and cultural identity. Understanding the value-laden nature of these processes helps us recognise the potential impacts on different communities, their cultural heritage, and their ability to participate in decision-making processes. Simultaneously, urbanisation and city technologisation raise ethical considerations. Decisions regarding resource allocation, access to services, technological surveillance, and governance structures can have ethical implications. It is essential to critically examine the values and ethical frameworks that underpin urban development to ensure that these processes align with principles such as sustainability, or respect for human rights (Knebel et al., 2022). In certain cases, recognising the value-laden nature of urbanisation and city technologisation underscores the importance of public participation and democratic decision-making processes. As these processes shape the built environment and impact people's lives, involving diverse stakeholders and communities in decision-making becomes crucial (Popham et al., 2020). Public deliberation allows for the inclusion of different perspectives, values, and concerns in shaping the future of cities. By engaging in critical dialogue, considering diverse perspectives, and promoting inclusive, sustainable, and ethically grounded urban development, we can navigate the complexities and trade-offs involved while striving to meet the needs and aspirations of the communities they serve.

Urbanisation and city technologisation represent both global and local societal challenges. The world is undergoing rapid population growth, with a significant portion occurring in urban areas. This global trend of urbanisation poses challenges in terms of providing – as stated previously – i.a. adequate housing, infrastructure, services, and resources to meet the needs of expanding urban populations. Such challenges have significant environmental implications on a global scale. The escalating demand for resources, increased energy consumption, and waste generation in cities contribute to climate change, pollution, and the depletion of natural resources. Addressing these issues requires collective action on a global scale. Furthermore, achieving sustainable development is a global objective, with urbanisation and city technologisation playing integral roles in this pursuit. Striking a balance between economic growth, social equity, and

environmental sustainability in urban contexts is a shared challenge that necessitates global collaboration and the exchange of knowledge. While cities worldwide encounter similar challenges related to urbanisation and city technologisation, they also face context-specific impacts and obstacles. Each city possesses unique social, cultural, economic, and environmental characteristics that influence the nature and magnitude of the challenges encountered. Local governments, communities, and stakeholders must address these specific challenges to ensure effective urban development. Localities may contend with resource constraints that limit their capacity to manage urbanisation and city technologisation. Limited financial resources, inadequate infrastructure, governance capabilities, and expertise can impede the ability of local governments to address challenges effectively. Urbanisation and city technologisation can amplify social inequalities at the local level. Marginalised communities, low-income groups, and vulnerable populations often face greater difficulties in accessing quality housing, services, and technology, leading to social disparities within cities (Kempin Reuter, 2019). Effectively tackling this societal challenge necessitates active involvement and participation from local communities. Engaging with residents, understanding their needs and aspirations, and incorporating their perspectives into decision-making processes are crucial for successful urban development at the local level. Local governments play a vital role in shaping urbanisation and city technologisation through policies, regulations, and planning. Local decision-making processes and governance structures must be responsive, inclusive, and accountable to effectively address local challenges and harness the opportunities presented by urbanisation and city technologisation. Urbanisation and city technologisation pose a ubiquitous societal challenge of global significance, necessitating international cooperation for effective mitigation (Concilio, Rizzo, 2016).

The predominant strategies observed worldwide in addressing the challenges of urbanization and the advancement of city technology primarily revolve around urban planning and design, cost-effective and carbon-neutral housing endeavours, sustainable transportation and infrastructure investments, social and community development, intelligent urban projects and initiatives, and the utilization of customized governance mechanisms. The subsequent table scrutinises these strategies.

Table II.2. Measures addressing urbanisation and city technologization. Source: own elaboration.

Urban planning and design
• Land-use planning: Implementing comprehensive land-use plans that guide urban growth, promote mixed-use development, and protect natural areas. • Compact city development: Encouraging higher density development to minimize urban sprawl and promote efficient land use. • Transit-oriented development: Designing urban areas around transit nodes to reduce dependence on private vehicles and promote sustainable transportation options. • Green infrastructure: Incorporating green spaces, parks, and urban forestry into city planning to improve environmental quality, mitigate climate change impacts, and enhance residents' well-being.
Affordable housing initiatives
• Affordable housing policies: Implementing regulations and incentives to encourage the development of affordable housing units and ensure that a range of housing options is available for different income groups. • Social housing programs: Establishing social housing programs to provide subsidized housing for low-income households and address housing affordability challenges.
Sustainable transportation and infrastructure
• Public transit development: Expanding and improving public transportation networks to provide accessible, affordable, and efficient mobility options. • Active transportation infrastructure: Creating pedestrian-friendly and bike-friendly infrastructure to promote walking and cycling as alternative modes of transportation. • Smart traffic management: Utilizing technology to optimize traffic flow, reduce congestion, and enhance transportation efficiency. • Sustainable infrastructure: Investing in sustainable and resilient infrastructure systems, such as water and wastewater management, energy-efficient buildings, and renewable energy sources.
Social inclusion and community development
• Community engagement programs: Encouraging active participation of local communities in urban planning processes, decision-making, and implementation of initiatives. • Social integration policies: Promoting social cohesion and inclusion by addressing social disparities, fostering diversity, and supporting community-based initiatives. • Neighbourhood revitalization: Implementing programs to improve the quality of life in disadvantaged neighbourhoods, focusing on infrastructure upgrades, social services, and economic development

Smart city initiatives and digital inclusion acceleration
• Smart city policies: Building on the technologies (IoT, AI, 5G) new capabilities to ease decision making process. • Smart city projects: Enabling the access to information and knowledge, being the framework for new projects and initiatives formation. • Smart city programmes: Establishing new and innovative business models allowing to create more efficient local public services. • Digital inclusion programs: Addressing the digital divide by promoting access to affordable internet connectivity, providing digital skills training, and ensuring access to technology in underserved communities. • Data governance and privacy regulations: Establishing policies and regulations to protect individuals' privacy rights and ensure responsible use of data collected through smart city technologies. • Innovation hubs and tech incubators: Creating spaces and programs to foster innovation, entrepreneurship, and the development of local technology solutions that address urban challenges.
Governance frameworks
• Integrated urban development strategies: Adopting comprehensive strategies that integrate social, economic, and environmental dimensions of urban development. • Decentralization and devolution of powers: Empowering local governments with decision-making authority and resources to address local challenges effectively. • Policy coordination: Ensuring coordination and collaboration among different government agencies, departments, and stakeholders involved in urban development.

These initiatives aim to foster sustainable urban development, improve quality of life, address social inequalities, and promote responsible and inclusive adoption of technology. Successful implementation typically entails a combination of top-down policies, bottom-up community engagement, and collaboration among multiple stakeholders to ensure comprehensive and sustainable urban development. Additionally, it is crucial to emphasize the importance of societal knowledge and the transition of society. Furthermore, it is important to recognize that initiatives such as smart city projects often require significant investments in technology infrastructure and ongoing maintenance costs. Ensuring the economic viability of smart city initiatives and identifying sustainable business models present challenges. Exploring public-private partnerships, innovative financing mechanisms, and considering long-term economic sustainability are critical for the success and scalability of smart city projects (Blanck, Ribeiro, 2021).

Universities play a crucial role as key stakeholders in addressing the societal challenges associated with urbanisation and city technologization. They contribute to comprehending the complexities of urban development, devising innovative solutions, and preparing future professionals and leaders in relevant fields. Through interdisciplinary research, universities deepen the understanding of urbanisation and city technologization, including their impacts and potential solutions (Schmid et al, 2018). The knowledge generated from this research informs policies, planning, and decision-making processes. Universities offer degree programs in various fields such as urban planning, urban studies, architecture, engineering, environmental science, and information technology. These programs equip students with the knowledge and skills necessary to tackle the challenges of urbanisation and city technologisation. Additionally, universities provide training programs, workshops, and seminars to professionals and practitioners working in urban-related fields. These initiatives help enhance their skills and keep them up to date with the latest research and best practices. Moreover, universities establish living labs and demonstration projects within their campuses (Jernsand, 2019) or in collaboration with local communities (Filho et al., 2020). These initiatives serve as testbeds for new technologies, urban design concepts, and sustainable practices. By leveraging their research expertise, educational programs, community engagement, and advisory roles in policymaking, universities make significant contributions to addressing the societal challenges associated with urbanisation and city technologisation. They foster innovation, generate knowledge, and nurture a new generation of professionals equipped with the necessary skills and perspectives for sustainable and inclusive urban development.

Teachers have a valuable role to play in engaging students in understanding urbanization as a societal challenge while also addressing their digital and entrepreneurial competencies. They should accomplish this with case studies and simulations that immerse students in real-world urbanization scenarios. By examining the impacts of urbanization on various stakeholders (see for example: MIT, Urban Studies, and Planning Course, http://catalog.mit.edu/subjects/11/), analysing the complexities involved, and proposing entrepreneurial solutions using digital tools and technologies, students can gain a deeper understanding of the topic.

Teachers can encourage students to explore different technologies used in cities, such as smart infrastructure, Internet of Things (IoT) devices, data analytics, and digital platforms. Through this exploration, students can analyse the benefits, risks, and ethical implications of these technologies, considering their impact on urban life and enhancing their digital literacy skills. Organizing field trips to urban areas or inviting guest speakers from urban planning departments, local government, or community organizations can provide valuable insights and experiences for students. Interacting with experts and community members allows students to understand urban challenges and explore entrepreneurial opportunities to address them.

By incorporating digital technologies and tools into classroom activities, students can utilize mapping software to analyse urban growth patterns, employ data visualization tools to present their findings, or develop mobile applications that address specific urban challenges (see for instance: Urban Big Data Center, www.ubdc.ac.uk). Encouraging students to explore and apply digital tools enhances their technological proficiency, while facilitating entrepreneurship initiatives empowers them to develop innovative solutions for urban challenges. Participation in hackathons addressing urbanization issues can further engage students in collaborative problem-solving. Working in teams, students can combine their digital skills and entrepreneurial mindset to prototype innovative solutions that tackle specific urban problems. Assigning group projects that require students to work together fosters peer-to-peer learning, collaboration, and the sharing of ideas and resources. Teachers should also encourage reflective and critical thinking by prompting students to analyse the social, economic, and environmental impacts of urbanization. Exploring the ethical dimensions of urban development, considering unintended consequences, and reflecting on the role of entrepreneurship in creating sustainable and inclusive cities will contribute to a well-rounded understanding of the subject matter.

Further recommendations for teachers could suggest to:

- present case studies and real-world examples of city technologization initiatives from different regions around the globe. Students can delve into the successes, challenges, and social impacts of these initiatives, fostering critical

thinking and a comprehension of the entrepreneurial opportunities and ethical considerations associated with city technologization.

- introduce students to data analysis techniques and visualization tools. By examining urban data sets, students can identify patterns and trends, and effectively communicate their findings through visual representations. This enhances their digital skills, data literacy, and their ability to leverage data for entrepreneurial purposes.
- invite guest speakers from technology companies, startups, or urban planning departments to share their experiences and insights on city technologization. Foster partnerships with local tech organizations or urban innovation hubs to provide students with hands-on experiences, mentorship opportunities, and exposure to entrepreneurial activities in the urban tech sector.
- promote digital storytelling as a means for students to communicate their understanding of city technologization. Encourage them to create videos, websites, or interactive presentations that convey the social, economic, and environmental impacts of urban technologies, and discuss potential entrepreneurial opportunities arising from these advancements.

By incorporating these pedagogical approaches into teaching, students can actively participate in understanding urbanization and city technologization as a societal challenge, while simultaneously developing their digital and entrepreneurial competencies. These approaches empower students with the necessary knowledge, critical thinking abilities, and entrepreneurial mindset to navigate the intricate terrain of urban technology. Furthermore, they enable students to contribute to the creation of inclusive and sustainable cities amidst the ongoing process of urbanization.

Take-aways:

- Urbanization and city technologization are interrelated challenges that place strains on resources and attract individuals to urban areas in search of opportunities and an improved standard of living.
- The impacts of urbanization and city technologization encompass increased demands for infrastructure, environmental consequences, social inequalities, and governance complexities.
- Urbanization and city technologization are intricate challenges due to their susceptibility to unpredictable dynamics influenced by various interconnected factors.
- Urbanization and city technologization are value-laden matters as they involve societal values, ethical considerations, and trade-offs during decision-making processes.
- Urbanization and city technologization are both global and local challenges, as they have ramifications at different scales, ranging from individual cities to regional and global contexts.
- Instances of urbanization and city technologization as societal challenges include strained infrastructure, inequitable access to services, environmental degradation, and privacy concerns.
- Measures aimed at addressing these challenges encompass urban planning, affordable housing initiatives, sustainable transportation, social inclusivity, digital inclusion, and policy frameworks.
- Universities contribute to these efforts through research endeavours, offering educational programs, engaging in community partnerships, providing policy advice, and fostering international collaborations.
- Teachers can engage students in understanding urbanization and city technologization by incorporating case studies, fieldwork experiences, technology integration, entrepreneurship initiatives, and reflective thinking. These approaches aid in the development of students' digital skills, entrepreneurial competencies, and comprehension of the complexities and opportunities associated with urbanization and city technologization.

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PART III – DIGITAL SKILLS AND ENTREPRENEURIAL COMPETENCES

CONTEXTUALISING THE DIGITAL SKILLS

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1. The Digital Era: Global Transformation

Thanks to constant technological progress, the world is currently undergoing an economic transformation (referred to as the fourth technological revolution), which is changing the traditional view of people's position on the labour market and the content of their work. This phenomenon is considered the era of digitization and is associated with the automation and digitization of work. It occurs in all industrial sectors, whether in agriculture, manufacturing, retail or services like administration, health care or business intelligence, and is present all over the world. Traditional activities performed by people are gradually being replaced by artificial intelligence and specialized robots. Common activities, such as production, packaging or distribution of various products, registration and processing of company customer requests, or customer satisfaction surveys,

are nowadays increasingly performed by specialized machines with specific software.

These changes can be already seen in labour markets today, and they will massively affect the structure of job markets in the future. These challenges point to the need to build and acquire specific skills and competencies for people, especially around working with computers, using specific software, and designing digital services.

The growing demands for digital skills are already present in most of the EU countries. For example, the European Commission through the European Centre for the Development of Vocational Training (CEDEFOP) conducts the European skills and jobs survey (ESJS), which is aimed at collecting information on the skill requirements, skill mismatches and initial and continuing learning of adult workers in EU labour markets. In 2021, CEDEFOP conducted the 2nd ESJS wave aimed to inform the policy debate on the impact of new digital technologies and technological change on the future of work and skills. The survey was also affected by the context of the COVID-19 pandemic. The focus of the 2nd ESJS was on the relationship between technological change, changing job-skill requirements and skill mismatches of EU adult workers, as well as on their adaptability to such trends via remedial vocational education and training.

The interim results of the survey (CEDEFOP briefing note, 2021) showed that within EU countries there is an increasing demand for specific skills in positions where the digital content is strongly present. These are positions such as:

- software development,
- managing & analysing digital data,
- creative design,
- finance banking & insurance,
- digital collaboration,
- networks & databases,
- ICT programming,
- or use of computers.

Of course, this demand in the labour market will be accompanied with several changes in society. On the one hand, it will bring benefits to some communities and individuals who keep up with the times and adapt to current and future trends. And on the other hand, due to the technological progress and digitalization, several

traditional job positions will become redundant, with substantial layoffs as a result. Among job positions, for which the digitalization is expected to lead to positive employment growth, are found (according to Mandl, 2021):

- traditional engineering profiles, such as engineers and quality control staff,
- newer profiles, such as industrial data scientists, big data statisticians and data security analysts,
- workers with a multidisciplinary skill set, such as managers with advanced data analysis/statistical competencies,
- workers with advanced management capabilities and soft skills.

On the other hand, anticipated changes in the labour markets are also associated with potential problems that will affect the jobs that are most threatened by digitization and automation. Among the negative impacts of digitalization on society are (Mandl, 2021):

- job loss for low-skilled routine workers,
- limited capabilities of workers and the education system to adapt to changing skills needs,
- labour shortages in science, technology, engineering, and mathematics (STEM) and with regards to workers with multidisciplinary skill sets,
- increase in involuntary atypical employment.

The digital transformation of the society is nowadays present throughout the EU. However, there are significant differences between individual countries. This can be seen, for example, from The Digital Economy and Society Index (DESI), which is an index compiled by the European Commission. This index summarizes indicators on Europe's digital performance and tracks the progress of EU countries. DESI includes country profiles which support Member States in identifying areas requiring priority action as well as thematic chapters offering a European-level analysis across key digital areas, essential for underpinning policy decisions. The index consists of indicators from the areas of human capital, connectivity, integration of digital technology and digital public services. Data for 2022 (European Commission, 2022a) show that the most digitized economies and communities in the EU are found in Finland, Denmark, and the Netherlands. On the other hand, the least digitized are in Greece, Bulgaria, and Romania. To maintain competitiveness

with developed countries and communities, it is therefore important that lagging countries and communities start taking measures for changes in their economies. They should take measures that lead to greater information and communication connectivity between their communities, greater digitization of government services, and place greater emphasis on training and teaching digital skills and competencies within their national education systems.

2. What are digital skills?

The digital transformation of society today requires mastering the use of various digital tools, whether in the field of work, education, administration, or tourism. Mastering these applications often refers to mastering digital skills, sometimes called digital literacies (Oberländer et al., 2020). Defining what digital competencies are is not something simple. Martin (2005, p. 155) proposed that digital literacy is "the awareness, attitude and ability of individuals to appropriately use digital tools and facilities to identify, access, manage, integrate, evaluate, analyse and synthesize digital resources, construct new knowledge, create media expressions, and communicate with others, in the context of specific life situations, to enable constructive social action; and to reflect upon this process". Resulting from a literature review of educational studies, Ilomäki et al. (2016) described digital competencies as the skills and knowledge required to be involved in and contribute to a digitalized society. More recently, results from the European DigiComp project (Carretero et al., 2017) identified five areas of digital competencies, namely: 1) information and data literacy; 2) communication and collaboration; 3) digital content creation; 4) safety; and 5) problem solving. Each of them contains different competencies (Table III.1).

Table III.1. Digital competencies areas and dimensions according to Carretero et al. (2017)

Competence Areas	Competence Dimensions		
1. Information and data literacy	1.1 Browsing, searching, and filtering data, information, and digital content	1.2 Evaluating data, information, and digital content	1.3 Managing data, information, and digital content
2. Communication and collaboration	2.1 Interacting through digital technologies	2.2 Sharing through digital technologies	2.3 Engaging in citizenship through digital technologies
	2.4 Collaborating through digital technologies	2.5 Netiquette	2.6 Managing digital identity
3. Digital content creation	3.1 Developing digital content	3.2 Integrating and re-elaborating digital content	3.3 Copyright and licenses
	3. 4 Programming		
4. Safety	4.1 Protecting devices	4.2 Protecting personal data and privacy	4.3 Protecting health and well-being
	4.4 Protecting the environment		
5. Problem solving	5.1 Solving technical problems	5.2 Identifying needs and technological responses	5.3 Creatively using digital technologies
	5.4 Identifying digital competence gaps		

In their report, Carretero et al. (2017) defined eight proficiency levels regarding digital competencies. The first and second ones relate to the foundation of knowledge, where the aim is to complete simple tasks with (1) or without (2) guidance and with remembering as the main cognitive process in place. Levels three and four relate to tasks that are well-defined and straightforward problems (3), up to the ability to solve non-routine problems (4) independently. In that level, understanding becomes the main cognitive process. Users are considered as advanced when they complete different tasks and problems, choose the most appropriate task for a particular issue, and can guide others (level 5), or to adapt to others in a complex situation (6). In that case, the cognitive process ranges from applying knowledge, to evaluate a situation and adapt to it. Finally,

levels seven and eight required highly specialized knowledge to resolve complex problems with limited solutions (7) or with many interacting factors (8). It relates to the process of creation when the finality is to practice and guide others (7) or to propose new ideas and processes to the field (8). The European framework for the digital competencies of educators (Redecker, 2017), proposes that the progression to digital competencies goes from awareness to leadership and innovation. It must be mentioned that the ISTE standards for educators have been develop in the US to guide teachers on how to empower learners regarding digital technology (Crompton, 2017), and that the professional digital competence framework for teachers was developed for the Norwegian situation (Kelentrić et al., 2017). Despite the variety of frameworks produced, the Digicomp framework (Carretero et al., 2017), that gained momentum worldwide (Oberländer et al., 2020; Zhao et al., 2021), will serve as the foundation for this handbook.

Despite the growing interest in digital competencies in education and institutions, Zhao et al. (2021) shows, in a literature review from 33 papers regarding digital competencies and higher education, that university students and teachers still have a basic level of digital competencies. This is one of the main reasons for the development of the Digi-Soc project. The level of digital competencies in higher education also depends on the policies implemented by the universities and on their digital policies and the elements that are introduced in the curriculum.

3. Implementation of digital skills

3.1. Insights from the literature

Literature on digital technology suggests that digital transitions, including the development of technologies such as artificial intelligence, big data analytics, mobile and social media technologies, and the Internet of Things, can contribute to environmental, social, and economic sustainability (Rosário, Dias, 2022). In the industrial literature, digital transformation is often seen as capable of making a company more resilient to risk (Bondar et al., 2017).

However, various barriers limit the implementation of digital transformation. In the manufacturing sector, Vogelsang et al. (2019) show that the main barriers to digitalization are related to a lack of skills in terms of process and IT knowledge, and information about technologies. They also raise the issue of technical barriers, such as the fact that one technology sometimes depends on other technologies that need to be known, cybersecurity, or the mismatch between new technologies and current infrastructures. They also identifiy barriers related to individual fear of losing control over data production, lack of transparency, and fear of job loss. Other barriers relate to cultural and organizational issues such as lack of strategic vision, risk aversion, traditional management or lack of time and financial resources. Finally, there are environmental barriers related to the lack of standards and legislation around technology.

Bjerke-Busch, Aspelund (2021) found similar results for the digital transformation of public institutions in Norway. In their study, barriers are based on external and internal factors, where external barriers can be a lack of financial cross-funding, lack of digital competence and mindset of politicians, lack of arenas for collaboration, or cultural and normative barriers. Internal barriers can be related to hierarchical and divided work structures, as well as to a lack of willingness to use digital tools, lack of experience among users or resistance to changing roles and work tasks.

Beyond the private and public sectors, the implementation of digital transformation needs to be accepted by citizens. In their study, Liu, Zowghi (2022) show that citizen involvement in digital transformation can be mediated by different types of communication, whether human-mediated, computer-mediated and hybrid. In addition, digital transformation faces moral barriers related to the exclusion of people. This needs careful consideration, as research already shows that digital transformation needs to be accompanied by digital literacy and education to provide inclusive tools (Buchert et al., 2022; Durand et al., 2022; Schou, Pors, 2019).

Given the sometimes-significant barriers to the implementation of digital competencies in society, one issue might be to focus on how education is addressing this challenge. In the following section, we will review how our universities are implementing digital literacy and discuss the main challenges and issues to be considered in higher education.

3.2. The role of educational institutions

Digital skills are part of all three missions of higher education institutions – educational, research and the so-called third task. Universities prepare students for the current and future requirements of the labour market, as well as for the requirements of their participation in social life in the future digital society.

A survey among higher education institutions in the EU (Gaebel et al 2021) mapped what changes universities have made in the development of digital skills. In terms of institutional anchoring, for many schools, the digitization strategy is part of the already existing overall development strategies of the university, 16 percent have a separate strategy and 12 percent have no strategy. The COVID-19 pandemic has created pressure to digitize the functioning of schools. Respondents stated that the main impact was the increase in the use of digital technologies in education, but that greater cooperation with other schools was also important. Only to a lesser extent did digitization contribute to deepening cooperation with employers or with the wider society. Universities consider new teaching methods based on digital technologies to be beneficial especially from the point of view of introducing new teaching methods and greater flexibility in teaching. More than half of universities (54%) responded that the development of general digital skills is part of almost all degree programs, and a further 26 per cent that it is part of at least some programs. But the study also showed that these are often only given on an optional basis. In the teaching of digital skills, it is mainly about general digital skills or digital skills specific to the given discipline or study area. The ethics of behaviour in the digital space, as well as security, are mostly only part of selected study programs. Among the main digital skills that universities plan to deepen in the future are artificial intelligence and machine learning.

As Laufer et al. (2021) notes, digitization in higher education has brought new possibilities for students, namely individualized education, or lifelong learning. On the one hand, it increased the level of equality for students from less represented social groups. At the same time, however, it created new differences between students who do not have the same conditions for studying in their

households (e.g., technological barriers but also unfavourable family conditions).

In 2022, the European University Association (EUA) issued 3 main recommendations for the development of digital skills in higher education institutions (EUA 2022):

1. Recognise and support the role of higher education institutions in the digital transformation, including for skills development.
2. A more comprehensive and shared understanding of digital skills. This mainly means an emphasis on digital skills as problem-solving skills to enhance students self-learning autonomy and capacity.
3. Improve the knowledge and evidence base. This mainly includes to improve evidence and information on skills needs.

Relevant government organizations and educational institutions should react to these upcoming societal changes to meet with the actual and forthcoming requirements of the labour markets. Relevant government organizations should provide sufficient resources and capacities from the legal, financial, and institutional perspectives to educational institutions. The support must enable them to implement new educational procedures, practices, and technologies, to facilitate this societal transition.

Educational institutions, with the help of relevant government organizations, should be able to adapt their curricula to reflect current labour market needs. Educational programs that support and improve digital skills and competencies should be introduced and taught by educational institutions at the primary level. Of course, the range and depth of competencies should be adjusted based on the difficulty of the level of education. Regarding the teaching of the necessary digital competencies for the needs of the labour market, higher education institutions are the most important institutions for imparting suitable digital competencies. Colleges and universities should promote and educate more demanding and complex competencies. In the digital transformation, higher education institutions have an opportunity to facilitate access to education for individuals of different social backgrounds. At the same time, universities and colleges provide to students with the necessary tools and skills to face current global problems (poverty, health

quality, income disparities, environmental crises, among others) from a transdisciplinary perspective (Kaputa et al., 2022).

These institutions play a key role in this process, as they provide a high level of education and prepare future employees and employers for specific industries. For all economies that want to be competitive in the international competition in the future, it is necessary to start with adaptations and changes aimed at supporting digital skills at their colleges and universities.

Regarding these challenges, the European Commission in 2020 introduced The Digital Education Action Plan for the years 2021 –2027 (European Commission, 2022b). It is a policy initiative that sets out a common vision of high-quality, inclusive, and accessible digital education in Europe, and aims to support the adaptation of the education and training systems of Member States to the digital age. The Digital Education Plan sets out two strategic priorities and fourteen actions to support them. Priority no. 1 is oriented towards fostering the development of a high-performing digital education ecosystem. Priority no. 2 is oriented towards enhancing digital competencies for the digital transformation.

To foster a high-performing digital education ecosystem, it is important to focus and improve following points (DEAP, 2020):

- infrastructure, connectivity, and digital equipment,
- effective digital capacity planning and development, including effective and up-to-date organizational capabilities,
- digitally competent and -confident educators and education & training staff,
- high-quality content, user-friendly tools and secure platforms, which respect privacy, and follow ethical standards.

To enhance digital competencies for the digital age, it is important to improve the following (DEAP, 2020):

- support the provision of basic digital capabilities and competencies from an early age:
  - digital literacy, including management of information overload and recognizing disinformation,
  - computing education,
  - good knowledge and understanding of data-intensive technologies, such as AI,

- boost advanced digital skills: enhancing the number of digital specialists, and of girls and women in digital studies and careers.

To fulfil the mentioned priorities, it is necessary for the universities and colleges to carry out activities that are in accordance with the established Digital Education Action Plan. Therefore, it is important that individual universities have adopted their own strategies and plans, with clearly defined priorities and activities, with which they can improve their technical foundation, teaching curricula and operational staff (teachers, academics, and other personnel) and thereby contribute to the fulfilment of the Digital Education Action Plan.

3.3. Fostering digital skills

"Research at the Massachusetts Institute of Technology suggests that students' brain activity while listening to teacher lecturing in the classroom is lower than while sleeping (Fullan, Langworthy, 2014)." – from Caena et Redecker, 2019. "Helping students to take ownership of their learning through ongoing assessment and reflection on their progress is essential. If they are asked to create, share and connect knowledge to the world, deploying the information and collaboration opportunities offered by digital tools, this can catalyse meaningful learning and increase student motivation (Fullan, Langworthy, 2014)." – from Caena et Redecker, 2019.

What makes it difficult for academics to teach? As noted above, digital skills are becoming more widespread and are gaining momentum in society. This point requires the education world, especially higher education, and universities in particular, to prepare students by bridging tools, methods, and awareness of the "digital challenges". It is also important for teachers to reach a satisfactory level of competence using digital tools to be able to teach digital tools (Caena, Redecker, 2019). However, academics can report that even if they have access to digital technology in their faculty, they often do not know how to use it in their courses. (Pomerantz, Brooks, 2017).

Various barriers have been identified by educational researchers. For example, the work of Polly et al. (2021), at a Southeastern University in the United States, reports that different types of

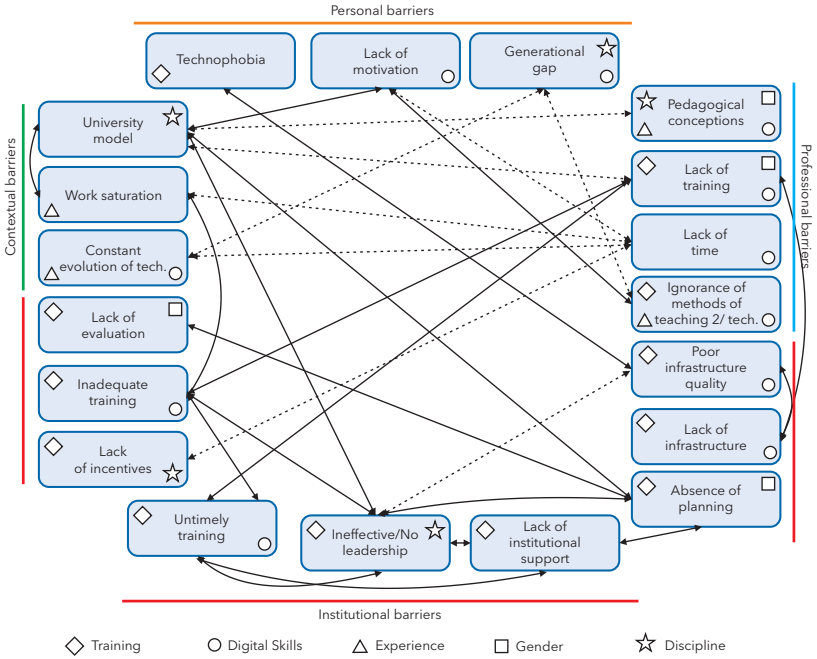

Fig. III.1. MBIT model proposed by Mercader (2020, modified). Grey lines represent strong relationships and dotted lines weak relationships, based on qualitative and quantitative results.

barriers are encountered by faculty members to use digital technologies in their courses. The first barrier is related to a lack of time. Respondents feel a lack of incentive from their institutions to create content and reasons to invest in creating digital content. Teachers also report a lack of time to attend workshops that would enable us to acquire more digital skills for teaching. Faculty also report that the ever-changing tools and complexity of technology are barriers to their use and create a sense of being behind the curve. They also raised concerns about the complexity of intellectual property and security issues associated with digital content, as well as difficulties with student equipment (PC vs. Apple computers), which means that certain programs will not work on either type of equipment or that teachers will have to adapt, adding to the cost of digital education. Finally, the report raises the question of the design of

the learning environment and how it is often not adapted to digital teaching and the use of technology.

In her work, Mercader (2020) highlights that other factors influence the adoption of digital technologies. These can be related to age, experience, or gender (Lane, Lyle, 2011), teaching experience (Monacis et al., 2019), or even the academic discipline in which the teacher is involved (Mercader, Gairín, 2020). As a result, Mercader (2020) worked to develop a Model of Barriers to the Incorporation of Digital Technologies (MBIT). By conducting a mixed methodology targeting 527 professors (quantitative) and 29 professors (qualitative), he shows that the most frequently cited barriers are technophobia, lack of time, lack of planning, lack of incentives, lack of evaluation, work saturation, and university accreditation model. The result of the correlation (Figure III.1) also suggests the strong correlation between ignorance of the teaching method, including digital tools, and lack of motivation and the university model involved. Furthermore, this university model is correlated with a lack of planning and ineffective leadership. Correlations also appear with lack of training and inadequate or untimely training proposed by the institution.

CONTEXTUALISING THE ENTREPRENEURIAL COMPETENCES

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1. The Importance of Being Earnest and Animated by an Entrepreneurial Spirit

As we live in a rapidly developing and changing world that brings many different global challenges to individuals as well as to communities, it is imperative that we all improve individual areas of our lives. There are several societal problems today, ranging from environmental issues, military, energy, and health crises to the continuous flood of new technologies that are beginning to replace the human workforce. One of the areas that can significantly contribute to finding effective and practical solutions for various social problems in the future is a healthy, competitive business environment. An excellent competitive business environment generates countless entrepreneurial opportunities and ideas, promotes new collaborations, or enables individuals to work with others, thus shaping the future for the common good. For this reason, it is crucial for communities and countries to maintain their competitiveness to satisfy

current needs and secure their competitiveness for the upcoming future. For individual economies to be competitive, it is essential that their central governments, professionals and professional associations, the non-profit sector, and other vital actors jointly create suitable conditions for developing the business environment and entrepreneurial culture.

Small and medium enterprises (SMEs) play a crucial role in economies. According to the World Economic Forum initiative for Future Readiness of SMEs and Mid-Sized Companies (World Economic Forum, 2023a), SMEs represent around 90% of all firms globally, employ roughly 70% of employees, and contribute to up to 70% of global gross domestic product (GDP). At an aggregate level, these businesses play significant roles in enabling, constraining, and shaping the nature of growth, innovation, and sustainability of global, regional, and local economies. The main reason why SMEs will play an essential role in overcoming these social challenges, in addition to their high share of employment or GDP creation from a global perspective, is that their competitive advantage is that they have smaller portfolios of activities to perform. This fact leads to fewer and more direct communication channels between their departments. The smaller scale within SMEs allows them to react more effectively and quickly to different emergencies and challenges. Furthermore, the initiative argues that when business models need to pivot, either to keep pace with volatile conditions or to take advantage of market opportunities, SMEs tend to be better positioned to implement a revised or new business model.

Furthermore, the World Economic Forum's Future of Jobs Report 2023 (World Economic Forum, 2023b) also points to a need to change the entrepreneurial environment and business mindset. The report assesses the impact of macro trends on jobs and skills over the next five years and the relevant role of technological changes. The report finds that nearly a quarter of all jobs globally will change in the next five years. Investment in the green transition, as well as increasing consumer awareness of sustainability issues, will create new opportunities. For example, renewable energy engineers, solar energy installation, systems engineers, sustainability specialists and environmental protection professionals will be in high demand, translating to an estimated growth of approximately one million jobs. Modern technologies will create structural change,

with a quarter of companies seeing job decline from new technology adoption and more than half seeing job growth. The Future of Jobs Report 2023 also suggests that the human-machine frontier is shifting to new terrain. While expectations of the displacement of physical and manual work by machines have decreased, tasks requiring reasoning, communicating, and coordinating are expected to be more automatic soon. This recent report also provides a list of skills nowadays needed in the entrepreneurial area. The list of top 10 skills on the rise contains various elements, such as cognitive skills, self-efficacy, management skills, technology skills, working with others, and engagement skills, that are already in high demand. The list contains the following skills:

- Creative thinking,
- Analytical thinking,
- Technological literacy,
- Curiosity and lifelong learning,
- Resilience, flexibility, and agility,
- Systems thinking,
- AI and big data,
- Motivation and self-awareness,
- Talent management,
- Service orientation and customer service.

The arguments mentioned above are going to require a change of skills and competencies in the job market. These arguments only increase the emphasis on the existing need for active education in the field of entrepreneurship and business environment. Several international organisations, such as the European Commission (EC) and the Organisation for Economic Cooperation and Development (OECD), provide various recommendations, reports and support mechanisms aimed at improving education in the entrepreneurial environment. These organisations have been aware of the importance of delivering entrepreneurship education for a long time. For example, the European Commission provided recommendations for universities to improve education in this field in 2008 with the report: "Entrepreneurship in Higher Education". According to this report (European Commission, 2008), entrepreneurship education and training should aim to develop entrepreneurial capacities and mindsets that benefit economies by fostering creativity, innovation, and self-employment. The expert group writing this report

identified potential obstacles for higher education institutions when adapting new entrepreneurship courses, programmes, and activities in higher education. An indicative list of principal risks and barriers identified by the experts (European Commission, 2008) is set out below:

- Lack of support from decision-makers,
- A bureaucratic culture inside institutions and organisational inertia; inappropriate institutional policies, practices, cultures, and structures,
- Conflicting academic philosophies on the role of entrepreneurship in higher education,
- Lack of cooperation among different departments/faculties,
- A negative image of entrepreneurs and a lack of positive role models for young people,
- Only a minority of professors and professionals are committed,
- Courses are taught just as academic courses by educators who have no link with business life,
- Entrepreneurship may not be correctly understood, with a risk that this "heading" is used to "cover" any business courses (e.g., finance, marketing, accounting),
- Failure to get students enthusiastic about this type of course,
- No understanding of the need for tailored programmes,
- Poor use of a broad base of pedagogical tools,
- Lack of rewards, incentives, and recognition for faculty and educators,
- Lack of alignment between practices, outcomes, and impact,
- The business world tends to underestimate the universities' role as a driver of economic development,
- Sustainability issue: the fragility of funding and resources.

On the other hand, the expert group also identified potential rewards (as factors of success). An indicative list of the main benefits identified by the experts (European Commission, 2008) is set out below:

- Support programmes for entrepreneurship educators are in place,

- A back-up infrastructure of venture capital and bodies that can support entrepreneurship is present,
- There is a common understanding of the need for cultural change from a bureaucratic culture to an entrepreneurial culture, and there is an institutional progression towards an entrepreneurial university model,
- The impact of entrepreneurship education is clear,
- Institutions can provide students with a diversity of learning experiences,
- Universities are integrated adequately into their territorial, economic and social environments and interact with all stakeholder groups,
- Professors and educators are highly qualified, and academic expertise is combined with practical experience,
- The focus of teaching is not only on start-ups, and the concept of entrepreneurship is not simply equated with business,
- Student-led approaches are encouraged.

Regarding specific entrepreneurial competencies that should be cultivated in society for a better entrepreneurial environment, The European Commission has developed the European Entrepreneurship Competence Framework (EntreComp). It offers a comprehensive description of entrepreneurial competencies that can be used across sectors, disciplines, and systems to enable people to develop entrepreneurial competencies in individuals and groups. EntreComp identifies fifteen competencies in three key areas that describe what it takes to be entrepreneurial. To be entrepreneurial means more than business start-ups and commercial activity. EntreComp has an essential task in opening conversations and understanding what it means to be entrepreneurial in all aspects of life. Detailed information about EntreComp and entrepreneurial competencies is described in the following chapter.

2. What are entrepreneurial competencies?

The various challenges facing society require, among other things, that individuals be empowered to be actively engaged with ideas

and opportunities to build a sustainable future (European Commission, 2016, 2018, 2023).

Accordingly, the scientific literature has focused on an "entrepreneurial mindset" but without being able to define it properly. The first research in the fields related to the characteristics of entrepreneurs that make us successful, highlighting creativity, perseverance and autonomy (e.g., Baum, Locke, 2004; Cromie, 2000, synthesised by Daspit et al., 2023). More recently, Davis et al. (2016) wrote that the entrepreneurial mindset is defined by a "constellation of motives, skills and thought processes", but it has been criticised for remaining vague and challenging to understand, limiting the development of a common understanding (Daspit et al., 2023).

Table III.2. Entrepreneurial competencies areas and dimensions according to the European Commission (2018).

Competence areas	Competence dimensions				
1. Ideas and opportunity	1.1 Spotting Opportunities	1.2 Creativity	1.3 Vision	1.4 Valuing Ideas	1.5 Ethical and sustainable thinking
2. Resources	2.1 Self-awareness and self-efficacy	2.2 Motivation and Perseverance	2.3 Mobilising Resources	2.4 Financial and Economic Literacy	2.5 Mobilising others
3. Into action	3.1 Taking the Initiative	3.2 Planning and Management	3.3 Coping with Uncertainty, ambiguity, and risk	3.4 Working with others	3.5 Learning through Experience

Faced with this difficulty, the European Commission has set up the EntreComp framework (2018), which clearly defines what someone can learn, understand and do based on the different entrepreneurial competencies. The framework aims "to help citizens to develop their capacity to participate actively in society, to manage their own lives and careers and to take value-adding initiatives" (European Commission, 2016, p. 10). The report defines entrepreneurship as "the capacity to act upon opportunities and ideas and transform them into value for others. The value created can be financial, cultural or social" (European Commission, 2018, p. 4).

The competency framework consists of three areas:

1. Ideas and opportunities,
2. Resources,
3. Into Action.

Each area is further divided into five specific groups of competencies (Table III.2).

The framework is also based on eight proficiency levels, making evaluating the learner's progress in the different competencies possible. The levels of proficiency for EntreComp are the same as for the DigiComp framework and have been duly described in this handbook.

The three areas of competence are intertwined and represent the different facets of the definition of entrepreneurship. According to the European Commission (2016, 2018 and 2023), there is no gradation between them, and all three are necessary to achieve the objective. More specifically, based on European Commission (2016, 2018 and 2023) reports, ideas and opportunities are about developing vision and attitudes towards possibilities.

Identifying opportunities means that learners use their imagination and ability to identify opportunities that can create value, for example, by correctly identifying the challenges that need to be overcome or by developing the ability to make new connections to create opportunities.

Creativity refers to developing new ideas by exploiting, combining, and bringing forward new solutions.

Vision and valuing ideas refer to the process of imagining the future and identifying the potential to create value based on an idea. Ethical and sustainable thinking is a more reflexive competence that encourages the learner to reflect on the consequences of the proposed concept and its development, especially regarding sustainability.

The resource area focuses more on the "how" of the entrepreneurial process. It is based on self-awareness and self-efficacy, which aim to develop self-confidence in what can be done and believed, for example, in the ability to influence the event, overcome uncertainty or reflect the needs, want and aspiration in the long term.

Motivation is based on the idea of staying focused and not giving up during the process. It includes being determined, prepared, patient and resilient under pressure and potential failure.

Resource mobilisation involves managing the means needed and the means obtained. It requires the efficient use of resources to turn ideas into action. Financial and economic literacy is based on developing financial and economic know-how to estimate the cost of the concept, make decisions and manage finances in the long term. Finally, mobilising others relies on inspiring, enthusing, and getting people on board to work in a team and to communicate effectively.

The area "into action" is based on taking initiative, acting, and working to achieve a goal. Planning and management are set up to encourage prioritisation and organisation to achieve short-, medium- and long-term goals. Coping with uncertainty is a competence aimed at helping learners make decisions in uncertain and risky contexts.

Working with others is an extension of mobilising others' competence and aims to team up and manage conflict and competition effectively.

Finally, learning through experience is translated as "learning by doing", and the idea of using initiation to create value as a learning opportunity and to learn with others and reflect on successes and failures.

3. Lessons learned and recommendations

The following section deals with an analysis of those successful start-uppers who transformed a former brilliant idea into a successful business is considered. They represent a valid example to evaluate the importance of understanding people and market needs to develop a successful business model (section 3.1). Then, based on the previous section, we try to extract some recommendations to help young people start an entrepreneurial activity (section 3.2).

3.1. What can we learn from start-uppers? Comments on international successful examples

Several examples of famous worldwide start-uppers can be mentioned. In Table III.3, we tried to remark on the reasons for their success and the competencies they embraced.

Table III.3. Famous start-uppers and their competencies

Innovator (alphabetical order)	Enterprise	Market need / competencies
Agarwal, Ritesh	Oyo Rooms	Service-Database / Digital – Technical
Bezos, Jeff	Amazon	Service-Delivery / Digital – Social
Branson, Richard	Virgin Group	Service- / Digital – Social
Ellison, Larry	Oracle Corporation	Database-Software / Digital – Technical (software)
Gates, Bill and Jobs, Steve	Microsoft and Apple	Software / Digital – Technical (software)
Musk, Elon	SpaceX, Tesla	Satellites and Space travel / Digital – Technical
Page, Larry with Brin, Sergey	Google	Algorithms / Digital – Technical (software)
Sharma, Vijay Shekhar	Pay Through Mobile	Digital system / Digital – Technical
Zuckerberg, Mark	Facebook, Meta	Service-Virtual environment / Digital – Technical & Social (software)

Richard Branson is best known as the founder of Virgin Group, comprised of more than 400 companies worldwide.

Bill Gates is one of the most famous entrepreneurs in the world. He's an American business magnate, investor, author, and philanthropist. He founded Microsoft, which he launched along with Paul Allen in 1975. In this case, the market need was the exploitation of the massive number of digital calculations that a computer can do, the development of a simple operative system and an entire family of software for personal or industrial use.

Steven Paul Jobs (popularly known as Steve Jobs) was an American entrepreneur and investor. If you use a smartphone, specifically an iPhone, you probably know who Steve Jobs is! He started

unconventionally, but his idea about product design led to unforgettable innovative objects. His life and industrial path were described in several books.

Larry Ellison is one of the most famous entrepreneurs of all time. He is the co-founder of Oracle Corporation.

Jeff Bezos founded Amazon; the largest eCommerce marketplace used by millions of customers worldwide. His favourite book on business and entrepreneurship is "Built to Last: Successful Habits of Visionary Companies" by Jim Collins and Jerry I. Porras. He started his career with a brilliant idea that is a stringent need of women with new born children: buying diapers! It means very large – even if not heavy – packages that are difficult to carry. Besides, new-borns quickly grow, and the risk is a waste of money because of the need for a new purchase of a bigger size of diapers before all the previous were used. Bezos proposed a successful market formula: first, Amazon solved the transportation problem with a delivery service. Then, Amazon could also withdraw the residual number of diapers and substitute these items with new products. This service represents a win-win situation. Amazon identified several other needs and is still evolving and changing its business model, but the main entrepreneurial character – beneficial services for all of us – is kept alive.

Larry Page is one of the most successful entrepreneurs who founded Google with Sergey Brin. Sergey Brin is also an American entrepreneur and investor who partnered up with Larry Page to launch Google in 1997 on 15th September. They developed a search algorithm that is very efficient for the internet as a first step. Soon, the start-up started looking for new market sectors in the same industrial area.

Elon Musk is a technology entrepreneur and engineer with multiple citizenships, including South Africa, Canada, and the U.S. He is famously known for SpaceX.

Vijay Shekhar Sharma, one of the top entrepreneurs in the world, founded Paytm (Pay Through Mobile). Paytm offers a digital wallet and is India's most extensive eCommerce payment system.

Mark Zuckerberg founded the popular social media platform Facebook and, recently, Meta. As a university student, he understood the need of all his pairs to have a specific environment for social activities.

Ritesh Agarwal founded Oyo Rooms. It is the best Indian online Hotel booking site.

As a result, it is possible to observe an important point: all the star-uppers identified market needs and were ready to solve the need brilliantly with proposals characterised by specific know-how and competencies. Besides, their entrepreneurial ideas were always not only accepted but expected by many customers. Even through a simple analysis, a tight connection between owned competencies and developed business models is evident. Social and digital competencies are identified as the main ones to be considered in the case of the examined start-uppers.

3.2. Recommendations to start an enterprise for helping young people

This section joins several fundamental issues for someone wanting to be an entrepreneur and start an enterprise. In sections 3.2.1 and 3.2.2, principles for being a successful entrepreneur and the main errors to be avoided are introduced, respectively. The connections to those educational activities that can help young entrepreneurs during their school and college years are remarked.

3.2.1. Main principles to be considered for being a successful entrepreneur

The digital transformation, which is described in the manifesto for Industry 4.0 in the case of the industrial sector, gives new opportunities for new businesses in several sectors like online education, health and wellness, software as a service and remote work tool, e-commerce, online gaming, e-sports, streaming and coworking platforms, pharmacy, laboratories, digital agriculture, blue economy. The horizontal digital areas, for example, Artificial Intelligence, Digital Twins, Data Science, Digital Communications, Renewable Energies, Cybersecurity, and other issues, can be used to develop new products and services in the digital era.

Nowadays, digital innovation is the main feature to become a success for innovative ideas in vertical sectors (for example, see Fig. III.1 and Tab. III.1, where the most prominent companies are today mainly related to software and database developments). Any business, directly or indirectly associated with vertical sectors and

the integration of horizontal digital technologies and innovations, is seen as a differential value. Then, introducing specific educational programmes and training actions, such as hackathons and dedicated workshops, to enhance the understanding of the relevance of all the digital competencies is today a must.

Examples of the main principles to achieve success as an entrepreneur (considering the sustainable business for the future) are the following:

1. Test your idea. Seven out of ten new businesses fail during their first three years, and although several factors could contribute to premature closures, not testing the proposal may be one of them. Before developing your business, investigate whether your idea will resonate with the market. Talk to people in the industry and the market you want to target. Explore whether your proposal meets real needs, not only in the short term but also in the long term. Conduct surveys and collect feedback from potential customers. Young entrepreneurs can test their ideas in the educational environment by accessing a specific programme and start-up engines during their careers within academic institutions. At the same time, they can meet other young students with similar interests in entrepreneurial activities.
2. Pick the right market. This principle refers to the importance of knowing the market where you intend to compete. It is vital to invest in researching possible needs to be able to correct and adjust; otherwise, you will leave a critical phase in the hands of fortune. In your research, include aspects such as identification of the leading competitors and their competitive strategies, identification of key customers, the legal framework, the degree of innovation and even the price you should put on your product or service. In short, it is about an overview of the market and how you compete to minimise risks. The identification of the proper demand for new industrial products can be helped by experts and professionals working in hybrid environments, such as start-up engines that academic institutions and local municipalities or national institutions can host. Educational institutions with a specific programme

can be valuable because young students can be involved during their school years.

3. Draw up a value proposition. The value proposition materialises the company strategy for each customer segment. You must develop your venture's most relevant legal, strategic, organisational, operational, financial, and marketing aspects. The value proposition encompasses functional and emotional values that companies transmit to customers. That is, what you can offer and what differentiates you from the competition that will make the customer choose the company over its competitors. This case occurs when the help of experts and professionals working in hybrid environments, such as start-up engines, can significantly increase the success of entrepreneurial proposals because of their ability to establish a valid marketing plan by solving technical issues.
4. Customer-focused. The fourth principle is paramount to ensure the long-term viability of the company. Corporate development is directly related to the ability to increase customers' well-being. If the company cannot favourably satisfy their needs, the business is not sustainable. Customer focus is a quality that begins with an in-depth analysis of customer preferences and needs. As a result, the company will be able to create memorable experiences that will result in benefits: satisfied customers, higher levels of consideration, long-term loyalty, and satisfaction, which will translate into recommendations. Good preparation concerning digital skills and entrepreneurial competencies during the academic career establishes the fundamental need for a continuous learning mindset.
5. Teamwork. In a business, it is essential to work as a team and know how to delegate to others to cover all the necessary aspects of a business. The goal of teamwork is to bring together a group of people with similar abilities, bits of intelligence, ideas, and skills to meet objectives and increase motivation and creativity. Some of its benefits are the creation of synergies, facilitating empowerment, promoting flexible work structures, encouraging responsibility and involvement, and promoting a sense

of achievement, fairness, and brotherhood. Several cases can be mentioned concerning this point. Indeed, several founders of successful start-ups met their company co-founders during their academic careers (see, for example, Fig. III.1 and Tab. III.3). Fruitful collaborations among co-founders are key to success.

6. Eliminate unnecessary expenses. It is crucial to maintain good financial health. The company's costs must be analysed: keeping exhaustive control will allow you to detect unnecessary expenses without renouncing an efficient structure. Resources must be used intelligently in a company, and waste must be avoided. This principle constitutes a general rule that does not need any further comments.
7. Ability to adapt. The market constantly evolves consumer preferences, needs and habits undergo progressive changes under normal conditions. The pandemic has shown us that the speed of these changes can accelerate at a dizzying rate under certain conditions. One of the main factors that causes a company to fail is the resistance and refusal to adapt to change. The market is constantly changing, and technologies are advancing rapidly. Thus, companies must adapt and even anticipate these situations to achieve higher levels of consideration *vis-à-vis* competitors. Unfortunately, changing an educational programme is difficult because of the realities at the academic institutions. Even the ability to quickly change an educational programme is relevant to adapt to the rapid changes in the market needs.
8. Innovation and technology. Innovation and technology are positioned as agents that enhance entrepreneurship. In a venture, technology should be used as a proactive resource that drives the development of new products and services that meet the needs of a global, dynamic, and significantly changing market. There is no doubt that both innovation and technology favour the creation of a differential value proposal for the client. At the same time, they make it possible to increase efficiency, democratise access to essential tools and resources for the development

of business activities and achieve greater productivity. In this way, technology and entrepreneurship invite entrepreneurs to develop innovative and creative processes to improve processes, reduce costs and optimise resources. Luckily, this aspect is typically well considered by education and academic programmes where all types of innovations and new technologies are treated in the teaching courses. This fact is authentic for those educational institutions dealing with education and research.

9. Electronic signature: concept and advantages. The electronic signature is an opportunity for entrepreneurs to provide greater added value. This tool allows the development of innovative and agile processes and the best customer experience while reducing costs and optimising resources. An electronic signature is a set of data in electronic form that you can use to identify yourself as a signatory. The eIDAS regulation established three types of electronic signatures, and you need to choose the one that best suits your needs[9]. These digital tools are today available from many providers and are required for several activities. This information is related to digital skills and can be better transmitted during the academic career.

3.2.2. Main errors to be avoided when creating a start-up

Entrepreneurship is a process with many ups and downs. Many stories about successful entrepreneurs often address only the most positive aspects of the process, implying that it is simple and easy, which is not representative of what happens. Below, a set of common mistakes often made are presented. They must be indeed avoided[10]:

1. Not having a business plan. Many people start their business without drafting a business plan first. That would give them a more detailed market analysis and allow them to plan short and long-term goals and actions. It would also let them prepare a financial analysis to assess the viability

[9] More information is available on the following website: https://web.uanataca.com/en/blog/electronic-signature/qualified-advanced-simple (accessed on September 2023).

[10] Entrepreneur Europe, 2015

of their project. Preparing a business plan does not mean everything described there will happen, but it is a crucial tool for entrepreneurs to keep focused on the goals they wish to achieve. It is essential to establish action plans with specific descriptions of the goals, along with the fact that good planning allows for increased productivity and avoids wasting time. The Business Model Canvas is suggested here as an excellent tool to think about the main parts of a new project, e.g., an innovative product, process, or service.

2. Poor financial management. Entrepreneurs tend to make one of two mistakes: invest too much money at an early stage or invest too little. Either option can be harmful to the business. Therefore, the person undertaking the entrepreneurial process must be concerned with correct financial management. This involves identifying the investments to be made, forecasting expenses and income, and analysing the economic and financial viability of the project. Several tools supporting this task, e.g., the IAPMEI tool[11], can be used to obtain a detailed business plan analysis.
3. Thinking there are no competitors. Many people do not consider the competition because they feel that the product or service, they are developing is innovative. Yet, there are very few cases of organisations without competitors. Enthusiasm for the business may lead to not studying direct and indirect competitors, although it is a rather important step when aiming at entrepreneurship. Competitor analysis makes it possible to identify and understand the market and the positioning of the business concerning competitors and finding opportunities. This analysis should be done by listing current and potential competitors and identifying different elements, such as market share, brand awareness, positioning, marketing objectives, old and present strategies, organisational structure, strengths and weaknesses, prices, profitability, and

[11] For more details: https://www.iapmei.pt/SOBRE-O-IAPMEI/Missao-Visao-Valores.aspx, accessed in November 2023.

financial capacity. After identifying all the elements, the entrepreneur can identify the opportunities and threats to the company's activity[12].

4. Hiring human resources and suppliers at the lowest cost. Initially, most entrepreneurs do not have many financial resources and try to save as much as possible. However, hiring human resources and suppliers on the cheap can be detrimental in the long run, as they are usually synonymous with low qualifications and/or little experience. According to the Council for Productivity (2019)[13], a positive relationship exists between managers' capabilities and productivity. An extra year of education is also associated with a 5% increase in productivity.
5. Devaluation or overvaluation of marketing and communication. At this point, there are two types of common perspectives: – there are those who believe that their product or service is so innovative that customers will appear naturally without the need to establish any marketing and communication strategy; – and there are those who invest a lot of money, time or effort in communication strategies without trying to study the market and its target audience (e.g., paid advertising and social networks when the people in the target audience are not users of those networks).
6. Low profit margins. Adapting the strategy of having a low-profit margin to attract customers through offers at the lowest cost on the market may prove not to be very effective, especially if it is not viable to maintain the same values. After having access to a cheaper product or service, the customer will hardly be willing to pay more for it, preventing the company from increasing profit margins in the future. In this sense, costs and revenues must be properly analysed to determine margins and their flexibility for future changes (e.g., a decrease in margins to retain customers).
7. Doing it all by oneself. Entrepreneurs often lack a team and must perform several functions in parallel, which can

[12] Baynast, Lendrevie, Lévy, Dionísio, Rodrigues, 2018.

[13] Council for Productivity (2019).

lead to a loss of focus on the core business. This problem can be mitigated by delegating some less relevant tasks, hiring human resources with skills and experience in specific areas, and seeking advice from mentors/experts experienced in their fields.

8. Customers and human resources as a last resort. When absorbed in developing a new organisation, product or service and making money, there is a risk that entrepreneurs forget to look at their project from the customer's point of view. It is crucial to seek feedback constantly through customer satisfaction surveys, employee suggestions, 360° evaluation, and both from the target audience, human resources, and other stakeholders.
9. Do not share the idea with anyone. Many people do not share their ideas with others for fear of being stolen, which can damage the business's success. Sharing ideas and thoughts with several people often opens horizons, as it is possible to get new perspectives or validate the existing ones. It does not mean the entrepreneur should expose his ideas in detail to anyone. Understanding what can be effectively relevant to share with each person and directing your speech towards more and better feedback is essential. No entrepreneur can avoid making mistakes during their professional careers. Nevertheless, the more errors they get to know from their peers, the more they learn from them, and the less likely they are to make them.

3.3. Which or what competencies are needed to start an enterprise?

When you think about starting an enterprise with an innovative product or service, you will need a strong understanding of finances. You should be able to market your business and utilise the latest technology when necessary. Make sure to communicate effectively and stay positive, even in high-pressure situations. Being able to delegate to your employees and lead them well is vital in helping your business succeed. Managing your time is also essential. Whenever there is a need for a negotiation, you should be ready "to fight" for the good of your business.

This section contains three subsections: the first deals with the skills that are required to start entrepreneurial activities (3.3.1); the following subsection concerns the need for continuous attention to knowledge and innovation (3.3.2); the last one deals with assessing the entrepreneurial "spirit".

3.3.1 Skills for starting an enterprise

Starting a business requires several skills that you will need to hone and improve if you are going to be successful.

There are so many factors that play into whether your business will succeed. And, while not every element has to do with your performance as a business owner, some of the essential skills for starting and running a business in 2023 and beyond are within your control or achievable. They include the following primary skills[14]:

1. Financial literacy. To start and stay in business, you will need to experience financial growth at some point. You do not need to have the skills of a financial planner to start a business, but you need an excellent working knowledge of finances and financial management. As you grow your business, you may hire someone with a better understanding of finances to handle that aspect of the company. But you still need a good working knowledge of all things. You should be able to budget effectively and report your financial performance. You should also be able to find out what areas affect your revenue.
2. Effective marketing skills. No matter what kind of business you want to start, you must do a lot of marketing. You must be a successful marketer to gain clients or customers and keep your business growing. Convincing someone that they need your products or services is a particular skill. In addition to increasing your customer base, you need marketing skills to hire employees and develop your team. You must market your business; if you are just starting, that can be incredibly challenging. But when you employ the proper marketing techniques, you can sell yourself, your business and your products or services to anyone.

[14] From: https://startupnation.com/start-your-business/essential-skills-start-run-business/#:~:text=A%20good%20handle%20on%20technology,and%20the%20ability%20to%20delegate, accessed on October 2023.

3. Tech-savviness. The modern entrepreneur's most essential tools are arguably a computer and a smartphone. Staying on top of the latest technology trends can feel nearly impossible. But, if you want to start a business, it is worth taking extra time to learn new technology as it hits the market. When you can wield the power of technology in your business, many areas become easier. For example, when you know how to use the best financial software, doing payroll and keeping track of revenue becomes simpler. Understanding social media will help you market your business and even attract employees. You will probably have to use Excel and Microsoft Word a lot. Be prepared to adapt continuously to new and improved technologies!
4. Strong communication skills. Good communication is one of the most valuable skills anyone can have, especially in the workplace. However, strong communication skills are essential for entrepreneurs. When you start a business, you communicate with employees, clients, customers, and vendors. You must communicate clearly and concisely, no matter what medium you use: email, phone, video chatting, or other media. Possessing this skill is even more essential when face-to-face communication is limited. Good communication will also help ensure you have strong relationships with all the people mentioned above. Being an entrepreneur does not necessarily mean you need to be an extrovert, but it does mean you must be a good communicator when it counts. Miscommunication in the business world often spells losses.
5. The ability to have a positive attitude even when things are stressful. There will be times when nothing seems to be going your way. There will be plenty of times when you are not profiting the way you have in the past or the way you think you should. There will be times when you need to make difficult decisions like letting staff go or raising prices. How do you think you will be able to handle all these things? If you can run a business, you will stay firm against the pressure.

6. Smart employee delegation. You cannot run a business alone. Initially, you might do everything yourself, but you cannot do it alone. You are going to have to start hiring employees. A good entrepreneur can let go of micro-managing everything for the good of their business. You should also be able to recognise the skills of different employees and give them the opportunities they need to shine.
7. Effective leadership. Delegation will not be enough if you are not a strong leader. Being a good leader always means pushing your employees to do their best. You should strike the right balance between motivating and critiquing when necessary. Fortunately, leadership is a learned skill, not something you must necessarily be born with. There are lots of resources and online education options that will help make you a better leader.
8. Strong time management. No matter what industry you are in, starting a new business comes with a seemingly endless to-do list. Sometimes, it might feel like you must be a superhero to get it all done. But you do not! You just must be good at time management. You need to create and stick with a schedule, including meeting deadlines. The more effectively you manage your time, the more opportunities you will have to grow your business. Your time is valuable, and when you are using your time effectively, your business will benefit.
9. The ability to negotiate for the good of your business. Money is going to be tight when you first start your business. You want to save money in as many areas as possible, and negotiation can help you in that department. You can negotiate with vendors for the best prices on the items you need. Being able to negotiate effectively is not just about money. It is also about time. Unhappy with a deadline from a client? Good negotiation skills will help you get a more desirable deadline. Negotiation goes hand in hand with communication. Whether talking to someone over the phone or exchanging messages by email, you should always be prepared for a negotiation. It will also help you when someone else starts a negotiation with

you. If a customer or client is unhappy about a timeline or a price, negotiating gives you the confidence to stand firm.

3.3.2 The continuous acquisition of knowledge aims to improve or acquire new competencies

Throughout life, people are confronted with changes that force them to adapt, including in childhood. This stage is characterised by many changes (essentially motor and neurological) essential for growing up and enabling learning that will provide vital life skills.

As in childhood, growth – in the case of entrepreneurs, intellectual development – is only possible through the acquisition of knowledge and through learning, and these processes lead to change, which, in turn, also leads to understanding. Therefore, change and learning are interconnected, and we should all seek to invest continuously in our professional and personal development (growth). The decision not to learn may generate stagnation in the long run.

For entrepreneurs, the continuous acquisition of knowledge aims to improve or acquire new competencies, respond adequately to the needs of a project as they arise and capture opportunities that may emerge because of this learning. For example, when presenting a project, the purpose is to attract investors (opportunities) and receive feedback to improve the project.

The whole act of undertaking a project is related to the learning process since the project tends to be built and reconstructed by applying the acquired knowledge and acquiring new knowledge.

Knowledge can be achieved both through formal and informal learning. Formal learning can be acquired through training programmes at universities and training centres or e-learning programmes. This type of learning is characterised by access to certification and is usually quite structured and standardised for everyone who wants to learn. On the other hand, informal learning could also be an important resource for improving entrepreneurial skills, notably through experiences, conferences, webinars, podcasts, online communities, mentoring, and other issues[15].

This type of learning has the following advantages: more focused and learner-driven; valuing learner autonomy and control;

[15] Enterprise league, 2019.

characteristically more fun and lighter; learning happens in the learner's space and based on his/her/their interests; no pressure to take exams and tests.

In organisations, knowledge assumes relevance for improving internal processes and systems, developing organisational culture, and creating competitive advantages. This knowledge can be found in the circle of the organisation itself through:

- Market analyses. It is an in-depth study of information and data based on predicting a positive or negative impact on the organisation's market. For the entrepreneur, this knowledge enables him/her to identify his/her/their target audience, competition, and macroeconomic expectations.
- Human resources experience. An organisation's human resources often possess the relevant competencies and experience. In this sense, the entrepreneur or manager should take the opportunity to absorb some of that knowledge and promote ways to disseminate and share it with the rest of the team. Kawasaki (2011) 16 suggests that, when selecting and recruiting the team, entrepreneurs should focus on the diversity of human resources (ages, education, life stories, etc.) as they add richness and different points of view to the organisation.
- Knowing the client. Understanding the customers' needs and actively communicating with them may represent a good source of knowledge acquisition in developing new products, processes, or services.
- Technical content, courses, and contests. Throughout the year, various entities linked to entrepreneurship provide multiple opportunities to acquire knowledge and improve skills.

Example

IAPMEI provides programmes and content to support entrepreneurship or those with entrepreneurial aspirations (IAPMEI, 2021b). Another example is Portugal's network of incubators and accelerators (RNI, 2021), which also promotes the contents

[16] Kawasaki (2011)

and initiatives of various actors of the national entrepreneurial ecosystem.
Several universities (e.g., MIT and Stanford University) offer a set of online courses where it is possible to access the contents of the classes in an open-access format.
Internet access allows you to access several presentations, videos, TED Talks, and Coursera courses, enabling you to acquire and deepen your skills as an autodidact.

The contact network is more than a list of contacts of people or organisations, and it is important not only at an organisational level but also at the individual level. A network of contacts is the result of the ability to establish a connection with people who can contribute to the improvement of the project, whether through advice, sharing communications, knowledge, or any relevant information, and this enhances the creation of new business opportunities.

Just like acquiring knowledge and improving skills, networking is not watertight. The older the connection, the higher the quality and trust in the relationship, so relationship building should be continuous.

In parallel, this relationship-building gives rise to or develops non-technical competencies, such as those presented in Figure III.2, which are fundamental as they complement the technical competencies that the entrepreneur often already possesses. The contact network may also enable the development of technical competencies when it comprises experts from the vertical sector in the entrepreneurial project context – or of other relevant areas – as it is an essential resource for sharing technical knowledge.

Some entrepreneurs, especially first-time entrepreneurs, struggle to build their networks. This fact is, however, an obstacle that is easy to overcome with the use of digital tools, namely through:

1. Digital media. With digital transformation, facilitated access to communication technologies allows establishing a contact network with people relevant to the organisation (e.g., future partners, suppliers, customers, or mentors). It means somebodies can easily streamline all their contacts through email, social networks (e.g., LinkedIn, Twitter, Facebook, and Instagram), telephone, and

digital communication platforms (e.g., Zoom, Google Meet, Teams, Webex, and Skype).

2. Fairs, conferences, and events. The primary purpose of this kind of initiative is to generate or expand the contact network, namely with potential investors or sector specialists. In addition to these events facilitating contact with people relevant to the entrepreneurial project, they enable entrepreneurs to acquire new competencies, learn about sector trends, identify opportunities, and find inspiration through experiences and advice from others. One way to find out about initiatives being developed is to turn to the websites of entities (e.g., municipal councils, national networks of incubators and accelerators, entrepreneurship centres, and event ticketing platforms) or online groups of people in the area. Moreover, participating in these initiatives, media, and platforms allows entrepreneurs to meet people who work in the same sector or have already gone through their present stage, which may help them boost their projects. On the other hand, as entrepreneurs get more and better contacts, they gain confidence and motivation to communicate and increase their chances of finding unique opportunities and becoming a reference in their area.

Example

"Made of Lisboa" is a platform that brings together all the information about the entrepreneurial ecosystem in Lisbon, with a section dedicated to news, events, and entrepreneurship initiatives occurring in Portugal's capital. Through the site, it is also possible to get to know and contact some of the incubators, start-ups, and respective founders of this online community.

In the Porto region, the *ScaleUp* Porto initiative seeks to promote the city's innovation and entrepreneurship ecosystem. On this site, it is possible to consult events and activities and see the location of start-ups and scaleups in Porto.

In the Beira Baixa and Alentejo regions, the website of the Get's project provides information on some of the players in this ecosystem, as well as events and business trends.

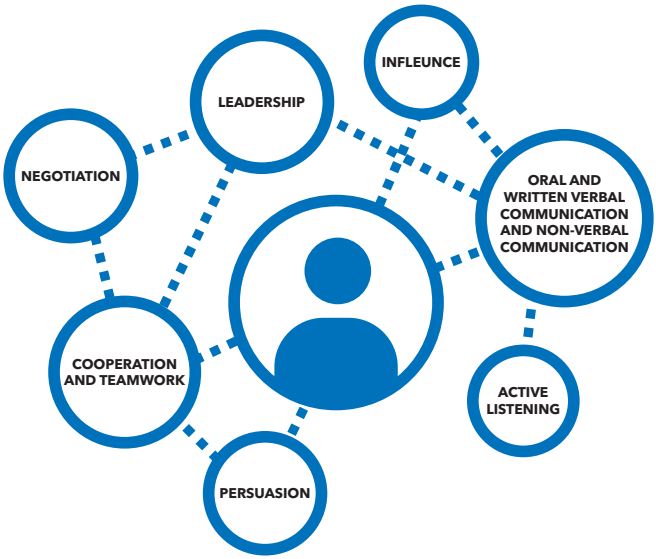

Fig III.2. Non-technical competencies

3.3.3 Assessing the Entrepreneurial Spirit

The entrepreneurial "spirit" is not a static concept. It can change due to various factors, such as the environment and culture of the entrepreneur. Besides, entrepreneurs may alter their entrepreneurial profile by investing in education and, thus, improving skills considered essential for evolving as an entrepreneur.

Several tests are available online to allow us to do an auto-assessment concerning the entrepreneurial "spirit". They use various factors for this auto-evaluation, such as personality traits, possible motivations, and how one would react in certain situations. However, it should be noted that these free self-tests mainly provide an overview of personality characteristics or entrepreneurial profiles. These assessments are based on personal perceptions and may not be as accurate as the analysis of a professional in the area. One of the most common and popular means of online assessment is the personality test named "16personalities.co"[17], where one of

[17] Available at: https://www.16personalities.com/free-personality-test, accessed in November 2023.

the personality type results is the entrepreneurial personality. The test is available in several languages, e.g., Portuguese and English. Other equally exciting suggestions geared solely towards the entrepreneurial profile are the "Stefan Lindstrom Tes"[18], psychological and entreprenology specialist (available in English); the "Entrepreneurial Profile Tes"[19]; and the "PsychTests AI"[20] (available in English).

Finally, we highlight that the suggested tests will not indicate an exact path to follow. If that is the intention, we advise participating in entrepreneurship events, such as Web Summit, or training, ideation, and acceleration programmes promoted by various European entities and universities. Participating in these initiatives can be an essential driver of the entrepreneurial "spirit" and for discovering one's entrepreneurial profile. Additionally, having an entrepreneurial "spirit" does not only mean creating your own business, but you can also have it working for others (intrapreneurship) or causing some impact on your community (social entrepreneurship) or the environment (environmental entrepreneurship).

[18] Available at: https://stefanlindstrom.se/ept-test/, accessed in November 2023.

[19] Available at: https://entrepreneurprofiletest.com/, accessed in November 2023.

[20] Available at: https://testyourself.psychtests.com/, accessed in November 2023.

THE ESSENCE OF INTERDISCIPLINARITY

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1. Cross-domain and multidisciplinary approaches in education

Cross-domain and multidisciplinary approaches are increasingly vital in today's rapidly changing world. These approaches involve integrating various disciplines and perspectives to offer students a more comprehensive education. The need for such programs stems from the growing complexity of modern issues, demanding interdisciplinary solutions. Students trained in multiple domains can better grasp these problems and devise innovative solutions.

The advantages of cross-domain and multidisciplinary education are well-documented in academic literature. Research shows that students exposed to interdisciplinary education gain a more comprehensive understanding of the world around them (Becher, Trowler, 2001; Kezar, Maxey, 2015; Klein, 2018). They develop critical thinking skills and the ability to analyze problems from diverse angles, vital skills in today's workplace (Gupta, 2016; Szekeres, Marincas, 2017). Additionally, cross-domain and multidisciplinary education can spur the generation of innovative ideas and solutions (Lang et al., 2016; Shalin, 2018).

One significant challenge in implementing cross-domain and multidisciplinary education is the limited integration among disciplines. Scholars note that disciplines often operate within their boundaries, hindering collaboration and knowledge sharing (Jones, 2017; Klein, 2018). This can lead to a lack of understanding and mutual respect, impeding collaboration (Thompson, 2016).

To address these challenges, several strategies have been proposed in the literature. One approach is the use of transdisciplinary methods, which involve integrating different disciplines and

stakeholders in a collaborative process (Lang et al., 2016; O'Rourke, Crowley, 2013). This fosters collaboration, mutual understanding, and a shared vision for the problem or issue at hand. Another strategy is the creation of interdisciplinary programs designed to encourage collaboration between different disciplines (Garrison, Vaughan, 2013; Szekeres, Marincas, 2017). These programs aim to cultivate an environment that promotes the exchange of ideas and knowledge across disciplines.

The importance of cross-domain and multidisciplinary education is evident in various fields, from healthcare to engineering. In healthcare, multidisciplinary teams are crucial for delivering quality patient care (de Bono et al., 2015). These teams comprise professionals from various disciplines who collaborate in diagnosing and treating patients. In engineering, cross-domain education is essential for developing innovative solutions to complex problems, such as renewable energy and transportation systems (Davies et al., 2017).

In addition to fostering collaboration and innovation, cross-domain and multidisciplinary education can play a pivotal role in addressing complex social and environmental issues. For instance, multidisciplinary research has been instrumental in tackling climate change by amalgamating expertise from diverse fields such as biology, ecology, and social sciences (Ferrari, Schulze, 2019). Similarly, cross-domain education has demonstrated positive outcomes in the realm of sustainability education and research (Beringer, Inouye, 2018).

However, despite the numerous advantages of cross-domain and multidisciplinary education, its integration into higher education programs can pose challenges. One such challenge is the absence of incentives for faculty members to partake in cross-disciplinary collaboration (Kezar, Maxey, 2015). Faculty members are often assessed based on their research productivity within their specific disciplines, discouraging them from collaborating across fields. Another obstacle is the scarcity of resources, encompassing funding and infrastructure, to support cross-disciplinary initiatives (Davies et al., 2017).

To surmount these challenges, higher education institutions must proactively cultivate an environment that champions cross-domain and multidisciplinary education. One approach involves incentivizing faculty members to engage in interdisciplinary research and teaching (Gupta, 2016). Recognizing their contributions to

cross-domain and multidisciplinary research through awards, fellowships, and other forms of acknowledgment can be effective.

Another strategy entails providing financial support and infrastructure for interdisciplinary initiatives. This may entail establishing interdisciplinary research centres, creating cross-disciplinary degree programs, and allocating resources for collaborative research and teaching projects (Davies et al., 2017; Kezar, Maxey, 2015). These endeavours can help dismantle disciplinary barriers and promote collaboration between various fields of study.

Furthermore, institutions can incorporate cross-domain and multidisciplinary education into their curriculum. Achieving this involves developing cross-disciplinary courses or modules that expose students to diverse disciplines (Becher, Trowler, 2001). Encouraging students to enrol in courses from different departments or faculties can also stimulate interdisciplinary learning and collaboration.

Moreover, institutions can promote cross-domain and multidisciplinary education through experiential learning opportunities such as internships, research projects, and service-learning programs (Garrison, Vaughan, 2013). These experiences empower students to apply their knowledge and skills in real-world contexts, collaborating with individuals from various disciplines.

In conclusion, cross-domain and multidisciplinary education are increasingly imperative in higher education programs. They provide students with a holistic understanding of the world, nurture critical thinking skills, and cultivate collaboration and innovation. Despite implementation challenges, institutions can take proactive steps to endorse cross-domain and multidisciplinary education by offering incentives to faculty members, supporting interdisciplinary initiatives with funding and infrastructure, integrating cross-disciplinary education into the curriculum, and providing experiential learning opportunities. In doing so, institutions can equip students to confront the complex challenges of the 21st century and contribute meaningfully to their fields and communities.

2. Cross-domain knowledge and societal challenges

When confronted with societal challenges, cross-domain knowledge is inherently essential. Consider, for instance, the task of

addressing issues related to aging societies and the associated challenges. While it is true that medical doctors, sociologists, psychologists, economists, and others can each contribute potential solutions, the true efficacy lies in fostering collaboration among these diverse fields and more. Only through enhanced cooperation can we achieve efficiency and cohesive solutions that yield more profound and effective results.

In this context, the relevance of interdisciplinarity in higher education is steadily growing, especially in research and development (R&D) activities that increasingly adopt challenge-oriented approaches necessitating cross-domain strategies. Borrego and Newswander (2010) have identified three categories of interdisciplinary research based on the degree of integration among disciplines:

1. Disciplinary integration: This entails combining knowledge and methods from two or more disciplines to address a shared research question. While collaboration between disciplines is a focal point, each discipline retains its distinct methods and theories.
2. Interdisciplinary integration: This involves merging knowledge and methods from two or more disciplines to generate new insights that transcend individual disciplinary boundaries. The emphasis here lies in synthesizing knowledge from multiple disciplines to tackle complex problems.
3. Transdisciplinary integration: This encompasses the integration of knowledge and methods from multiple disciplines, along with active engagement with stakeholders outside academia (e.g., policymakers, community members), to tackle real-world problems. The primary focus is on co-creating knowledge that is responsive to the needs and perspectives of a wide range of stakeholders.

The identification of these three types of interdisciplinary research underscores the importance of discerning the level of integration among disciplines in interdisciplinary research and how this integration can impact the development of learning outcomes in interdisciplinary education.

Another valuable classification of interdisciplinary work comes from Klein (2010), who, in his chapter within "The Oxford Handbook

of Interdisciplinarity," offers a taxonomy to categorize and distinguish various types of interdisciplinary endeavours. Klein suggests there are four primary types of interdisciplinarity:

1. Multidisciplinarity: This entails multiple disciplines independently addressing a problem or topic, often with limited interaction or collaboration between them.
2. Pluridisciplinarity: In this type, multiple disciplines collaborate on a problem or topic, but they lack a shared framework or approach to their work.
3. Interdisciplinarity: Here, multiple disciplines work collaboratively on a problem or topic with a shared framework or approach, actively seeking to synthesize disciplinary knowledge.
4. Transdisciplinarity: This approach integrates multiple disciplines, including non-academic stakeholders such as practitioners, policymakers, and community members, who collaborate to develop a shared understanding of a problem or topic and co-create knowledge to address it.

Klein's taxonomy of interdisciplinarity provides a valuable framework for comprehending and distinguishing the various forms of interdisciplinary work. It proves particularly useful for researchers, educators, and practitioners engaged in interdisciplinary endeavours, aiding them in aligning their approaches with the specific goals and nature of their interdisciplinary projects.

3. Some examples of cross-domain education and societal challenges

Cross-Domain Education and Climate Change: Climate change stands as one of the most pressing challenges of our era, with far-reaching consequences for ecosystems, economies, and human well-being. Effectively addressing climate change necessitates a comprehensive grasp of its scientific, economic, policy, and social facets. Cross-domain education emerges as a pivotal tool in preparing individuals to confront this multifaceted challenge.

By integrating insights from environmental science, economics, and policymaking, learners gain a holistic understanding of climate change and its repercussions. Cross-domain education empowers

individuals to comprehend the scientific principles underpinning climate change, the economic implications tied to transitioning to sustainable energy systems, and the policy mechanisms required for effective mitigation and adaptation strategies. Furthermore, collaborative efforts across domains cultivate innovative solutions that harmonize environmental sustainability with social and economic considerations, exemplified by initiatives like sustainable urban planning and renewable energy technologies.

Cross-Domain Education and Public Health Crises: Public health crises, epitomized by the recent COVID-19 pandemic, present substantial trials for global health systems and societal well-being. Responding to such crises demands a multidimensional approach encompassing medical knowledge, public health expertise, insights from social sciences, and effective policymaking. Cross-domain education proves invaluable in equipping individuals with the competencies and knowledge vital for mounting an effective response to public health emergencies.

By integrating wisdom from medicine, epidemiology, public health, and social sciences, a comprehensive comprehension of public health crises emerges. Cross-domain education empowers healthcare professionals to apply medical knowledge within the context of epidemiological analysis and public health interventions. It also equips policymakers with a broader perspective encompassing the social and economic determinants of health, enabling the development of evidence-based policies addressing not only the immediate crisis but also its long-term repercussions, particularly among vulnerable populations. Moreover, cross-domain collaboration fosters the evolution of innovative approaches to disease surveillance, prevention, and healthcare delivery, enhancing the overall resilience of health systems.

Cross-Domain Education and Poverty Alleviation: Socioeconomic inequalities and poverty persist as substantial global challenges. Confronting these issues necessitates a multifaceted understanding of their root causes and the formulation of comprehensive poverty alleviation strategies. Cross-domain education emerges as an indispensable tool in equipping individuals with the diverse knowledge and skills needed to combat poverty from multiple angles.

The integration of wisdom from economics, social sciences, and development studies facilitates a holistic understanding of poverty

and its underlying determinants. Cross-domain education endows individuals with a nuanced comprehension of the economic, social, and political factors contributing to poverty, including income inequality, access to education and healthcare, and social exclusion. This interdisciplinary approach paves the way for the development of comprehensive poverty alleviation strategies that encompass economic empowerment, social welfare policies, education and skill-building initiatives, and community development programs. Cross-domain collaboration also encourages the exchange of best practices and innovative approaches to poverty reduction, leading to more effective and sustainable outcomes in this critical area.

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PART IV – HEIS READINESS FOR INSTITUTIONAL CHANGES – AIMING TOWARDS BECOMING FOURTH GENERATION UNIVERSITIES

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1. Introduction – fourth-generation universities

A fourth-generation university is a new concept of higher education that aims to co-create a sustainable future with its stakeholders. It goes beyond the traditional missions of teaching, research, and economic development, and engages in collaborative problem-solving and innovation for the common good. A fourth-generation university is responsive to the environmental, social, and economic challenges of our time, and seeks to create public value and positive impact.

The idea of a fourth-generation university is based on the historical evolution of universities since their inception in the 12th century. The first generation of universities focused on teaching and disseminating knowledge, i.e., they had an education orientation. The second generation, which emerged in the late 19th and early

20th centuries, added research and scientific discovery to their mission. The third generation, which developed in the late 20th century, embraced entrepreneurship and economic development as their goals, that way aiming to build a role in national capacity building and policy generation. Simultaneously these universities partnered with outer sectors and entered commercialisation of education and research (Heller, 2021). The fourth generation, which is still emerging, expands its mission to include co-creation and sustainability (Asgari, Khorsandi Tashoh & Ghiasi Nodoosh, 2021; Oztel, 2020). It also highly promotes and needs to follow societal values on the global level, such as fairness, equity, and environmental sustainability.

A fourth-generation university is characterized by the following features:

- It is embedded in its local and global context, and interacts with various stakeholders, such as government, industry, civil society, and other universities, to address complex and difficult problems.
- It is flexible and adaptive, and able to respond to changing needs and expectations of its stakeholders and society. It fosters a culture of creativity, innovation, and learning among its staff and students.
- It is accountable and transparent, and measures its performance and impact based on multiple criteria, such as academic excellence, social relevance, environmental responsibility, and economic viability.
- It is inclusive and diverse, and promotes equity, access, and participation for all members of its community. It respects and values different perspectives, cultures, and disciplines, and fosters inter- and trans-disciplinary collaboration.

The description of the third and fourth generation of universities can be supplemented with the mission statement for the Third Mission (TM) of universities. Third Mission is a term that refers to the social, enterprise, and innovative activities that universities perform in addition to teaching and research tasks (Loi & Di Guardo, 2015). TM aims to establish relevant interactions with society and to contribute to the well-being of the local and global community. TM can take various forms, such as knowledge transfer, patent

disclosure, entrepreneurship, cultural diversity, and social responsibility (University of Turin, 2023). The Third Mission of universities is considered an important function of universities in the context of the knowledge society, as it helps them to adapt to the changing needs and challenges of the contemporary world (Loi, Di Guardo, 2015; SocialErasmus+, 2023). This is also a way of enhancing the visibility and reputation of universities, as well as their impact and relevance for society (Oztel, 2020).

As fourth generation university is not only a provider of education and research, but also a partner and facilitator of change. It contributes to the advancement of the UN Sustainable Development Goals and the global common good. It is a vision and provides change requirements for the future of higher education (Oztel, 2020).

2. Managing institutional changes

Individuals' growth mindset and personal mastery are the key elements of change in any organization. If the organization wants to change, it requires an attitude of growth mindset from individuals. Stanford University psychologist Carol S. Dweck has investigated the power of mindset. She shows how individuals' success in school, work or hobbies, and life in general, is influenced by how they think about their talents and abilities, either through a fixed mindset or growth mindset. (Dweck, 2016, p. 4–14). A fixed mindset is based on the individual's belief that their qualities are carved in stone, and they only have a certain amount of intelligence, a specific personality, and a particular moral character. This belief creates an urgency to prove themselves over and over. People are all born with a love of learning, but the fixed mindset can invalidate it. (Dweck, 2016, 6, 53).

The growth mindset is based on the belief that the individual's essential qualities can grow through effort, strategies, and the help of others, e.g., organizations' support mechanisms. People may differ in many ways, in their initial talents and aptitudes, interests, or temperaments; they can change and grow through application and experience. Individuals with a growth mindset believe that a person's true potential is unknown; it is impossible to see what can be accomplished with years of passion and work. (Dweck, 2016, 7).

Senge (2006, 131) uses the phrase "personal mastery" for personal growth and learning. Individuals who have a high level of personal mastery are constantly expanding their ability to create the results in life they really seek. The spirit of the learning organization comes through such individuals. Individuals who have a high level of personal mastery, live in continual learning mode, they are aware of their growth areas, and they never arrive. (Senge 2006, 132–133).

As change is inevitable yet unknown of content community provide the best means for educating individuals and supporting the development of their unique personal strengths and capabilities. Thus, to prepare them for the forthcoming changes. and timing, universities want to prepare with skilled staff members in all levels and create and offer learning environments and pedagogical solutions that are resilient to negatives of change. One example is the Proakatemia study path at TAMK (Tampereen Ammattikorkeakoulu/Tampere University of Applied Sciences)[21] TAMK Proakatemia is a learning community with an innovative team-based approach called team learning, or experiential action learning. In the heart of the pedagogy and curriculum in Proakatemia Trust, Courage, Doing, Learning and Success. A strong team and Proakatemia.

As described in Future of Universities Thought Book, (Davey et al. 2018), future oriented Universities, which are the universities that drive change hard within their institutions, will get a head start on the rest by embracing uncertainty and a more innovative development. This provides a vision of University 4.0, in which academics and students work in real time symbiotic partnerships with industry, government, and societal stakeholders to simultaneously create and implement new knowledge and solutions to address business and social issues. (Davey et al., 2018)

One of the authors of Future of Universities Thought Book, John Goddard, urges universities to confront future challenges. In his opinion over the next 20 years universities will be confronted by unprecedented political and technological drivers for change coming from within and outside the higher education sector. The most successful universities will be those that adapt their institutional structures to engage constructively through teaching and

[21] This example, and examples below, come from the universities involved in the DIGI-SOC project.

research with global societal challenges, notably those identified in the UN's Sustainable Development Goals (SDGs). This will involve universities working in new ways with businesses, government and civil society at both global and local levels and becoming truly civic institutions. (Davey et al., 2018)

As Noel Lancy, one of the authors of Future of Universities Thought Book, sharply points out about the challenge within universities; technological change moves at a significant pace, compelling social change in its wake. Higher education institutions should be at the forefront of this wave, but the bureaucracy involved in the evolutionary change required often cannot keep pace. Disruption is a given! Change should be brought about by the proactive directive of institutions rather than a lagged reactive response that still may not fully meet the changing demands of society. (Davey et al., 2018)

When the individual mindset and learning abilities are in place, a good change management project needs organizational supporting elements to succeed. McKnight and Glennie (2019) present in their article a Readiness Rubric for Successful Change Management. They propose educational leaders to use the rubric collaboratively with school stakeholders to build ownership and understand strengths and challenges for successfully implementing a new initiative. Change implementation plans must indicate clear roles and responsibilities, tasks, timelines, and indicators of success, all of which are aligned with the change goals and fit the unique context of the school. (McKnight, Glennie: 2019)

Managing the change in a collaborative manner seems to be one critical element in the process. Management should also ensure enough support (e.g., professional development, materials, resources) to overcome the challenges the new work, pedagogy or tools may cause.

2.1. Managing changes – observations from the real cases

Change can thus be initiated from different directions and have different levels of efficacy. That can be clearly seen in a survey made with the DIGI SOC project participants. Examples from five of the participating universities are included below. One thing that can be said about these universities is that the work with change continues

in all of them, to try to reach higher levels of impact/penetration/change.

Digital competences

Strategic change has been initiated at UNIL (Université de Lausanne /University of Lausanne). The university has decided to implement a digital strategy, to strengthen the level of digital skills of students at all levels. Included in the process of change are 'a deep reflection' on learning outcomes, as well as the creation of a digital learning outcome framework. At the time of writing this is however still under development by the direction of the university. UNIL-representatives express the hope that this will be implemented during 2023.

Also, at UEKat (Uniwersytet Ekonomiczny w Katowicach/University of Economics in Katowice), learning of digital skills is part of the university strategy. It can be found in the university's Development Strategy for 2018–2025, in strategic goal C1.1. – "Modern teaching offer", which contains a development initiative titled 'E-learning and ITC tools'. This consists of pilot distance classes using ICT tools in the field of e-/m-learning, as well as the use of basic and specialized software.

As in most other places, the digital institutional learning accelerated significantly at UEKat in the transition to online work during the pandemic. In common use at the university are online learning tools such as Google Classroom and Google Meet, electronic documents, and electronic signatures.

'UEKat accessible for the disabled people' is a set of training tools for research, teaching and administrative staff aimed at expanding competences and increasing awareness of disability. Two courses concern digital competencies: Adaptation of didactic materials in electronic version for classes with visually impaired students and how to increase the availability of online meetings and elements of e-learning.

However, one shortcoming that has been identified is the lack of a holistic view on the issue of digital competences. At the institutional level, they are developed separately and apply only to those groups of academic staff and students who want to develop such capabilities and competencies on their own. And since there is no obligation to participate in that type of training, this causes inequalities between employees that possess digital capabilities

and competencies and those who are less knowledgeable in this regard.

TUKE (Technicka Univerzita v Kosiciach / Technical University of Kosice) has started to work towards greater digital skills among its staff. This has been done within the framework of the European university Ulysses, of which TUKE is a part. This European university is committed to modernizing its member institutions, and to that end the course Digital Skills and Digital Soft Skills for Educators has been developed. This course gives participants tools to help them navigate a digital teaching environment, and it is now being promoted to teachers at TUKE. Note, however, that while this course is open for enrolment all the time, it is not compulsory. Therefore, it remains to be seen how big an impact it will have on the teaching at the university. It should also be noted that something else that has been identified as a shortcoming at TUKE is the fact that there is no learning centre, i.e., no unit of professional educational support, from which teachers could ask for help, feedback, and mentoring.

At MIUN (Mittuniversitetet / Mid Sweden University), digital skills are not taught largely because both staff and students are expected to already have (and often also do have) such skills when they come to the university. A rapid transition to online teaching of course took place during the first half of 2020, as a response to the global pandemic. Fortunately, digital solutions were already in place, since MIUN has long worked with distance education, having had students that have only joined teaching sessions and seminars online. Many teachers therefore already had at least some experience in distance/digital education. It was nevertheless a challenge, not the least for the unit of educational support, when almost all teaching had to become digital in the space of a few weeks. Many people worked hard to learn how to lecture online, and to come up with digital solutions for things like how to take attendance of the students present, and to how to best go about having digital exams for big groups of students. For larger meetings/lectures, Zoom is used, for smaller meetings/lectures, Microsoft Teams. Electronic signatures are also in use at the university.

Digital institutional learning also takes place within the framework of Digital Impact Day (MIUN) and the SPRINT Innovation Festival hackathon at TAMK. In the ERASMUS+-project Bridge, MIUN cooperates with TAMK and the Munich University of Applied Sciences,

and the focus is on spreading the MIUN concept Digital Impact Day to the other two universities. Institutional learning, and thus the potential for change, is in both cases however often limited to participating teachers and company representatives. More about both Digital Impact Day and the SPRINT Innovation Festival below.

Entrepreneurial competences

Fostering an entrepreneurial mindset is something that at MIUN ties into the current university strategy (2019–2026). It is considered essential to realize the aims of contributing both to regional development and to solving global challenges. And this is something that is done mainly by the innovation advisors at MIUN Innovation. The innovation advisors participate in courses on 13 different programs to teach entrepreneurial skills to students. Specifically, they teach design thinking, the NABC-method (from Stanford Research Institute, SRK) and Business Model Canvas (by Alexander Ostewalder). How much focus there is on entrepreneurship on the different courses varies, however, but teachers responsible for the courses are always present during the teaching sessions in question, and they still own the pedagogical process. There is also evaluation after each entrepreneurship-unit.

At MIUN there is also the course Student Innovation Mid Sweden (SIMS), which is taken by last-year students at six different engineering programs, as well as by some exchange students. This is a full-time 10-week course, and companies in MIUN's network provide real-life challenges for the students to solve. The students work in mixed teams (with each team consisting of 4–7 students from at least two different programs), and their task is to develop a prototype or a product or service. During the course, the teams get guidance and coaching from company representatives, as well as from innovation advisors at MIUN and Bizmaker (an incubator in Sundsvall, where MIUN has one of its two campuses).

So, this is a strategic focus area at MIUN. One shortcoming and limitation identified by the MIUN innovation advisors, however, is that despite the strong support by the direction, the institutional learning there usually only takes place among those involved, i.e. between the responsible teachers and the innovation advisors in the case of the innovation units on the 13 different programs mentioned above, and in the case of SIMS, between the companies

involved, and the representatives of MIUN Innovation, Bizmaker, and the departments at MIUN that send their students to the course. Thus, the changes that can occur because of the institutional learning are limited.

As mentioned above, MIUN also collaborates with TAMK and the Munich University of Applied Sciences in the ERASMUS+-project Bridge, through which the MIUN Innovation concept Digital Impact Day is spread to the other two universities. At the Digital Impact Day, students from different programs at MIUN work together in teams to solve a one-day challenge focusing on a societal problem (the problems being supplied by companies and organizations). Earlier this was a physical event at MIUN, a physical event that however became digital during the pandemic. (We might note that in the new European Digital Impact Day that is created in the ERASMUS+-project, the students are now also mixed between universities, meaning that not only do the students in each team come from different programs, but also from different universities.)

Entrepreneurial competences are also a strategic focus area at UEKat, and it is covered by three strategic goals in the Development Strategy of UEKat 2018–2025. First, C 1.1. "Modern teaching offer", contains a development initiative titled Modern teaching, which involves the verification of the curricula of the first and second cycle studies with the aim of implementing practically oriented classes and informal learning; meetings, study visits outside campuses, as well as cooperation with students from other universities. The strategic goal C1.2. "Individualized Student development paths" includes the following development initiatives: Mentoring, tutoring, coaching as part of the student educational path throughout the entire study cycle and Support for extra-curricular student activities. Included in these initiatives are a set of activities encouraging students to more entrepreneurial behaviour in the context of finding their own developmental path and greater scientific and business activity. And strategic goal C1.3 also has relevance in this context: Business-oriented study programs with a focus on Monitoring of educational needs of the labour market and Industry-specific dedicated study programs and specializations force entrepreneurial behaviour in the sphere of searching for business partners and developing practical skills among academics and students.

Entrepreneurial competences are on the one hand developed during classes which focus on project work in groups. In cooperation with businesses and local governments, students get to solve practical problems. On the other hand, entrepreneurial competences are also developed among people working in student organizations. They acquire the competencies to organize events, plan and implement projects, and work in interdisciplinary groups.

The identified gap is however the same one as was identified for digital capabilities above. At the institutional level, entrepreneurial competences are developed separately and apply only to those groups of academic staff and students who want to develop such competences of their own volition.

At TAMK, coaching pedagogy has been used for over 20 years on the Entrepreneurship and Team Leadership bachelor program. This pedagogy is aimed at cultivating an entrepreneurial mindset and to promote the own-initiative skills of the students. The SPRINT Innovation Festival is a TAMK-wide course (that was started ten years ago) where this coaching pedagogy is implemented and scaled across the whole institution. That means that this is an example of a pedagogical change, that has become a strategical change at TAMK.

The idea with the festival is for the students to learn multidisciplinary teamwork, get to collaborate with industry/working life partners, and to learn the innovation process. During the festival, coaching pedagogy is used, and all coaches have received prior training to enhance their coaching skills.

It has however been noted that the coaching pedagogy does not spread and percolate across institutions without continuous nurturing. Teachers need up-to-date refreshing of methods and tools, and encouragement, to make use of the coaching pedagogy in other courses than the SPRINT course. TAMK however points out that this applies especially to new teachers. Another identified shortcoming is a lack of a cross-institutional community centred around the coaching pedagogy.

In 2021, the SPRINT festival was digital, and in 2022, it was a hybrid event. Thus, during those two years, the students got to make use of their digital skills as well. During the evaluation of the 2022 SPRINT, TAMK staff however expressed the opinion that the festival ought to go back to being a physical event.

When it comes to the teaching of entrepreneurial skills at TUKE, there are several courses that are offered through the European university Ulysses, e.g., Deeptech Entrepreneurships, and summer schools, e.g., Start-up Management, in which students from TUKE can take part, and in which TUKE teachers are also involved. The development of entrepreneurship at the university is primarily the role of the University Science Park Technicom, which provides a Startup Center and organizes training sessions, workshops, and hackathons in various fields, inviting both students and teachers to participate. Since 2014, the Start-up Centre at TUKE has supported over 90 start-ups with significant innovation potential, and several of them have successfully secured seed investments and launched numerous successful products. Every six months, the Start-up Centre at TUKE hosts a competition called "Do you have an idea? Present your start-up!" This competition offers an opportunity for students and teachers to showcase their innovative ideas, projects, and business solutions. Following this, they may receive incubation support at Technicom for up to one year.

Moreover, various faculties are actively engaged in different programs aimed at fostering entrepreneurial skills. For instance, students from the Faculty of Economics and the Faculty of Informatics collaborate in the 10-week Challenger Accelerator program, supported by local business partners. This means that there are ample opportunities to cultivate entrepreneurial skills through the programs offered by Technicom and the university's faculties.

Additionally, traditional courses on business development are also part of the curriculum at most of the faculties. However, in the latest strategic document titled "Long-term Plan of the Technical University in Košice 2016–2023," there is only one relevant objective related to "the expansion of courses in the area of business development, or the more effective promotion of such courses". The systematic integration of entrepreneurial skills as transversal skills across various courses has yet to be discussed at the university level. It is hoped that the new strategic plan will change the previous narrative and will formulate a transition towards a more holistic approach. Unfortunately, the potential for rapid institutional change is limited due to the absence of a university learning centre already mentioned above.

Nonetheless, there are grassroots initiatives led by faculty members, such as the Inspirational Club for Teachers at the Faculty of

Economics, which has resulted in collaborative changes. Through this initiative, training sessions, workshops, and meetings known as "Teachers for Teachers" have been organized. For instance, in March 2023, a seminar on "Active Learning in Math" was conducted to support peer learning among math teachers from different faculties. In November 2023, the Inspirational Club will organize a university conference where one of the discussion topics will be entrepreneurial education at the university.

The UAB (Universitat Autònoma de Barcelona / Autonomous University of Barcelona) is a member of the ECIU, which is a European university formed by the European Consortium of Innovative Universities (consisting of 13 universities), to promote and spread entrepreneurship and entrepreneurial competences. Within the ECIU University program, students, teachers, and researchers cooperate with cities and businesses across a variety of disciplines (and indeed also across country borders) to solve real-life challenges, using the challenge-based learning (CBL) educational model. The CBL is a learner-driven method, where learners take ownership of their challenge, define the problems they want to work on, and acquire the necessary knowledge and skills to solve the challenge. Teachers guide and facilitate team culture, helping the students to manage the tasks and move towards innovative thinking. And the ECIU thus facilitates the spreading of entrepreneurial skills all through the consortium, the members of which are found in Sweden, Finland, Norway, Denmark, Poland, Ireland, Lithuania, Germany, The Netherlands, France, Spain, Portugal, and Italy (with an associated member university in Mexico). This is thus an example of a strategic change on an almost pan-European scale.

3. Assessing changes at HEIs

Self-assessment is a cornerstone of every quality management system in education. One's reflection upon the way teaching is delivered and received allows building a stable and impactful learners' journey. In this chapter we propose a Self-assessment Canvas for Higher Education in 21st Century. Further, we present some self-assessment tools and methodologies, mostly relevant to the skillset and learning objectives presented in this handbook.

Traditionally we see self-assessment as a students' action. They should be able to identify standards and criteria to apply to their work so that they can make judgments about the extent to which they have met their expectations, according to Boud (2003). The same author claims that self-assessment might be considered:

1. for individual self-monitoring and the checking of progress,
2. to promote good learning practices and learning-how-to-learn skills,
3. for diagnosis and remediation,
4. as a substitute for other forms of assessment,
5. as a learning activity designed to improve professional or academic practice,
6. to consolidate learning over a wide range of contexts,
7. to review achievements as a prelude to recognition of prior learning,
8. for self-knowledge and self-understanding.

However, Ross and Bruce (2007) also saw teachers' self-assessment as a powerful technique for improving achievement. They outlined a theory of teacher change that links self-assessment by teachers to their professional growth. In this case self-assessment should be understood as a process in which teachers make judgments about the adequacy and effectiveness of their own knowledge, performance, and pedagogical skills for the purpose of self-improvement (Akram, Zepeda, 2015).

Students' self-assessment is an important process for evaluating their own learning progress and identifying areas for improvement. It involves reflecting on their own learning experience, analysing their strengths and weaknesses, and setting goals for their own learning. In parallel, teachers' self-assessment is about evaluating their own teaching practices, reflecting on teaching methods, techniques, and strategies, and analysing their effectiveness in facilitating student learning and achievement. Self-assessment allows to take corrective action to improve learning and teaching practices. It enhances own self-awareness and mindfulness, which can lead to better interaction between teachers and students. It should be pointed out here that recently two dimensions have been intensely explored as domains for self-assessment in higher education,

namely societal challenges, and digital capabilities (Caena, Redecker, 2019; Kotzebue et al., 2021).

Moreover, all reliable accreditation institutions for higher education nowadays require a thorough review and assessment of schools' curricula and strategic settings. It is a rule of thumb that before any peer review is set up for the participating schools, the deans are expected to submit the self-evaluation reports to reflect upon alignment with the standards of a certain accreditation scheme. In other words, self-evaluation provides the evidence needed to demonstrate that a university meets the accreditation standards. But it should not be seen as a synonym for reporting or ticking the checklist boxes. Accreditation institutions strongly underline that a HEI's ability to reflect upon itself is fundamental to sound strategic planning, which then adds to the overall quality and results in accountability and societal impact. For example, referring to the so-called global triple crown accreditation for business education, the AACSB requires its applicants and participants to run continuous self-assessment at least concerning risks specific to schools' financial situation; the portfolio of assurance of learning tools that will ensure the currency and relevancy of the business curriculum; curriculum management; and quality of teaching and impact on learner success (AACSB, 2022). EQUIS pinpoints assessment processes for: monitoring the quality of students' work; programmes and coursework ethics, responsibility, and sustainability (EQUIS, 2023). Similarly, AMBA calls for constant curriculum assessment (AMBA, 2023). Thus, self-assessment needs to be applied as a part of the governance structure of every university. It can be proposed as a canvas, as in the figure below.

1. The Foundation: Vision and Mission
   Self-assessment mainly done by presidents and deans.
   The canvas shows us that at the heart of a university's self-assessment lies a crucial step: revisiting its core strategy. The uniqueness and clarity of this strategy form the bedrock of its educational pursuits. The vision and mission not only guide but define the institution's purpose and direction. It's essential to ask about the purpose, and about who benefits from the actions. This introspection forms the initial layer of self-assessment.
2. Aligning Curriculum with Core Values

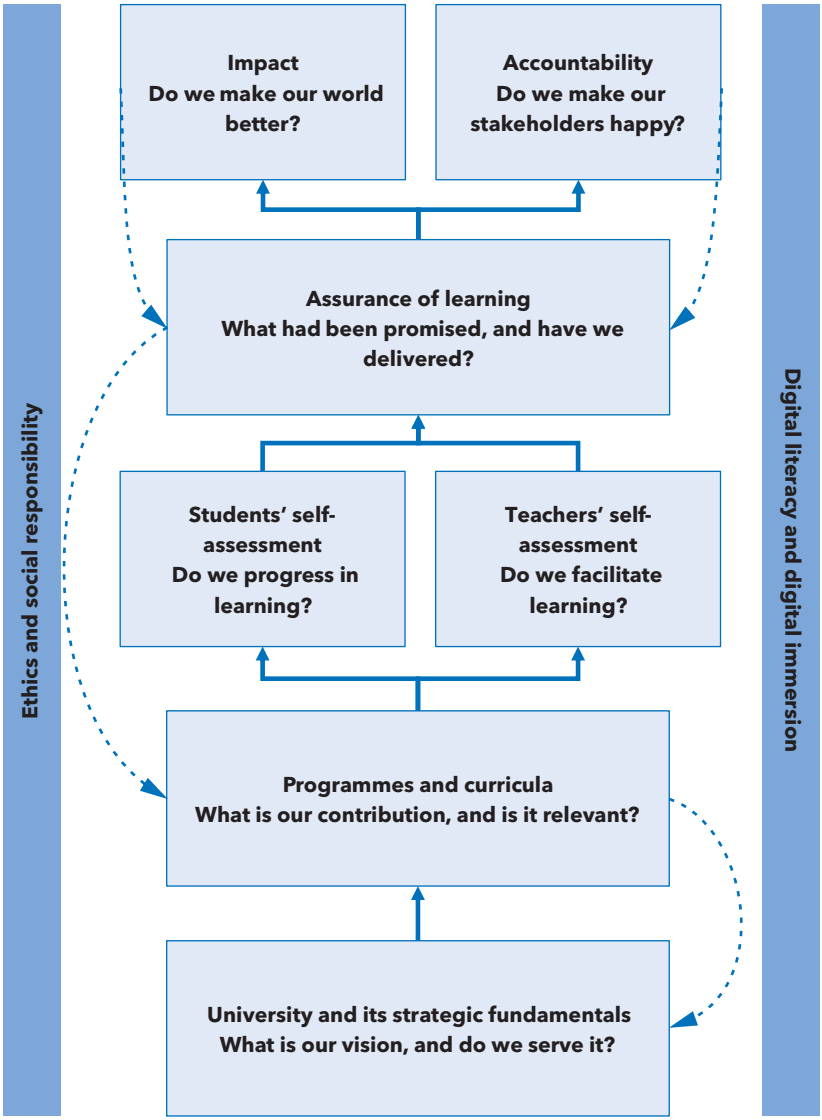

Fig. IV.1. Self-assessment canvas for Higher Education in the 21st Century.
Source: Marcin Baron – own elaboration.

Self-assessment mainly done by deans and programme directors.

Progressing deeper, the assessment extends to evaluating the portfolio of programmes and curricula. Key questions that emerge here are: Are the programmes and curricula in harmony with the institution's vision and mission? Do they comprehensively cover all content-related subjects? Do they emphasize ethical practices, social responsibility, and the evolving realm of digital literacy?

3. Evaluating the Learning Framework
   Self-assessment mainly done by faculty and students.
   While being sure about the solid framework for the teaching, in the third stage, two key stakeholder groups shall self-reflect upon learning and teaching. Students should answer the following question: Do we relevantly progress in learning? Faculty members, on the other hand, should ask themselves whether they sufficiently facilitate the learning. The facilitation is much more important than just passing on the knowledge.
4. Assurance of Learning (AoL)
   Self-assessment mainly done by deans and programme directors.
   With the advancement of the student cohorts comes the introduction of the Assurance of Learning. As defined by Peregrine (2023), "Assurance of Learning (AoL) is a comprehensive approach that enables educational institutions to measure and demonstrate the effectiveness of their academic programs. It ensures that the assessment process is linked to the mission of the institution, supports strategy, assesses knowledge, and improves student learning outcomes, results, program and/or course curricula, and teaching methodologies." In other words, there is a need for a constant (regular) check on whether the school delivers what has been promised, mainly in terms of general professional and social competencies of the graduates.
5. Reflecting Societal Impact and Accountability
   Self-assessment mainly done by presidents and deans.
   The pinnacle of self-assessment looks beyond the university walls. Here, the institution evaluates its societal footprint.

Does the education and research resonate with positive change (impact)? Moreover, is there a synchronization between what's offered and stakeholders' expectations (accountability)? Success lies in serving and making a difference in the communities and markets the university operates within.

The journey of self-assessment is not linear. The canvas of this process contains interconnected loops, emphasizing the importance of revisiting and reassessing. Bottlenecks at one level might hint at unresolved issues at a prior stage. Thus, self-assessment is not a one-off task but a cyclical and integrated process, ensuring continuous institutional evolution. In essence, self-assessment in higher education is a compass, which ensures that institutions not only stay true to their vision and mission but also evolve and adapt in a changing educational landscape.

HEI Innovate, another useful and unique platform for self-assessment of entrepreneurial and innovative attributes in Higher Education Institutions (HEIs), was created in 2013 in a collaboration between the European Commission and OECD.

It was significantly improved in 2023. The enhanced tool features upgraded statements, informative documents addressing the significance of all eight key areas, European policy considerations pertaining to entrepreneurship and innovation within higher education, and a choice of potential steps to follow the self-assessment. The HEInnovate website is found at: www.heinnovate.eu. Registration is free and open to the public.

This online tool allows HEIs to evaluate the current state and progress in eight crucial dimensions of entrepreneurship.

The evaluated dimensions are the following ones:

- Leadership and Governance
- Organisational Capacity: People, Resources, Incentives and Rewards
- Entrepreneurial Teaching and Learning
- Preparing and Supporting Entrepreneurs
- Digital Transformation and Capability
- Entrepreneurial Ecosystem and Networks
- The Internationalised Institution

Impact of the Entrepreneurial Higher Education Institutions

In the self-assessment process, representatives from HEIs need to start by selecting one of the dimensions. Once selected, they will be directed to the corresponding dimension. Each of the eight dimensions contains 4–5 statements that can be rated on a scale from 1 to 5 according to their level of accomplishment. Once all eight dimensions have been evaluated, the results are presented in bar charts and spider diagrams. The platform also offers a variety of additional sources for further study on each dimension and plenty of case studies. Another available feature is the "Action cards," which provides HEIs with specific recommendations tailored to their entrepreneurial profile.

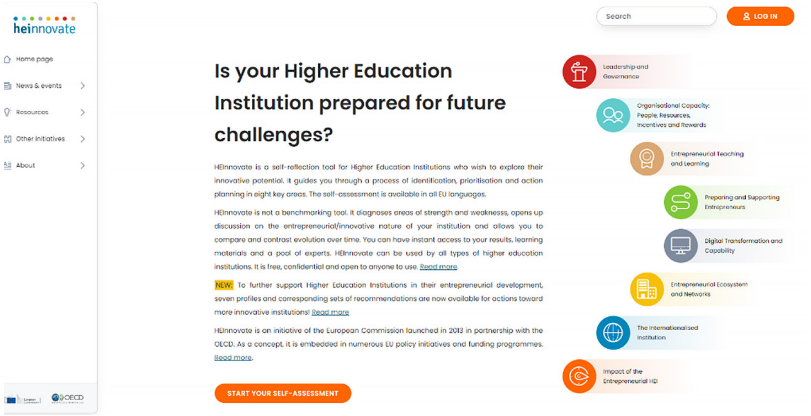

Fig. IV.2. HEI Innovate platform. Source: https://heinnovate.eu/en.

We can delve deeper into the dimension of "Entrepreneurial Teaching and Learning." From the perspective of HEI Innovate, entrepreneurial teaching and learning aim to cultivate an entrepreneurial mindset through innovative pedagogies, student-centred learning, support for flexible learning methods, and diverse learning paths. At the core of Entrepreneurial Teaching and Learning is a focus on innovation, sustainability and addressing real-life challenges. Therefore, it encompasses a much broader concept beyond simply supporting start-up creations.

The tool inquiries about the presence of formal and informal learning opportunities to foster entrepreneurial mindsets and capabilities across all departments and programs. It also assesses whether there are validated entrepreneurial learning outcomes

and impacts. Furthermore, it evaluates the extent to which the institution collaborates with external stakeholders to co-design and deliver a curriculum that addresses societal challenges. Lastly, the evaluation examines if the results of entrepreneurship research are integrated into teaching and learning activities.

HEI-Innovate can also serve as a valuable tool for facilitating institutional change. Registered institutions have access to materials for organizing workshops aimed at engaging university stakeholders. Among these resources is a highly practical training manual that provides guidance on how to arrange HEInnovate workshops, offering suggestions for all the necessary written materials such as agendas, invitations, and formats.

These workshops are designed to assist HEIs in identifying their strengths, and weaknesses, and prioritizing future actions. At the conclusion of each workshop, documenting the actions taken serves as a useful means of recollecting the outcomes. The HEI-Innovate platform's manual offers a comprehensive overview of the HEInnovate tool and methodology, along with guides for three different types of HEInnovate workshops, categorized as 1-day (or 0.5-day) activities:

- Stage 1: Introduction to HEInnovate
- Stage 2: Discovery and Planning
- Stage 3: Implementation and Impact

These workshops are tailored according to the participant's level of knowledge, understanding, and familiarity with HEI-Innovate dimensions and their self-assessment experience. Each workshop should conclude with a call to action, emphasizing active participation and motivation. For all three types of workshops, content is clearly defined, as well as objectives, outputs, and expected outcomes.

For instance, in Stage 2, participants are tasked with formulating an action plan, including a list of realistic steps required to enhance the entrepreneurial culture of their institution, and fostering motivation for action. Meanwhile, in Stage 3, participants are guided to identify potential collaborative projects aimed at driving institutional change with a strategic impact.

To inspire and inform participants, the HEI-Innovate platform provides access to approximately 150 case studies from Higher Education institutions across Europe. These case studies span from older

publication dates to the latest submissions in 2023, showcasing initiatives such as Start-up-oriented professorships at the University of Cologne in Germany or the Use of gamification to cultivate entrepreneurial thinking and actions at Aarhus University in Denmark.

Furthermore, this initiative extends to a European level through the EIT's HEI Initiative (EIT HEI Initiative webpage https://eit-hei.eu/). Launched as a collaborative EIT Community effort, coordinated by EIT Raw Materials, this initiative aims to support HEIs by providing expertise, coaching, and access to the EIT innovation ecosystem, as well as funding. It enables universities to develop innovation action plans tailored to their specific needs.

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HEInnovate launches updated self-assessment tool at 2023 Education and Innovation Summit (2023) available at https://eit-hei.eu/heinnovate-launches-updated-self-assessment-tool-at-2023-education-and-innovation-summit/

PART V – STORIES, CASES, INITIATIVES: PEDAGOGICAL MATERIALS

This section of the book delves into selected stories that guide the creation of pedagogical materials. These stories stem from cases and initiatives we have undertaken as teachers and trainers.

The first two cases present concise scenarios for short-term courses. We place particular emphasis on essential digital skills and entrepreneurial competences that are crucial in today's landscape, identified based on the challenges our students have expressed. Specifically, we incorporate much-needed data visualization for effective communication in today's context, along with an emphasis on ethical and sustainable thinking to heighten learners' awareness of grand challenges.

The subsequent two initiatives narrate the journey of more intricate and demanding courses centred around societal challenges, experienced by groups of international students. At their core, we prioritize learning objectives that we deem especially significant for learners from diverse fields such as business and economics, political science, design, engineering, and geography. The central message here, beyond structuring such courses, is the emphasis on fostering an open mindset and cross-domain thinking essential in a multicultural teamworking environment. Essentially, we point to the skills that students often underestimate, placing at the forefront the inquiry into how we acquire, evaluate, and manage data.

Lastly, by immersing ourselves in various courses and real-world situations, we aim to gain a better understanding of the factors influencing learners' engagement and disengagement as they prepare to navigate self-employment or community involvement. We leverage various real or closely aligned situations to observe, evaluate, and self-master digital and entrepreneurial competencies. For trainers, this provides a perfect opportunity for the action learning process, offering chances to reflect on the outcomes and hone training skills. The examples we utilize primarily involve societal challenges, whether it's a hackathon, collaboration with a company,

or a workshop offered by the city. The environment serves as a genuine testbed for learners who are compelled to apply their competencies in response to the situations they encounter.

1. Training the digital skills – Introduction to Data Visualisation.

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1.1. Title of selected action – course Introduction to Data Visualisation

The course is focused on practical skills in the field of data analysis through their visualization and effective communication of results to the public.

1.2. Summary of the action

The course Introduction to Data Visualization is focused on acquiring basic digital skills in data manipulation and visualization. In addition to getting acquainted with the basic ways of data visualization, students have a task of working on a group project. This project should point out a social problem through data visualization. The course is focused to strengthen digital skills as well as selected basic entrepreneurial skills. Students have to design the project goal, sharing tasks among themself, implement tasks according to the project plan and evaluate the achieved results with respect to the set project goal.

1.3. Learning objectives

The course aims to achieve following three learning objectives:

- Graduates of this course should be able to formulate a work group with clear team roles and responsibilities.
- Graduates of this course should be able to find, collect and analyse suitable online data.
- Graduates of this course should be able to apply visual methods to describe the selected problem.

Regarding digital capabilities, graduates of this course mostly improve these following competencies:

- Browsing, searching, and filtering data, information, and digital content: graduates will be able to identify and process online data.
- Solving technical problems: graduates will acquire basic knowledge and skills for using GeoDa and Power BI programs.

1.4. Target audience

This course is designed for younger students who can implement the acquired competencies in the upcoming years of the study and in their final theses. The course is ideal for undergraduate students of bachelor studies. It is also taught to students of the first year in the master studies.

1.5. Methodology (Implementation)

The teaching of the entire course takes place in the computer room. In every lesson, students work with computers that are equipped with the required software (GeoDa, MS Power BI), have access on the internet, and have access to datasets for work. One lesson has the following structure:

- In the first part of the lesson, the teacher presents and explains the topic of the lesson.
- In the second part of the lesson, the teacher assigns an exercise (an example) focused on the lesson and the students have time to solve the given assignment.
- In the last part of the lesson, teachers and students go through the given exercise.

The course is organized in three parts. In the first part, students learn to modify data into a form suitable for analysis (e.g., data organization, data cleaning, data pivoting). In the second part, they learn the principles and acquire practical skills of visualizing data distribution (data distribution through histogram, box plot graph, maps) and relationships between data (e.g., scatter plot, scatter plot matrix, bubble chart, parallel coordinate plot). All skills are explained on practical examples in specialized software. In the last

part, students learn the principles of graphic presentation and how to avoid the common mistakes.

The syllabus of the course contains the following topics:

1. Introduction to the course. Creating working groups.
2. Preparation of data for visualization. Data formats. Data types. Getting acquainted with the Geoda environment. Exploratory data analysis.
3. Entering data into Geoda. Data transformation in Geoda
4. Techniques of data distribution visualization (histogram, boxplot). Data distribution visualization techniques (map, cartogram)
5. Techniques of visualization of relationships between data (scatterplot, scatterplot matrix, bubble chart, conditional plot)
6. Techniques of time series visualization (averages chart)
7. The most common visualization errors
8. Introduction to Power BI. Entering data into Power BI
9. Creating graphs, maps, and formatting data in Power BI
10. Merging datasets in Power BI. Setting for data update
11. How to publish projects with Power BI
12. Final presentations with discussion
13. Final presentations with discussion

1.6. Potential challenges and ideas to overcome

Based on a survey of students' views on the course Introduction to Data Visualization, following strengths and weaknesses of the course were identified. The findings from the discussion with students are presented in the following table.

Strengths	Weaknesses
• The subject solves practical problems in the society. • Students' outputs were discussed with experts from practice. • Several digital elements are used in the teaching – from working with searching, processing, and cleaning online data, through working with final outputs via Power BI software. • Students appreciated the use of MS Teams for mutual communication and cooperation, which made their work more efficient, e.g., made it easier for them to share and store their partial outputs.	• Students would welcome an overview of examples of social problems, which would serve as an inspiration to them to choose their own, specific problem. • In some groups there were free riders – students who were less involved in the project. • Students would appreciate more information on where and how to search for data, how to process and clean them. • Students would appreciate the full version of the Power BI software and more hours of practical work with the software.

After collecting results of students' views on the course, we organise discussions with students to propose and incorporate solutions for improvement.

1.7. Expected results / sustainability of the action

Graduates of this course meet with all set learning objectives:

- They are able to formulate a work group with clear team roles and responsibilities.
- They are able to find, collect and analyze suitable online data.
- They are able to apply visual methods to describe the selected problem.

Since the subject Introduction to Data Visualization is approved in the valid study programs of the Faculty of National Economy as a compulsory optional subject, it is taught every year. Therefore, from a sustainability point of view, this activity to improve digital skills is sustainable.

1.8. About the University of Economics in Bratislava (UEBA)

The University of Economics in Bratislava is the largest university in Slovakia specializing in education in the field of economics and management. In 2023, about 6,500 students studied at its seven

faculties. The university offers a total of 57 study programs, of which 19 are at the first level (bachelor), 22 are at the second level and 16 (master) are at the third level of study (PhD). The development of digital skills at the university is part of the university's wider strategic intentions, which aim to support the skills of graduates that are needed for future labour markets in the digital economy. Currently, however, there is no separate comprehensive strategy that would define goals and propose activities for the development of students' digital skills. However, there are several supporting initiatives that are long-term oriented mainly to the development of IT infrastructure (computer rooms, wi-fi) as well as software for teaching at the university (especially MS Office and statistical programs). For a long time, digital technologies in teaching were mainly used for sharing teaching materials via e-learning systems (mainly Moodle). Their use in teaching increased radically during the pandemic, when due to lockdowns the entire education went online (via MS Teams). The strategic development of students' digital skills is carried out decentralized at the level of study programs and subjects. For a long time, only basic computer skills were developed, but in recent years the number of subjects in which students learn the basics of data literacy, analytical skills and the basics of programming has been slightly increasing. However, digital skills in digital content creation, security and problem solving are not usually part of these initiatives. The introduction of new digital skills is based on requirements from practice as well as on the initiative of teachers of individual subjects. Further development of digital skills is therefore significantly limited by the skills of teachers.

2. Training the entrepreneurial competences: Ethical and Sustainable Thinking

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2.1. Context

Engaging learners / students with the game called "The Fish" can serve as a vital component of classes / workshops focused on ethical and sustainable thinking. In our example, a total of 24 students participated, forming two groups with four teams in each group. Each team consisted of three students, and they were encouraged to think out unique names for their teams, adding a personal touch to the game. In the first part of the workshop, the educator provided a detailed explanation of the game's rules. The game was designed around a scenario based on the fish industry operating in a lake. It simulated the experiences of fishermen over a span of 10 days. The game materials consisted of colourful bonbons, two plastic plates, and 8 paper cups (for every team).

2.2. Rules of the game[22]

You are fishermen who live close to the lake and run a fishing business. Your welfare depends on the lake. You need to pay your bills, pay for food and education for your children.

The object of the game: To have as many fish as possible at the end of the game.

- At the beginning are 20 fishes in the lake and this is the carrying capacity of the lake because no more than 20 fishes can be in the lake at any one time.
- Each team will fish in the same lake.
- Each game is played in 10 rounds (10 days).

[22] Adapted from the Cloud Institute for Sustainability Education, www.cloudinstitute.org and Education for Sustainability in Wisconsin, www.eeinwisconsin.org

- Every night the population of fish reproduces – increases by 25% (the number of fish can be round up)
- You can fish 1–3 fish every day.

There are different variations of the game that can be played:

- Each player selects a fishing technique at the start and maintains it throughout the game.
- Each player selects a fishing technique but has the freedom to switch techniques in every round.
- Government regulations impose catch restrictions on all players, allowing only one fish to be caught per round.
- A Town Meeting is organised, enabling players to engage in discussions and collaboratively establish the game's rules.

2.3. Play flow – the example

During the workshop, we played two games. In the first game, each team was instructed to choose a specific fishing technique at the beginning and maintain that technique until the end. However, neither group of students completed the full game, as they were able only participate in 4 or 5 rounds because most teams opted to prioritize their profits and decided to fish 2 or 3 fish per day.

The second game introduced a rule change, allowing students to switch fishing techniques freely in each round. One group of students began collaborating and actively worked towards maintaining

Fig. V.2.1. Students playing the Fish game at the DOGI-SOC Workshop in Bologna, April 2023.

the sustainability of the lake. As a result, they successfully completed all 10 rounds of the game. It was interesting to observe their behaviour during the game, as whenever someone wanted to break the agreement, other students expressed their disagreement and protested it.

In contrast, the second group of students did not collaborate, which led to their inability to complete all 10 rounds.

2.4. Reflections

After the game, the students were provided with an opportunity to engage in reflection. They actively discussed their mental models,

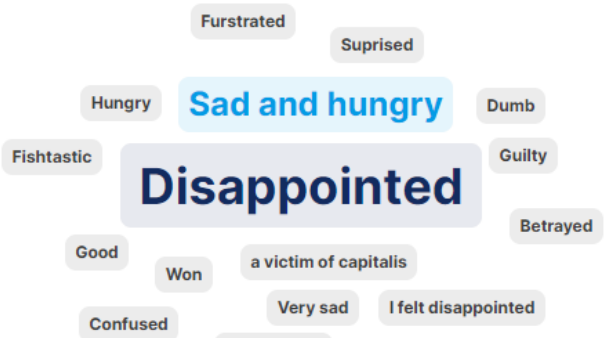

Fig. V.2.2. Answers from students to the question: How did you feel at the end of the game? How did you feel when you went out from the fish?

Fig. V.2.3. Answers from students to the question: Why did you take too many fish?

attitudes, and emotions. They also shared their individual experiences from their teams.

The reflection was built around the following questions:

- How many of you assumed the objective was to have as many fish as possible for yourself/ for the group? Are these two mutually exclusive? Which mental models did you experience in the game?
- How did you feel at the end of the game? Are you happy with the result? Who is the winner and who is the loser?
- For those who limited their catch, why did you do it?
- How was the work in your group? Was it cooperation or competitiveness?
- What strategies could help you to fish sustainably? How can you get to that point?

Fig. V.2.4. Answers from students to the question: Did you assume the objective was to have as many fish as possible for yourself?

Fig. V.2.5. Answers from students to the question: Did you assume the objective was to have as many fish as possible for the whole group?

- What role does (should) government play in taking care of the commons? What role does (should) the individual play in sustaining the commons?

The reflection session was organized in two formats. Firstly, students engaged in group discussions where they openly shared their thoughts. Additionally, some questions were posted online, allowing students to provide individual answers. This approach facilitated a better understanding of the group's attitude, which was visualized using word clouds. The pictures below show a selection of answers captured during the session using the platform www.sli.do.

2.5. Connection to real-life societal challenges

Following the reflection on the game, the second part of the workshop aimed to connect the game experience with real-life examples. The students were tasked with presenting some facts and knowledge about the exploitation of natural resources. Firstly, they discussed in their teams, and secondly, they shared with the class[23]. Later the educator added some examples from the region.

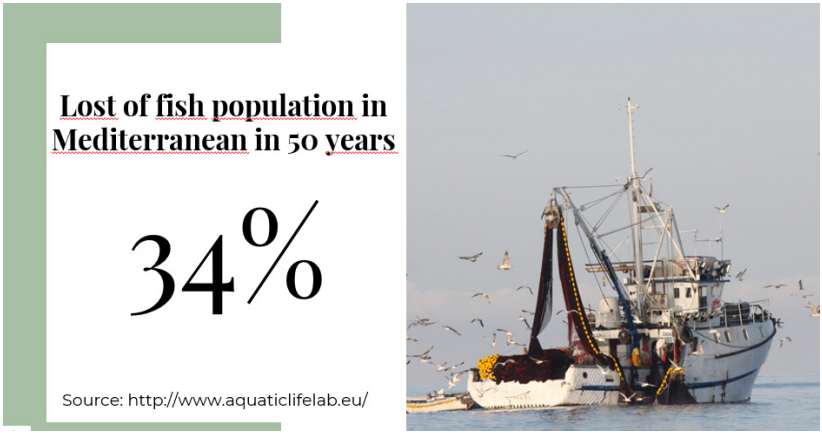

Fig. V.2.6. Slide from the educator´s presentation

[23] We used the Think-Pair- Share concept to engage students to the discussion.

2.6. Theoretical conceptualisation – tragedy of commons and sustainable management of Elinor Ostrom

The final part of the workshop focused on the theoretical conceptualization and explanation of the processes that the students encountered both in the game and in real life, specifically through the lens of the Tragedy of the Commons. The educator provided a brief overview of the concept of commons, as well as an introduction to Garrett Hardin's seminal work on the Tragedy of the Commons, which presents a rather pessimistic outlook for human populations. To encourage students to think in a more sustainable manner and focus on best practices, the educator posed the following question as the final challenge:

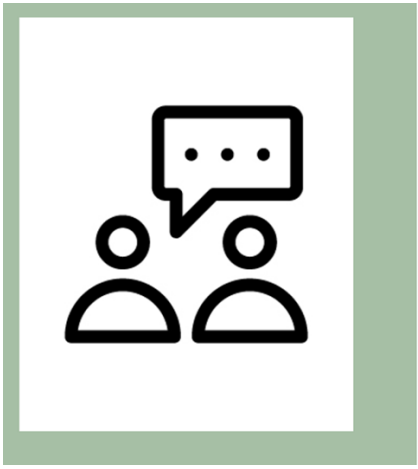

Fig. V.2.7. Slide from the educator´s presentation

Students mentioned some of the best practices which opened the debate about the concept introduced by Elinor Ostrom: Sustainable management of natural resources. The educator then explained the eight design principles associated with the sustainable management of commons. These principles were easily linked to the student's experiences from the game and the debate about best practices.

As many of the students were studying economics, at the end of the workshop, it was recommended that they explore the book

Doughnut Economics written by Kate Raworth. The book is also inspiring for students from other disciplines because it presents an alternative concept to mainstream economic theory by focusing on respecting the planetary boundaries and promoting sustainability.

3. Mastering the cross-domain entrepreneurial competences: The Intensive International Students' Week

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To illustrate a potential programme targeting entrepreneurial competence mastering, we present the activities carried out during the workshop DIGI-SOC LTTC2 entitled "Building your own competencies within an international, digital and entrepreneurial environment by academic knowledge". The workshop has been held at the University of Bologna, UniBo (Bologna, Italy). It started on April, Monday 17 at 9:00 and ended on April, Friday 21 2023 at 17:30. The workshop aims, and programme are described briefly in section 4.1. Learning objectives and expected results are commented in section 4.2. The target public is introduced in section 4.3. The methodology and implementation in section 4.4. Potential challenges and ideas to overcome them in section 4.5. Eventually, results and sustainability of the action in section 4.6.

The importance of the tools and methods to help students to improve and develop their entrepreneurial "spirits" and digital competencies are well described by the following text prepared by the colleagues at MIUN (Mid Sweden University).

To teach entrepreneurial thinking, and foster the entrepreneurial mindset, representatives of MIUN Innovation participate in courses and teach entrepreneurial skills to students on 13 different programs. See more about this in chapter 5.

At MIUN there is also the course Student Innovation Mid Sweden (SIMS), which is taken by last-year students on six different engineering programs, as well as by some exchange students. (Specifically, the students taking the course are last year students studying for a Bachelor of Science in computer engineering, and for a Master of Science in computer engineering, industrial economy, technical design, electronic systems engineering, or engineering physics. The students from engineering physics are new on this course and have been added during the DIGI-SOC project.)

This is a full-time 10-week course (giving the students taking part in it 15 credit points), and companies in MIUN's network provide real-life challenges for the students to solve. The students work in mixed teams (with each team consisting of 4–7 students from at least two different programs) to solve a challenge in the best possible way. Specifically, their task is to develop a prototype or a product or service. During the course, the teams get guidance and coaching from company representatives, as well as from innovation advisors at MIUN and Bizmaker (an incubator in Sundsvall, where MIUN has one of its two campuses).

Concerning the competences identified in EntreComp, the Entrepreneurship Competence Framework, the SIMS course is mainly intended to focus on and train the competences 2.2 Motivation and perseverance and 3.2 Planning and management.

One change that has been implemented during the DIGI-SOC project concerns the companies that present challenges for the students to solve during the course. They are now offered a few hours of guidance and coaching together with the students working on their challenge, by innovation advisors at MIUN Innovation and Bizmaker. The purpose is for the company representatives together with the students to first agree on and clearly define the problem that the students are going to try to solve, and then to evaluate different possible approaches for solving the problem, that way hopefully coming up with a promising approach that the students can develop further.

3.1. Aims and programme of the workshop "Building your own competencies within an international, digital and entrepreneurial environment by academic knowledge"

The DIGI-SOC LTTC2 workshop is organized through several activities for five working days starting on Monday and ending on Friday (17–21 April 2023). The activities have been held in Almalabor that is the UniBo's Incubator, where young students/start-uppers/entrepreneurs are guided by professionals and experts to design and produce their first prototypes based on their innovative ideas. Almalabor's is a dedicated space for meetings, assemblies and laboratory activities that is equipped with several machines for cutting and welding different materials to produce parts and a final assembly.

3D Printing machines (the most used technologies such as Filament Fused Fabrication and Stereolithography) are also available. This working environment was evaluated particularly useful for the objectives of the workshop because laboratory technicians are used to assisting the creative process and available for producing the prototypes that are the final products of this workshop. Besides students are immersed in a collaborative space where experts typically guide young start-uppers to develop their business and where ideas take a shape and become (patented) objects.

The aim of the five-day workshop is to stimulate the entrepreneurial "spirit" of all the participants through a specific assignment (see Table V.3.1) to all the students divided and working in interdisciplinary groups, stimulating a reaction with the aim to apply some of the investigated principles to develop industrial products.

The professors are also involved in the process as tutors and their help the creative work based on their competencies.

The workshop theoretical activities are organized in several lectures (see Table V.3.2) which contribute to give relevant information to the students about creativity, digitalization and digital tools and are useful to stimulate innovation thorough the Design Thinking principles. Several hours are reserved for the work in groups (see Table V.3.3). A detailed workshop programme is reported below.

Table V.3.1. Workshop assignment: objective

Assignment
1.0 Objective
The aim of this assignment is to design a game that addresses different facets of the societal challenges of ecological transition while allowing the player to experiment entrepreneurial competences. Through this assignment and its different stages, the idea is to give students the keys to create and implement a project that aims to address current societal issues. The game mechanics designed are intended to be reusable in the context of university teaching.
2.0 Defining the topics
Tuesday morning (11am to 12.30pm). We will have a post-it session with the aim of reaching a common understanding of the terms of transition and the societal challenges involved in the project. The terms to be defined are: transition, smart cities, agri-food and commons. For each of the terms (one after the other), all the participants (including the teachers) will use post-it notes to answer these three questions: – What is [the term] for you? – What are its opportunities? – What are its threats?"
3.0 Stages
The construction of the game will take place in 3 main stages: game concept document, including player identification, prototyping and iterations of the game mechanics. The game concept document is the stage where you can generate a large number of ideas for the game you want to create. It aims to reduce them to the most essential for the project. At the end of this stage, a game concept document is written, that explain your main idea about the game and the mechanics of it and that will be the main guide for the next steps. The player identification aims at identifying the people who are likely to use the product. So it is about describing exactly what that person is and feels. What do they see, hear, feel, say and do, fear or hope? The answer to these questions will enable the construction of an empathy map and, ultimately, the construction of the project so that it responds as well as possible to the person for whom it is intended. Prototyping is about creating the objects you need to play the game. It can be simple with paper and pens. The prototype will then be used to test the game and to iteratively improved it. The iteration phase allows you to test the game created with different publics, to test the rules and mechanics and to adjust it as long as you are not satisfied with them.
4.0 Game thematic
The game produced aims to answer or at least question social challenges of ecological transition. It should ultimately enable these issues and entrepreneurial skills to be worked on in future lessons. The thematics are the following: – Smart cities – Agri-food – Commons

Instructions for students
Task: Your task is to produce, in group, in a short time, a game aiming at developing entrepreneurial skills while responding to societal challenges. In this game, you will develop mechanics that allow players to better understand the chosen societal issue while allowing them to develop their entrepreneurial competences. Constraints: The game created aims to address the societal challenges of ecological transition. The game mechanics also required to allow the players to develop at least 3 entrepreneurial competences (list provided). Step 1: defining your subject In this first step, you will choose the societal challenge you want to focus on for your assignment. The time allocated will allow you to search for information about it. What are the main issues, how has it been addressed elsewhere, does a game already exist that addresses it? Don't hesitate to discuss this with your team of teachers.
Step 2: Game concept document including player's taxonomy In this step, you will think about general idea of the game you want to create. You will generate as many ideas as possible to respond to the command. It will be a question of defining the contours and the stakes of the chosen societal challenge, the possibilities available to you to address it. Don't forget to evaluate who the game is designed for. This step should allow you to clearly define who the people are who are likely to play your game and for whom is it design for. In our case, remember that this game is intended to be used in university courses. The players may be students or teachers. At the end of this stage, you should have synthesised your ideas into a game concept document that will be useful for the next steps. Step 3: Prototype In this step you will create a prototype of the game and start experimenting the consistency of the rule and game mechanics. Step 4: Iterations While the prototype is finalised, you will continue to improve the mechanics based on the feedback received by the players. At this end, you can ask the teaching team to be your cobaye for experimenting the game. This iteration phase continues until you are satisfied with your game. Friday presentation On Friday 21/04, you will present your work. As a group, you will be asked to present the context and the general idea of the game and to show its mechanics by playing a round. You will evaluate based the your ability to clearly present your idea.
Meta assignment for teachers
As the games are built around identified social issues, each theme (issue) is used to build the 'transition dice' to serve as a reminder of the issues at stake. Teachers will work together according to the progress of the students' work to highlight and organise the challenges addressed and build the dice with the help of Almalabor.
Resources
Board game mechanics: https://boardgamegeek.com/browse/boardgamemechanic

Table V.3.2. Lectures and pedagogical outcomes per activity during lectures

Workshop DIGI-SOC LTT2 Lectures			Pedagogical outcomes per activity
17.04.2023	Almalabor's approach to enterprise creation (Almalabor). Jacopo Fanti, resp. of (Almalabor)	Plenary session - @Almalabor	Inspiring talk about spotting (EntreComp #1.1) and vision (EntreComp #1.3)
	Almalabor: three case studies by start-uppers (Almalabor). M. Fraulini, (Almalabor)		Inspiring talk about spotting (EntreComp #1.1) and vision (EntreComp #1.3)
	Presentation of the programme of the week. Giampaolo Campana (UniBo)		Inspiring talk about self-awarenes (EntreComp #2.1) and motivation (EntreComp #2.2) + mobilizing resources (EntreComp #2.3)
17.04.2023	Invited lecture by Sanna Tahlo. The learning contract. Building your own learning contract (TAMK, Finland). Part 1.	Plenary session - @Almalabor	"Inspiring talk about individuals' self awareness (EntreComp #2.1 self awareness and self efficacy); support planning and managing own time (EntreComp #3.2 planning and management); support working with others (EntreComp #3.4 working with others). Motivation (EntreComp #2.2); mobilizing resources (EntreComp #2.3)"
	Invited online lecture by Yannick Rochat. Gamification! (Lousanne, Switzerland)		Inspiring talk about spotting (EntreComp #1.1) and vision (EntreComp #1.3)
18.04.2023	Invited lecture by Prof. Matteo Vignoli. Entrepreneurial development of innovative ideas (UniBO oper.space)		Inspiring talk (EntreComp #1.2)
	Invited lecture by Prof. Giovanni Emanuele Corazza. Creativity (UniBO & Marconi Institute for Creativity)		Inspiring talk (EntreComp #1.4)
19.04.2023	Invited lecture by Miriam Šebová. Ethical and sustainable thinking: assessing the consequences and impact of ideas, opportunities and actions (TUKE, Technical University of Košice, Slovakia).		Inspiring talk (EntreComp #1.5 Ethical and sustainable thinking).

19.04.2023	Invited lecture by Sanna Tahlo. The learning contract. Building your own learning contract (TAMK, Finland). Part 2.	Plenary session - @Almalabor	"Inspiring talk about individuals' self awareness (EntreComp #2.1 self awareness and self efficacy); support planning and managing own time (EntreComp #3.2 planning and management); support working with others (EntreComp #3.4 working with others). Motivation (EntreComp #2.2); mobilizing resources (EntreComp #2.3)"
	Invited online lecture by K. Nygard-Skalman and T. Westerlund. The importance of cooperation support systems for entrepreneurs. (MIUN, Sweden)		Inspiring talk (EntreComp #2.5 #3.4)
	Invited lecture by Giampaolo Pagliuca. Almacube's approach to enterprise creation (Almacube)		Inspiring talk (EntreComp #2.3 #2.4)

Table V.3.3. Coaching and pedagogical outcomes per activity during coaching

	Workshop DIGI-SOC LTT2 Coaching		Pedagogical outcomes per activity
19.04.2023	Coaching for participants to develop the assignment through societal challenges (UniBO & Consortium Members). Digital post-it session!	Rooms - @Almalabor	Motivation session on societal challenges
18.-19.-20.-21 /04/2023	Coaching for participants to develop the assignment through societal challenges (UniBO & Consortium Members)		Team up, collaborate and network (EntreComp #3.4 Working with others; EntreComp #3.5 Learning through experience)

DIGI-SOC (Digital skills and cross-domain entrepreneurship for societal challenges)

LTT C2: Building your own competencies within an international, digital and entrepreneurial environment by academic knowledge

Workshop programme

All the activities are located in Almalabor, Via Ugo Foscolo 7, Bologna

2023	Monday 17/04	Day 1: Entreprenurship and creativity Almalabor, via Ugo Foscolo 7, Bologna		
		09:00	Registration of participants. Check online questionaire filling	Plenary session - @Almalabor
		09:30	Knowing each others	Plenary session - @Almalabor
		10:00	**Almalabor's approach to enterprise creation (Almalabor). Jacopo Fanti, resp. of (Almalabor)**	Plenary session - @Almalabor
		10:30	**Almalabor: three case studies by start-uppers (Almalabor). M. Fraulini, (Almalabor)**	Plenary session - @Almalabor
		11:45	**Presentation of the programme of the week. Giampaolo Campana (UniBo)**	Plenary session - @Almalabor
		12:30	*Lunch break @ Almalabor*	
		14:00	**Group composition and tutor assignment. Project work assignment (UniBO)**	Plenary session - @Almalabor
		14:30	Invited lecture by **Sanna Tahlo.** The **learning contract.** Building your own learning contract **(TAMK, Finland)**. Part 1.	Plenary session - @Almalabor
		15:40	*Coffee break @ Almalabor*	
		16:00	Invited online lecture by **Yannick Rochat. Gamification! (Lousanne, Switzerland)**	Plenary session - @Almalabor
		17:30	End of the first day	

2023	Tuesday 18/04	Day 2: Competence awareness by the Learning Contract approach to increase self-awareness, self-efficacy and working within an international environment Almalabor, via Ugo Foscolo 7, Bologna		
		09:00	**Introduction to the facilities at University of Bologna (Almalabor-Almacube-oper.lab)**	Plenary session - @Almalabor
		09:30	Invited lecture by Prof. **Matteo Vignoli. Entrepreneurial development of innovative ideas (UniBO oper.space)**	Plenary session - @Almalabor
		11:00	**Coaching for participants to develop the assignment through societal challenges (UniBO & Consortium Members). Digital post-it session!**	Plenary session - @Almalabor
		12:30	*Lunch break @ Almalabor*	
		14:00	Invited lecture by Prof. **Giovanni Emanuele Corazza. Creativity (UniBO & Marconi Institute for Creativity)**	Plenary session - @Almalabor
		14:45	**Coaching for participants to develop the assignment through societal challenges (UniBO & Consortium Members)**	Rooms - @Almalabor
		15:40	*Coffee break @ Almalabor*	
		16:00	**Coaching for participants to develop the assignment through societal challenges (UniBO & Consortium Members)**	Rooms - @Almalabor
		17:30	End of the second day	

2023	Wednesday 19/04	Day 3: Ethical and Sustainable Thinking Almalabor, via Ugo Foscolo 7, Bologna		
		09:30	Invited lecture by **Miriam Šebová**. **Ethical and sustainable thinking**: assessing the consequences and impact of ideas, opportunities and actions **(TUKE, Technical University of Košice, Slovakia)**.	Plenary session - @Almalabor
		10:30	Invited lecture by **Sanna Tahlo.** The **learning contract.** Building your own learning contract **(TAMK, Finland)**. Part 2.	Plenary session - @Almalabor
		11:30	Invited online lecture by **K. Nygard-Skalman and T. Westerlund.** The **importance of cooperation support systems for entrepreneurs. (MIUN, Sweden)**	Plenary session - @Almalabor
		12:30	*Lunch break @ Almalabor*	
		14:00	Invited lecture by **Giampaolo Pagliuca. Almacube's approach to enterprise creation (Almacube)**	Plenary session - @Almalabor
		15:40	*Coffee break @ Almalabor*	
		16:00	**Coaching for participants to develop the assignment through societal challenges (UniBO & Consortium Members)**	Rooms - @Almalabor
		17:30	End of the third day	

	19:30	Social Dinner	

2023	Thursday 20/04	Day 4: Motivation and perseverance Ducati & Almalabor, via Ugo Foscolo 7, Bologna		
		09:30	Public transportation to Ducati. Via Antonio Cavalieri Ducati, 3	
		10:30	**Visit Ducati industrial plant and historical museum**	Ducati
		12:30	Public transportation to Almalabor	
		-	*Free lunch break @ free choice*	
		14:00	**Coaching for participants to develop the assignment through societal challenges (UniBO & Consortium Members)**	Rooms - @Almalabor
		15:40	*Coffee break @ Almalabor*	
		17:30	End of the fourth day	

2023	Friday 21/04	Day 5: Learning through experience - city transformation Almalabor, via Ugo Foscolo 7, Bologna		
		09:00	**Working time to complete the assignment and visit Almalabor facilities**	Rooms - @Almalabor
			Coaching for participants to develop the assignment through societal challenges (UniBO & Consortium Members)	Rooms - @Almalabor
			Visit to the Almalabor makerspace (UniBO)	Makerspace - @Almalabor
		15:40	*Coffee break @ Almalabor*	
		14:00	**Presentations of project works by groups: achievements voncerning the identity card of competencies**	Plenary session - @Almalabor
		15:40	*Coffee break @ Almalabor*	
			(Each group: 20'-30' presentation)	
		17:30	**Ceremony of certification delivery and end of the DIGI-SOC LTT C2 programme**	Plenary session - @Almalabor

3.2. Learning objectives, lectures and expected results

Lectures and activities of the workshop have been organised to fulfil the objectives of the DIGI-SOC project. In the following lines, lectures and learning objectives are briefly described (see Table V.3.2 and Table V.3.3).

During the first day of the workshop (Monday, 17 April 2023) a general overview of the working programme was given (see Table V.3.1). A particular attention was given to the University of Bologna structures, didactical and scientific research activities and to the Almalabor's function based on start-up promotion and support of start-uppers to develop innovative ideas of products. This presentation contributes to give a precise context of the activities developed by the host institution concerning promotion of entrepreneurial "spirit" among the young people and students.

Fig. V.3.1. Start of the workshop (left side). A lecture by a start-upper coached by Almalabor (right side).

Three start-uppers were invited to give talks about their experience giving birth to an innovative enterprise coached and guided by Almalabor. In Fig. V.3.1 the classroom during the start of the workshop (left side) and a start-upper invited to give a lecture about his experience in developing an innovative idea through the coach/guidance in Almalabor (right side). These talks were inspiring several competencies that can be identified among those defined in EntreComp: #2.1: self-awareness and self-efficacy; #2.2: supporting motivation; #2.3: mobilizing resources; #3.2: planning and management; #3.4: working with others (see Table V.3.2).

Before the afternoon session, the assignment (see Table V.3.1) was explained to all the participants. Students were grouped trying to assemble people with different backgrounds and nationalities. The aim of the workshop is producing a commercial game (learning by gamification) based on sustainability concepts, dealing with societal challenges. The construction of the game will take place in three main guided stages:

- Preparation of a game concept document based on game mechanics and including player identification;
- Prototyping;
- Testing by iterations/improvements of the game mechanics.

The game concept is the stage where students can be guided to generate many ideas for the final product. At the end of this stage, a game concept document is written that explain the main idea about the game and its mechanics. The player identification aims at identifying the people who are likely to use the product.

Prototyping is about creating the objects you need to play the game.

The prototype will then be used to test the game and to improved it by an iterative process. The iteration phase allowed us to test the game created with different publics, to test the rules and the game mechanics and, eventually, to adjust it if all the gamers are satisfied.

Further lectures were given by Sanna Tahlo and Yannick Rochat based on the learning contract and the gamification aspects, respectively. In this case: related to EntreComp #1.1: spotting and #1.3: vision.

The second day of the workshop (Tuesday, 18 April 2023) was devoted to the work on the assignment (coaching activities for professors and project development for students). Two specific lectures were scheduled to stimulate the creativity (Prof. Giovanni Corazza, University of Bologna and Marconi Institute) and innovation (Prof. Matteo Vignoli, University of Bologna, and Oper.lab of the University of Bologna). All the students had the opportunity to visit the laboratory of Almalabor to better understand how prototypes are generally produced in the University of Bologna incubator (the pedagogical outcomes are remarked in Table V.3.2).

The third day of the workshop (Wednesday, 19 April 2023) was dedicated to the importance of working within a collaborative

environment. Two lectures were focused on the mentioned topic (lecturers: Mirian Sebova, TUKE Univerity; K. Nygard-Skalman and T. Westerlund, MIUN University). A further lecture was delivered by Giampaolo Pagliuca as the representative of AlmaCube, a section of the incubator process at the University of Bologna, that helps start-uppers to develop their business in an international environment to reach international markets (all the pedagogical outcomes are remarked in Table V.3.2). The day ended with a session of coaching and project development.

The afternoon of the fourth day of the DIGI-SOC LTTC2 workshop (Thursday, 20 April 2023) was dedicated to the project development. During the morning a guided visit to the Ducati Museum (see Fig. V.3.2) and to the Ducati Manufacturing Shop in Bologna had the objective to show how a family business – started in 1926 with a production of radio transmitters in Bologna that were sold in the national market – has been transformed in one of the most important producers of motorbikes worldwide. Ducati is today a multinational enterprise and owns several production plants, but motorbike business started only after the end of the second world war.

Fig. V.3.2. Group picture at the Ducati Museum, Bologna.

The fifth day of the workshop (Friday, 21 April 2023) was the last day of the workshop and was dedicated complete the assignment by testing all the games, improving them with the aim of the teachers/coaches, preparing a presentation of the results of the workgroup. EntreComp #3.4 Working with others #3.5 Learning through experience are the learning objectives considered.

3.3. Public Target

The public target was first to identify successful example of activities already developed by the Consortium partners based on digitalisation and incubators of entrepreneurial initiatives. To identify all the activity already developed or under construction, a recognition of the scientific literature was fundamental to standardise the approach of all the participants in the project.

Finally, a workshop was organised with the aim to stimulate in a group of young students the understanding of a standardised way to define competencies and their relationships with the entrepreneurial "spirits". For this purpose, the activities of the DIGI-SOC LTTC2 workshop were planned to start with, and assignments based on theoretical lectures that are helpful to path the way towards innovations and entrepreneurships.

3.4. Methodology and implementation

At an educational level, it is relevant to educate young people and students to understand and recognize which are the competencies needed to innovate and to start entrepreneurial activities. In particular, the identification of skills and competencies is (perhaps) today more complex than in the past times due to the huge amount of information and stimuli that all of us receive thanks to the improvement in message diffusion. Information is easily accessible, but the amount of data is hard to manage. A first step can be an understanding the present societal context (sustainability of all the industrial activities) and challenges (increase in digitalization and digital tools), and then trying to model our competencies during the educational period to be able to participate in the innovation and entrepreneurial activities.

During the preparation phases of the DIGI-SOC LTTC2 workshop, we tried to identify specific outcomes (see Table V.3.2 and Table V.3.3) and then a series of activities were scheduled based on a specific assignment base on gamification that considers context and challenges. Several theoretical lectures were identified to stimulate creativity and collaboration of participants. Besides, all the activities were developed in a specific environment (Almalabor) where professionals/tutors help start-uppers, young inventors, and innovators to develop their business and manufacture their first prototype of innovative concepts,

3.5. Potential challenges and ideas to overcome them

Educating young people is a tough task and several intangible aspects can contribute to the results. Despite the uncertainties of the result, specific action must be scheduled and actuated if the aim is to stimulate the entrepreneurial activity, in particular involving young people. A fundamental challenge to develop entrepreneurial spirits is based on the need of matching competencies and skills with the market need. For this purpose, first we must be aware concerning our competencies and skills and which of them are necessary for starting to innovate and introducing new concepts and products on the markets. Then, the approach that we followed is based on two main streams: theoretical and leaning by doing approaches. In the first case, we identified pedagogical needs (see Table V.3.2 and Table V.3.3) and expertise that are related to several competencies and the entrepreneurial aptitude. Then, we assigned specific tasks that can be solved by applying some of the theoretical concepts and exploiting competencies.

The main challenge in this field is related to the uncertainties of the results based on the educational tools and methods. To overcome this item, a possible solution was the approach based on practice (learning by doing) during which is it possible to monitor the process by means of specific assignments.

3.6. Results and sustainability of the action

Inspiring and helping young people with the aim of developing an entrepreneurial "spirit" is not an easy task. A starting point could be

educating young generations to identify what competencies are needed depending on the historical-socio-economic context and train young people, in particular students, to develop their skills and creativity abilities to solve specific needs of the society based on specific challenges (sustainability, digitalisation, etc.). The aim of the workshop DIGI-SOC LTTC2 was focused on these mentioned issues.

Entrepreneurial coached project works developed by invited students to participate in the workshop have been evaluated on a presentation session during which professors and students tested the game. In Table A4 are displayed the evaluations of the group works. As a first comment, it is possible to remark that all the groups developed an original idea and manufactured products (games) thanks to a good schedule of all the activities and a favourable environment, where all the prototypes were manufactured in a few hours (Almalabor) based on sketches and CAD files. All the students received a certificate based on the good results (see Fig. V.3.3).

Fig. V.3.3. Final certificates delivery at Almalabor, Uiversity of Bologna

The workshop sustainability in terms of quality of the input and output could be considered good and the activity successful. We believe that, even a few days were scheduled for all the activities, the final products were presenting a good quality for three main reasons: (a) a huge amount of preliminary works concerning competencies and their relationships with the entrepreneurial "spirit"; (b) The interdisciplinarity of each group of students participants in the programme and the same interdisciplinary among the professors of the Consortium; (c) the choice of the location where the workshop was organised.

Supplemental Materials

A repository of all the presentation and the recorded material during the DIGI-SOC LTT C2 workshop is available under request to Giampaolo Campana at giampaolo.campana@unibo.it

Acknowledgement

A special thanks to all the members of the project DIGI-SOC Consortium because working together on this relevant topic and with all the students that participated in the workshop LTTC2 has been precious enrichment of our understanding of the role of educators.

4. Mastering the digital skills: The International Interdisciplinary Students' Week

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4.1. Context

The intensive training week was built around different learning tools. The "assignment" should be seen as the structuring element of the training. The different workshops, composed of lectures and group work, were designed to give students knowledge and tools necessary to carry out the assignment. Outside of this general framework, the "city exercise" – a real case activity – was designed to give students the opportunity to go outside the university and reflect on a particular theme. Here, we selected the issue of mobility and disability. Throughout the training week, students had access to the COURSERA and Moodle platforms. Many courses had been selected to allow them to go further in each of the topics covered.

4.2. Programme building – first things first

Even if this intensive week was primarily focused on digital skills, we decided to incorporate learning outcomes dealing with entrepreneurial competences. The selection of the competencies targeted was primarily done through the mapping of what Entre and DigiComp were most required (missing, not well covered, misunderstood) by the learners and their trainers. In this case, the selection was agreed upon by the organisers of the programme in advance and the identification of the capabilities and competencies was done internally by each partner first. Table V.4.1. presents the competences and skills included into the building of the program.

Table V.4.1. Digital and entrepreneurial competencies integrated into the programme.

DIGICOMP (LOD)				
1.1 Browsing, searching, and filtering data, information, and digital content – LOD1	1.2 Evaluating data, information, and digital content – LOD2	1.3 Managing data, information, and digital content – LOD3	Engaging in citizenship through digital technologies – LOD4	Safety – LOD5
3.1 Developing digital content – LOD6	3.2 Integrating and re-elaborating digital content – LOD7 – LOD8	5.4 Identifying digital competence gaps – LOD9		
ENTRECOMP (LOE)				
1.5 Ethical and sustainable thinking – LOE1	2.1 Self-awareness and self-efficacy – LOE2	3.5 Learning through experience – LOE3	2.2 Motivation and perseverance – LOE4	3.4 Working with other – LOE5

Based on the competencies selection, the following learning outcomes were identified:

DIGICOMP – LOD (learning outcome for digital skills):

- LOD1: Browse, search, and filter, with the appropriate tools, the data, information, or digital content, for further analysis.
- LOD2: Evaluate, individually or as a group, the validity of the data acquired, for further analysis.
- LOD3: Analyse, individually, using the appropriate tools, the data collected and evaluated, to answer the question posed.
- LOD4: Describe in writing the citizenship issues raised by digital technologies.
- LOD5: Set up, the basic procedures and tools, on your own equipment, to ensure your own digital security.
- LOD6: Make videos as a group, to share the information obtained during the learning sessions.
- LOD7: Make available, as a group, the content produced, for dissemination.
- LOD8: Modify, as a group, the content produced, based on the feedback received, to improve it.

- LOD9: Describe, orally and in writing, the training needs in digital skills, with the aim of improving them.

ENTRECOMP – LOE (learning outcome for entrepreneurial competences):

- LOE1: Describe, individually, the consequences that certain ideas and actions may have, to make them sustainable.
- LOE2: Describe, individually, one' s strengths and weaknesses, with the aim of identifying where to build on and where to improve.
- LOE3: Develop, individually and in groups, a project plan, to ensure and facilitate its implementation.
- LOE4: To build, as a group, a project allowing the investment and the development of the skills of each member.
- LOE5: Describe, in writing or orally, the points of the project that worked or did not work, with the aim of improving the next projects implemented.

It is critical to create the program around the capabilities and competencies (identifying the learning outcomes) and not around the trainers / places that are available, even if well matching the general idea of the intensive course.

4.3. Program building: the assignment and organisation of the week

Identify the students' assignment of the week and prepare for the assignment with delivery of critical knowledge. In our case we organised the workshops for trainers (facilitators of students' works) as well as for the students themselves. The learning outcomes that were aimed at through the assignment were the following ones: LOD1, LOD2, LOD3, LOD6, LOD7, LOD8, LOE3, LOE4.

Description of the assignment given to the students:

> Objective: This task will strengthen your skills creating digital content. Today, producing a teaser, a synthesis video, presenting one's firm/product/research/event, or even presenting oneself is very common. Learning how to produce such content properly is therefore the main objective of the assignment. The second objective is to produce content related to digital skills that could serve as a kind of learning material for other learners / students.

Task: Your task is to create, in group, in a short time, an informative 2-minute video on a topic related to digital skills. In this video you will share knowledge but most of all your experience, the know how you have acquired, the issues you have encountered and ways allowing you to challenge them.

Video building training and practice

In this training an expert should explain how to efficiently build a video (how to create a scenario, what the grammar of visual expression is, etc.). Then during the week, groups of learners shall elaborate their own scenario based on the topic they have to work on (the topics will be randomly assigned – see next sections). It is up to learners / students how they develop the topic further on. During this phase learners must decide on the content they want to share with others. Through the intensive week program learners will develop skills knowledge and experience and seek for additional information / knowledge, data, etc. It will be the content used for the filming process as well as film editing, etc. The completion of the assignment is only possible once a video is created and presented in front of the week participants, followed by discussion and feedback. Thus, on the last day of the week, the videos will be evaluated, and an award is to be given to the best video produced.

4.4. Program building: day 1

Workshop for trainers / facilitating learners during the week – expert on video production / media use:

Objective: This first workshop of the week is dedicated to the teacher team. The objectives are twofold, first, it aims at better understanding how to teach digitalisation for society and, second, how to teach in the digital era with digital tools.

Time: ca. 180 mins.

Learning outcomes: As the workshop was designed for teachers, it did not have learning outcomes developed for students. However, it aimed at reinforcing digital teaching competences of teachers.

Organisation: The workshop consisted of two lectures given by an expert, vice director of the teaching support centre of the University of Lausanne. The workshop was held in co-modal form.

The first part was dedicated to teaching digital tools and the second to teaching with digital tools.
Outcomes: The workshop allowed teachers to better understand the role they have, the tools they can used and the approaches they can promote to improve their teaching activities in line with the digitalisation trend.

Learners welcome address and breaking the ice:

Objective: The first event of the week aims to bring together students from the different project universities. This "ice breaker" type of matchmaking aims to provide a good intercultural experience for the students. It is not specifically aimed at work on learning outcomes.
Time: ca. 90 mins.
Organisation: The experiment was conducted in co-modal mode. However, for reasons of convenience, the onsite students and the online students were separated and worked together respectively. The instruction was to form groups of three people. In each group, the first person was given a strict 4-minute time limit to comment on the question "Have you ever had problems with technology and how did you solve them?" Once the 4 minutes were up, the other two people were given 2 minutes to react openly to what was said. There was then a new round until all three people had had their 4 minutes of speaking time. At the end of the activity, each group had to report back on the discussions in the form of "take away messages".
Outcomes: The activity provided space for students to get to know each other better. However, the activity was complicated to organise co-modally and the activity was therefore provided separately for online and onsite students, limiting their ability to communicate with each other.

4.5. Program building: day 2

Workshop on Datamining – local expert, sociologist working with data from social media:

Objective: An inspirational talk on the process of uncovering patterns and other valuable information from large data sets. The aim is to learn about data warehousing technology and the growth of

big data, developing data mining techniques that help transform raw data found in social media and data stores into useful knowledge about contemporary social issues.
Learning outcomes: LOD1, LOD2, LOD4, LOD7, LOD9, LOE1
Time: 60–70 mins.
Organisation: The talk was based on the presentation of different projects in which the speaker participated and was followed by a question-and-answer segment.
In the discussion of the first project, the tools and methods used to investigate the cultural ecosystem of Katowice, based on the analysis of data obtained through social media and online services, were introduced. This segment explained the design process of transforming raw data into visualizations to understand the mechanism governing the city environment.
Next, the methods and tools for an experimental research initiative that investigated the frequentation of five Bratislava parks during covid were presented. This was analysed through Instagram data to discover their detailed content and subjects. For this case, the automation process in the extraction of posts for subsequent data mining was presented in detail. Using the Python 3 tool, the following methods were taught: extraction of posts from the Instagram API, pre-processing, and cleaning of data, and finally data analysis and visualization.
Finally, Students were invited to ask questions and think about possible uses of these tools for urban planning efficiency applications.
Online students participated co-modally by asking questions and interacting with the students in class by proposing possible innovative solutions to solve urban-related issues in their own cities.
Outcomes: The workshop provided students with tools and methods for managing data obtained from social networks for conducting qualitative research. The lecture provided students with a first general overview of data processing tools

Workshop on Data pursuit – expert from a R&D institute working on maps, IDIs, archives and technical reports:

Objective: Data activism as scholarly pursuit could support data literacy as a driver of societal transformation. This workshop encourages critical approaches to knowledge production and the

phenomenon of datafication in society. Through this, opportunities for environmental conflicts and potential threats and the ability to visualize environmental data can be mapped.
Learning outcomes: LOD1, LOD2, LOD4, LOD7, LOD9, LOE1
Time: 50–60 mins.
Organisation:
Co-modal activity: The discussion was based on the presentation of one project instrument, and its results, in which the speaker had participated, and it was followed by a roundtable discussion segment.
In the discussion of the project, the tools and methods used for the development and implementation of a new e-service, in the form of an open-access information system regarding post-mining areas in the Silesian Voivodeship, were explained. This segment explained the process of the creation of an online database that features post-industrial sites and covered elements such as the presence of residential buildings, agricultural activity, and environmental conditions.
The online Database "OPI-TPP 2.0" provides access to:

- Catalogued information on post-industrial sites, with a focus on mining areas, in the form of a database, GIS information layer, and individual reports.
- Catalogued documents in digital format (the digital repository) → scans of documents, photographs, drawings, and 3D models.
- Tools to assess the attractiveness of post-mining areas (investment, ecosystem, cost):

Attributes in the database.
An independent tool for individual analysis.
Tool for comparative evaluation of post-mining areas.
At the end of the discussion, students were invited to ask questions and think about possible uses of this tool for potential projects.
Online students participated by asking questions, interacting with the students in class, and by proposing possible innovative solutions to deal with environmental issues in their own cities.
Outcomes: The workshop provided students with tools and methods for creating databases for conducting research in the field of durability. The format encouraged students with a reflection on the usefulness of databases in the environmental field.

Workshop on Cybersecurity university based expert dealing with IT security:

Objective: This workshop aims to provide students with basic information about cyber security. It aims to make them aware of the main sources of hacking, and to show them simple tools to protect themselves effectively and without the need for advanced computer knowledge.
Learning outcomes: LOD5, LOD9
Time: 50–60 mins.
Organisation: This workshop was organised in the form of a lecture given by a security professional from the University of Lausanne. The following topics were discussed:

- Password protection, flaws, and ways to limit the risks.
- Phishing, implementation techniques, and means of protection.
- The possibility of setting up a backup system, its usefulness, and its limits.
- The interest of keeping your equipment up to date, the dangers and risks of not doing so.
- The session ended with a question-and-answer session with the students.

Outcomes: The workshop gave the students the opportunity to reflect on their behaviour regarding online and digital activity, for security purposes. The content was accessible enough for beginners to let them engage in tools and advice to guarantee their online safety.

Workshop Data Exploration and Evaluation – university researcher / lecturer:

Objective: This workshop aims to strengthen the skills in accessing publicly available data on European regions and to encourage the students to search for insights, allowing for their own interpretations, I.e. allowing them to experience the process of data discovery, management, evaluation, and visualization.
Learning outcomes: LOD1, LOD2, LOD3, LOD7, LOD8, LOE3, LOE5
Time: 60–80 mins.
Organisation: Co-modal activity: A presentation on the Eurostat Data Browser database and how to access regional statistical databases to analyse gross domestic product regional indicators.

Following this, the on-site students formed groups of 3 to 5 persons and the online students formed a group of four participants. Their task was to download, visualize and interpret the Gross Domestic Product (GDP) data of the selected European regions. For this they were guided through twelve specific steps:

Step 1: Go to the Eurostat Data Browser, i.e., the official data portal of the European statistics (https://ec.europa.eu/eurostat/databrowser/explore/all/all_themes). "General and regional statistics" in the menu and further click on "Regional economic accounts" and "Gross domestic product indicators" in the left panel.

Step 2: Right now, in the right panel, you will be able to find a link to the main table marked "Gross domestic product (GDP) at current market prices by NUTS 2 regions [NAMA_10R_2GDP] [18/04/2022 23:00]". Go there.

Step 3: You have been taken to the table view with a long list of European regions and data on GDP in consecutive years. Find the "Download" menu button in the upper part of the screen. Use the list to choose "Full dataset [NAMA_10R_2GDP]" and "Spreadsheet (.xlsx)". Your download starts. Save the file to your computer. While opened it will look like this:

Step 4: For the task, you will use data denominated in the Purchasing Power Standard in sheets: 5 "Million purchasing power standards (PPS, EU27 from 2020)" and 6 "Purchasing power standard (PPS, EU27 from 2020), per inhabitant". First, go to sheet 5.

Step 5: Right now, you need to filter and copy/paste raw data (values) on at least the following NUTS2 regions:

- Yugoiztochen (Bulgaria),
- Nordrhein-Westfalen (Germany),
- Nord-Pas-de-Calais (France),
- Slaskie (Poland),
- your home NUTS2 region(s) – ask the teacher for assistance if needed.

Step 6: Use your knowledge of maths to re-calculate the raw data so that the value for 2000 equals "100" for every region (we call it a base year) and the consecutive values would be calculated proportionally to refer to the base year. For example, if original values are 2000: 300; 2010: 450; 2020: 600 – the re-calculated values will be 2000: 100; 2010: 150; 2020: 200.

Step 7: Use the insert chart menu in Excel to derive two-line charts like these.
Step 8: Repeat steps 5–7 for sheet 6 "Purchasing power standard (PPS, EU27 from 2020), per inhabitant" from your original database. Congratulations! Right now, you have four-line charts for analysis.
Step 9: In this step use the accessible sources of information to find out more about the regions under scrutiny. Try to understand what might have impacted the way these territories developed throughout the last two decades. It is worth thinking, for example, about:

- historical and geopolitical context,
- past and present industrial structure,
- Europeanization and globalisation plus their impact,
- social issues,
- and any other relevant background information.

Step 10: Now get back to the four charts. We all know that GDP is quite an aggregate measure. On the other hand, its calculation is hardly biased, which makes it a very general but useful indicator. Having this in mind, analyse the charts.

- What are the obvious observations (smaller, bigger, faster, slower etc.)?
- What might be the reasons why the trajectories are just like that?
- Are there any reasons why some observations might be misleading/biased (even though all NUTS2 regions are expected to be statistically equal)?

Step 11: Note down some key findings, so as not to forget them while exchanging opinions with peers in the room.
Step 12: Make your charts ready for presentation. Submit the pdf via the prepared form.
Outcomes: The activity allowed the students to work in groups. The students were organised into different mixed groups from different universities with the aim of leading them through an exercise where they had to find, manage, and evaluate information from the Eurostat Data Browser. Finally to present their results and analyse the differences between other groups as well as reflections on the process of information management and the results obtained.

4.6. Program building: day 3

Workshop # 2 on Data Exploration and Evaluation – university researcher / lecturer:

Objective: This segment aims to strengthen skills in accessing data on real estate markets publicly available on real estate listing platforms (websites) and encourage the students to search for insights allowing their interpretation in the context of finding factors determining real estate variables.
Learning outcomes: LOD1, LOD2, LOD3, LOD7, LOD8, LOE3, LOE5
Time: 60–80 mins.
Organisation:
Co-modal activity: A brief introduction to the real estate market and tools to help predict events in this economic field. Online and on-site learners are then guided co-modally through a six-step exercise which is as follows:
Task: Your task is to find, select and interpret data on factors determining prices on the housing market in New York City.
Step 1: Introduction to real estate markets
Discuss the following real estate issues:

- What is real estate from the legal and economic perspectives?
- Why real estate is a unique commodity (What features of real estate make them different
- from other goods)?
- Why real estate is a perfect example of an imperfect market? Summarise the discussion in the context of searching and data evaluation.

Step 2: Fill in the table. What kind of information about individual houses/flats do you consider relevant for their valuation or trading? Discuss the differences that exist between different countries (Spain, Portugal, Italy, Finland, Slovakia, Poland)?
Step 3: Go to the Realtor.com website (https://www.realtor.com). Then choose first for sale offer (upper left side of the screen) and check what kind of information you can get. Compare the set of information from Realtor.com with those provided in the table in the previous
Step 4: In the offer from the previous step, go to the section „Neighbourhood" then choose „West Village Neighbourhood".

Find out about neighbourhood the real estate market based on data such as: Median Listing Home Price, Median Listing Home Price/Sq Ft, Median Sold Home Price. On the map use the bar to check the noise level, flood risk or schools' quality.
Step 5: In the search window write „Harlem, Manhattan, NY". Compare data from Harlem with data on West Village. What are the differences? What do you think are the reason for these differences?
Step 6: Real estate buyers usually make decisions based on 4–7 criteria. Some of these factors may have more, others less weight. Real estate appraisers try to reflect the market situation by identifying and using these factors as price attributes in a specific market. Manhattan is a unique housing market, comparing with them show and explain unique price attributes on housing markets in Katowice, Kosice, Bratislava, Stockholm, Tampere, Bologna, and Lisbon. Are data on these attributes available?
Outcomes: In this workshop, the students had to explore different data sources from internet websites allowing them to analyse the variables that influence real estate market prices in different cities around the world. This allowed them to have a reflexion on the reliability of the information to predict changes.

Workshop on video production – expert on video production / media use:

Objective: This segment seeks to improve learner engagement through the effective use of media. It explains the process of creating a video, from concept to completion. The aim is to work in groups and make a three-minute teaser/synthesis video in three main stages (3 days) about subjects learned during the workshop week. Students are taught how to create a pre-production plan (script writing, storyboarding, and sourcing material). Learn the basics of filming (lighting, audio, recording and basic post-production skills) and acknowledge relevant legislation including accessibility and copyright in media production.
Learning outcomes: LOD4, LOD6, LOD7, LOD8, LOE2, LOE3, LOE5
Time: 2 x 60 mins.
Organisation:
Co-modal activity:

This segment aims to explain the process of creating a video. It consists of three phases: Pre-production, Production and Post-production. Phase one (Pre-Production: Day 1) is where all the planning and coordination takes place, phase two (Production: Day 2) is when to capture all the elements that will be in the final video and phase three (Post-Production: Day 3) is where all the elements are edited and combined to create the final video.
In detail these are the three phases to be taken:

Phase One: Pre-Production

The first step in the process of creating a video is all about preparation and setting the groundwork. During this phase, it's essential to do the planning, research, problem-solving, and organization necessary to set your video project up to be successful.

Fact Finding: Discuss together with the video production team to define the purpose, strategy, and goals for your video project and how it will be used after it is finalized. This is the part of the process where you'll want to communicate things like subjects, target audience, and the tone for the piece.

Pre-Production meeting: Outline the script and storyline. Make sure to set the timeline, identify the characters and any location details.

Site visit (Optional): Depending on the complexity of the shoot, it can be helpful to do a site scout of your location, especially if nobody knows the site.

Shoot preparation: The team should have its scripts defined and interviews questions discussed. Characters are checked, schedule is finalised, and locations are confirmed. All these details will help ensure that the production phase goes smoothly.

Phase Two: Production

The meetings are over, the preparation is complete. Now, it's time to have some fun! The production phase is where you capture all the interviews and footage for your video. This is the part where the story begins to come to life.

The production phase is where all the raw materials for your video will be captured. If you have specific visions, ideas, or visuals that you want to be included in the final product, be sure that you have clearly communicated that with your producer before the end of the production phase.

The production phase includes:

- Setting up the sound/lighting/video equipment
- Conducting interviews
- Recording voiceovers
- Capturing b-roll (extra footage that is used to support your story)

Phase Three: Post-Production/edition

After the production phase is finished, the edition phase comes to life. During the post-production phase, your video production team will begin the process to organize, plan, and edit the actual video.

Your team will carefully review all the footage and work on the selection of recorded material. Then, you will assemble the story and the edition does their magic to bring all the pieces together.

The post-production phase includes:

- Logging the interviews/scenes
- Producing the final story
- Music/sound selection
- Voice re-recording
- Video editing
- Final Delivery

The video production team will handle all the nuts and bolts of making the project come to life. This process takes cooperation and creativity, so don't expect that it will happen in some hours.

Revisions: Once the initial version of the video is edited, it's time to review the work. Assuming there are some changes that need to be made.

Final Delivery: Once the video is finalized, it's time to export the video to its final format. All platforms (Moodle, Coursera, YouTube, Facebook, etc) have slightly different specifications for optimal video playback. This should be discussed thoroughly in the pre-production process.

Outcomes: This workshop provided students with tools and methods for the creation of digital content. Even if this method is easier to organize and works well, an improvement could be done by mixing online and onsite students. Each group has worked on a topic of the week (Data pursuit, Datamining, Data management and evaluation and cybersecurity). They had to organise themselves autonomously for two days to produce a 3' video. The

groups had to learn how to work with technical hardware for the creation of quality content.

Initiating the group work on the assignments – facilitated on demand by trainers / teachers:

Objective: Start working on the assigned topic, plan activities, look for data, concepts, ideas to be used.
Learning outcomes: LOD1, LOD2, LOD3, LOD6, LOD7, LOD8, LOE3, LOE4.
Time: 90–120 mins.
Organisation:
Task for students: Find a comfortable place to start reflecting on what has been discussed over the last three days and use the knowledge. Exchange ideas, create plans, assign roles, look for support if needed.
Topics assigned (a proposal):

- How to present your professional profile on social media.
- How to secure data used in smart city / working environment / another context.
- How to seek/create data for tourism purposes / smart city / another context.
- How to evaluate your professional/personal dataset.
- How to escape the traps of video production.

4.7. Program building: day 4

City exercise – university researcher / lecturer:

Objective: Experiment the «smart city potentials and limits». Digitalization is today very present in our daily lives. This workshop aims at developing the ability to identify and use digital tools in the city context (public space, transports, etc.). It also aims at developing the capacity to analyse these tools and to express critique and solutions when unsatisfactory.
Learning outcomes: LOD1, LOD2, LOD4, LOD9, LOE4
Time: 180 mins.
Organisation:
Task for students: Online students must help a disabled person that can hardly walk, to go from the place they are sitting to the closest train station and help him/her to get on the train: that

person needs to go to the doctor in the next big city. The person has a big and quite heavy bag (without wheels) that student will have to carry. The student doesn't have a car, and a limited budget.
Step 1: by group (video group) student will first try to organise themself, during a zoom session of max. one hour for the trip to the station. Students will seek for information and digital tools that can help them (see if some exist, what information is available, etc.). Student will analyse them (availability / reliability / precision / usefulness / … valuation).
Step 2: each student will do the trip to the station to do field observation. Each will take a picture that represents, according to her/him, the difficulties/potentialities/help digital tools can bring to ease city mobility for persons in a disability situation.
Step 3: collect the pictures (one per group member) in a ppt presentation (one per page + a short comment + location of the picture) and indicate among them which is the one you think is the most representative for your group (just put it on the first slide)
Step 4: write 5 max. take away messages (one/two-line max. per message)
Step 5: send and discuss the presentation with other students and teachers.
Onsite students must organise a trip from University Campus to point A or point B and then to point C in Katowice. This trip must be accessible to persons in a disability situation (using a wheelchair, using a crutch, having problems with clear seeing, etc.). Student must also take into consideration the fact that some people may do the trip at night and need to feel safe… To organize this trip a short study visit in the city is required.
Step 1: by group (video group) student first organise the visit (max. one hour). They will seek for information and digital tools that can help them (see if some exist, what information is available, etc.), and analyse them (availability / reliability / precision / usefulness / valuation).
Step 2: the group will then do the visit in order to do a field observation. The group will take a picture of a situation that represents the difficulties/potentialities/help digital tools can bring to ease city mobility for persons in a disability situation.

Step 3: the group will prepare a ppt presentation. On the first slide they will present the picture, with a short comment and the location of the picture.
Step 4: on a second slide the group will write 5 max. take away messages (one/two-line max per message)
Step 5: send and discuss the presentation with other students and teachers.
Outcomes: Students produce material they presented to explain what they saw during the exercise. It allows them to concretely experience and understand the issues of accessibility in the city and to reflect on the opportunity to use digital technologies to improve them.
The workshop was organized in a "separate co-modality", meaning that online students worked together and onsite students also. Even if this method is easier to organize and worked well, an improvement could be done by mixing online and onsite students.
Take away messages provided by students are the following:

- Being in a wheelchair, it takes a lot more time for a simple way.
- Big cities are much more equipped for disabled people than villages.
- It's easier to carry heavy weights in the city-centre streets.
- Cities have a lot of passers-by that could be potential helpers unlike small towns.
- You can visit the bus/train website to know if the service is equipped with disabled necessities.

Mastering the group work on the assignments – facilitated on demand by trainers / teachers:

Objective: Continue working on the assigned topic, plan activities, look for data, concepts, ideas to be used.
Learning outcomes: LOD1, LOD2, LOD3, LOD6, LOD7, LOD8, LOE3, LOE4.
Time: 90–120 mins.
Organisation:
Task for students: Find a comfortable place to continue reflecting on what has been discussed over the last three days and use the knowledge. Exchange ideas, create plans, assign roles, look for support if needed.

Program building: day 5

Video production (editing) – facilitated on demand by trainers / teachers:

Objective: Finalise the video reflect on technique, clarity of message, details, make the doubles, if necessary, edit the video and master the sound.
Learning outcomes: LOD1, LOD2, LOD3, LOD6, LOD7, LOD8, LOE3, LOE4.
Time: 120–180 mins.
Organisation:
Task for students: Use provided computer rooms and rooms with silence to edit the video.

Plenary presentations of the assignments – all participants:

Objective: To reflect on the outcomes of the week with the learners and to learn from each other.
Learning outcomes evaluated:

- LOD1: Browse, search, and filter, with the appropriate tools, the data, information, or digital content, for further analysis.
- LOD2: Evaluate, individually or as a group, the validity of the data acquired, for further analysis.
- LOD3: Analyse, individually, using the appropriate tools, the data collected and evaluated, to answer the question posed.
- LOD4: Describe in writing the citizenship issues raised by digital technologies.
- LOD5: Set up, the basic procedures and tools, on your own equipment, to ensure your own digital security.
- LOD6: Make videos as a group, to share the information obtained during the learning sessions.
- LOD7: Make available, as a group, the content produced, for dissemination.
- LOD8: Modify, as a group, the content produced, based on the feedback received, to improve it.
- LOD9: Describe, orally and in writing, the training needs in digital skills, with the aim of improving them.
- LOE1: Describe, individually, the consequences that certain ideas and actions may have, to make them sustainable.

- LOE2: Describe, individually, one' s strengths and weaknesses, with the aim of identifying what to build on and what to improve.
- LOE3: Develop, individually and in groups, a project plan, to ensure and facilitate its implementation.
- LOE4: To build, as a group, a project allowing the investment and the development of the skills of each member.
- LOE5: Describe, in writing or orally, the points of the project that worked or did not work, with the aim of improving the next projects implemented.

Time: 120–180 mins.

Organisation:

Task for students: Plenary meeting room is used to showcase the videos, discuss the results, and evaluate the joint work done.

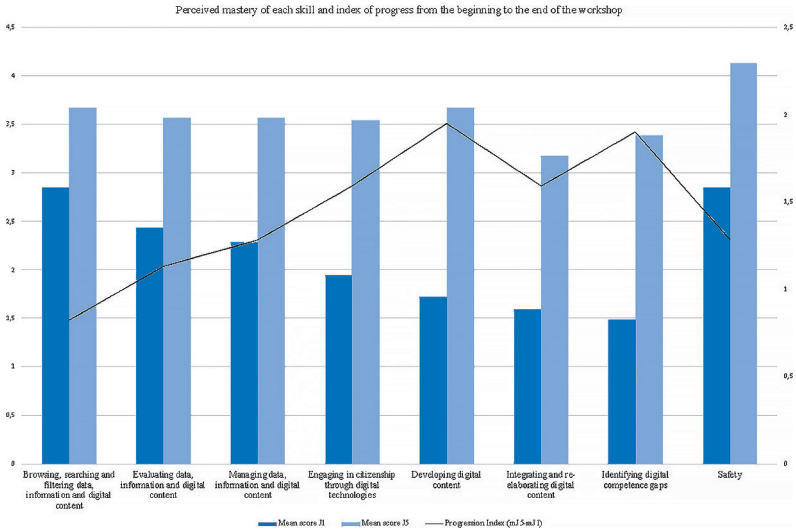

Fig. V.4.1. Digital and entrepreneurial competencies' evaluation

The evaluation points to the fact that we succeeded with building a sound offer; comments and debriefing identify relevant hints for improvement. They can serve as a testimony of how complex the activity is, even if it, for teachers / trainers, may seem like "as usual business".

Teachers Team Debriefing:

- Didn't anticipate technical issues (Showcase videos, cameras, Wi-fi): checklist can be useful for the future.
- Divide roles among staff to secure technical issues.
- For the future, the team should picture scenarios for ongoing problems.
- Workshop preparation – creating the content in advance will help to do the scenarios.
- Good to define the roles of one teacher responsible for online and another onsite
- Online students were overwhelmed and missed social aspects – Care more about basic biologic needs (free time to eat, toilet, rest, etc)
- Hybrid activities were not well coordinated – "maybe we should separate online and onsite activities for next time".
- Too many changes of classrooms- For the future would be better to have just one room for the week.
- 50 people onsite – maybe is a lot.

Online Students Comments:

- On the first days of the workshop, lectures were very concentrated and were difficult to follow.
- The content of seminars on the same day were different and students had difficulty to follow.
- The video production workshop was difficult to coordinate within online students ("difficulty to be creative without access to hardware equipment")
- Time in break-out rooms was something really useful but sometimes the time was too short to organize every task.

Onsite Students Comments:

- Workshops with group work was very appreciated. Students would prefer to work more in groups.
- The Internet was not working well so some of the seminars were not easily followed (Eurostat and real state data evaluation).
- Many hours of seminars. Some students didn't have enough time to have lunch at mid-day and were exhausted at the end of the day.
- Students highlighted activities like city exercise and video production.

5. Facing societal challenges in real case situations. Creating territorial projects shaping city spaces – participatory workshop

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5.1. The idea of the real case

Project work carried out by students together with employees of the City Hall of Ruda Śląska.

5.2. Objective

Developing a preliminary set of territorial undertakings/projects that may become an impulse for shaping the attractive spaces of the city of Ruda Śląska, also in the context of giving importance to the agglomeration-type location of the city and metropolitan aspirations of Katowice. The city is still under the pressure of coal-mine industry and deals with the so-called just transition.

5.3. Context

The work with students so far has been carried out at the university, mainly using heuristic techniques based on desk research studies and – in the case of some teams – computer-assisted interviews or short judgments using social media. They directed the students to get to know and evaluate the specificity of the city in many dimensions, also in historical terms. At this stage, however, it was not so much the assessment that was important, but rather the process of thorough recognition of the components of genius loci. They include components of areas that are important in the opinion of Students, also for the development of the "city as a whole". The work uses the concept of a prospective area and a regenerative area, as well as techniques appropriate for discovering the identity of areas.

5.4. The nature of societal challenges addressed

With the development of technology and easy access to the Internet, city dwellers become more willing to create / be part of virtual environments, including professional environments, social environments, club environments that they are interested in. This may lead to a temporary or permanent "abandonment" of the local identity of the inhabitants or a kind of departure from sharing the common values of a given area in favour of the values of other groups, including virtual environments. Thus, cities may be exposed to a lack of interest in supporting / creating bottom-up initiatives or limiting them to a few short-term activities that do not necessarily fit into the collective benefits of the community of a given territory. New skills are needed – mainly regarding the perception / search for opportunities, acquiring resources, taking initiatives. On the other hand, digital skills, including searching for information, assessing the credibility of data, creating, and managing new digital content, are key competencies in many professions. Therefore, the work of future external experts, who may become graduates of Urban Economy and Real Estate, should be focused on how to better use entrepreneurial competences and digital skills for societal challenges.

5.5. Real case description and the aims

The aim of the workshops is to learn about the city's potential and to indicate, in the conditions of a workshop with the participation of stakeholders (city), which areas should be used in the first place to identify / create territorial projects enabling the shaping of attractive city spaces.

Students together with employees of the Ruda Śląska City Hall and lecturers from the University of Economics in Katowice will take part in a) fieldwork and b) two sessions of creating ventures / projects. The proposals developed during the workshops will be "confronted" with the planned strategic initiatives of the city; the presented strategic initiatives will be the basis for a discussion on similarities and different ways of perceiving territorial projects shaping city spaces.

As part of the fieldwork, the data obtained in the conditions of desk research studies will be subject to validation – the image of

knowledge will be enriched as part of conversations, interviews, street surveys, and field observations.

As part of two sessions of creating ventures / projects, the following will be used:

- teamwork on proposals for territorial projects using the world cafe technique (workshop question: using the potential of the area, what results / transformations should be considered desirable for its development in the next 3–5 years and what must happen? – time 1 hour, one round, 7 teams, 7 minutes for work at each "table")
- joint work on one territorial project / project (selected by employees of the City Hall) using workshop techniques (workshop question: what future of the selected area / project do we want to propose, bearing in mind that it is an area with prospective potential? What does this future depend on?)

The continuation of the work will be a discussion on civilizational challenges (genesis, ways of dealing with them) that determine the functioning of urbanized areas.

To prepare students – participants of the workshop, it is necessary in the conditions of didactic classes at the university:

- Students' involvement in the project and getting to know the specificity of the area and its distinguishing features (3–6 hours in total),
- description of the area in a systematic way, including the presentation of the spatial arrangement / range of the area covered by the analysis, conditions of changes taking place in its area (3–6 h),
- deepening knowledge about the area through the application of several working methods (using digital techniques and direct contact – fieldwork) – (2–4 h).

5.6. Organizing the real case

An agreement between the University of Economics in Katowice and the City Hall in Ruda Śląska has been reached; this is the basis for the implementation of the real case project. The preparation of the workshop required establishing a common scope of commitments, including the place/time of the meeting, conditions, people

involved and expectations. During the workshops, students will work out solutions, then listen to the voice of local stakeholders and take part in a discussion / debate about the future of the city.

During the workshops, visual moderation techniques and workshop techniques will be used, which determines the size and layout of the room used and tools for conducting the workshop (see moderation techniques: e.g., H.-W. Franz, R. Sarcina, 2009, Building Leadership in Project and Network Management. A Facilitator's Tool Set. Springer)

5.7. Real case learning outcomes

- The Student / Graduate can use knowledge (thanks to the description and assessment of identified areas) for practical use of cooperation tools and reflective learning necessary to create territorial projects.
- The Student can present the results of work in a professional environment using the language appropriate for the discipline.
- The Student has knowledge of societal challenges that determine the functioning of urbanized areas.

The didactic goal of the project workshops – important for academic teachers – is to conduct classes in a way that enables the development of:

- entrepreneurial competences, including:
  - Spotting Opportunities – Use your imagination and abilities to identify opportunities for creating value.
  - Creativity – Develop creative and purposeful ideas.
  - Vision – Work towards your vision of the future.
  - Valuing Ideas – Make the most of ideas and opportunities.
  - Ethical and sustainable thinking – Assess the consequences and impact of ideas, opportunities and actions.
  - 2.3 Mobilizing Resources – Gather and manage the resources you need.
  - 2.5 Mobilizing others – Inspire, enthuse, and get others on board.

  - 3.4 Working with others – Team up, collaborate and network.
  - 3.5 Learning through experience – Learning by doing.
- digital skills:
  - 1.1 Browsing, searching, and filtering data, information, and digital content.
  - 1.2 Evaluating data, information, and digital content.
  - 1.3 Managing data, information, and digital content.
  - 2.3. Engaging in citizenship through digital technologies
  - 3.1 Developing digital content.
  - 3.2 Integrating and re-elaborating digital content.
  - 5.4 Identifying digital competence gaps.

5.8. Preparation for the workshop

Students build their knowledge on the studied city/cross-city area, create their own maps with searched and evaluated data; elaborate on the content identified / created. Thus, it is necessary to:

- apply tools and methods to browsing, searching, and filtering data, according to a specific assignment, individually and as a group – browsing various repositories, including public data and social media,
- apply tools and methods to evaluate data, information, and digital content – discussing, evaluating, checking for data reliability in teams / with local stakeholders (especially by interacting with them locally through direct questions, interviews, surveys, etc.),
- apply tools and methods to manage data, information, and digital content – creating own repository, allowing access to the repository by team members, creating maps with data,
- understand the issue of digitalizing society based on research – to get involved in digital society by contacting social media and observing reactions to various topics relevant for the study,
- critically reflect on being engaged in digital society – to critically reflect if the digital content may be published and made open for the local society.

5.9. Workshop execution

Students use their knowledge on the studied city/cross-city area to show new possibilities and to present it to local actors (public administration). Thus, it is necessary to:

- apply tools and methods to facilitate the process of creating ideas for projects,
- critically reflect on the results within the student teams,
- apply tools and methods allowing to present and promote the ideas.

5.10. Self-learning

Students use their work on new possibilities to confront it with opinions of local actors (public administration). Thus, it is necessary to:

- critically reflect on the results based on the feedback of local stakeholders.

Ways to do action learning i.e. how do we evaluate the learning outcomes in action:

- Due to multiple phases of executed activities, it is necessary to comply to the following action learning steps / approaches:
  - critical reflection and group discussion – were the students engaged in team reflection on tool used, data gathered, results achieved?
  - trial and error – where the students were emboldened to make trials and not be afraid of errors in various phases of actions?
  - discovery of actions made – what techniques were uses, were the techniques justifiable, would other techniques serve better and if so – were the students informed on the need to look for more data / other data?
  - learning from each other – were the actions taken knowledgeable enough so that all involved in the process could gain new insights, new perceptions?
  - evidence of impact – were the results critically examined / given constructive feedback / exposed to comments from external (to academia) environments?

To evaluate the activities performed and the readiness of students to actively engage in real-case situations, the following actions were performed:

- active observations while students working on the assigned tasks in groups (WorldCafe exercise) made by academic and professional (city officer) to check:
  - level of engagement,
  - collaborative approach,
  - knowledge sources,
  - opportunities spotted,
  - ethics when using the data,
  - creativity,
- discussion panel with the students and professionals to see:
  - self-awareness,
  - creativity,
  - valuing ideas,
- follow-up discussion / feedback session with the students in class environment to identify:
  - issues they ran into with regards the organization and running of their assignments,
  - ways they coped with the issues,
  - competencies used in particular when handling digital content, approaching the public and professionals,
- a questionnaire to check further on:
  - competencies used / levels of competence,
  - competencies unused / misused.

5.11. Lessons learnt

- identified based on the mutual discussion between the city and university,
- based on the workshop,
- discussion with peers (teachers).

For 65% of the participants of the real-case said it was a true benefit-building experience. For the remaining, it was hard to judge. No one said, he had no positive reflections.

The process of planning to meet people in the street and then to act as a person contacting respondents were among the first

two competencies not used. The reasons for that: it seemed simple, no need to prepare and plan and in some cases, or there was no one whom they could speak to in the street. The two other competencies not used were public speaking and being an expert to the city. The fact is that they could speak all the time in front of the representatives and themselves. And, indeed, they could build self-awareness of being an expert with the discussions made directly with the officials.

Interestingly, the competence of digital content management and its valuation was covered in a moderate way.

Having this opportunity to contact a representative of the city during such workshops, the most important thing for me would be ... (please finish the sentence briefly).

- getting to know opinions for the possibility of implementing the presented solutions and suggestions.
- an opportunity to learn about important issues concerning the city, which are difficult to find in online sources, as well as the opportunity to receive information about the point of view of the city's representatives on the topics discussed in the project work.
- expressing an opinion and indicating what could be modified in the adopted concept.
- getting the opinion of the representative to understand whether the project has a right to exist.
- getting an objective evaluation of our work. Information whether something can be accomplished.
- discussing our vision and get a comment on it.
- finding out what plans employees of the city office have for the development of this area.
- discussion, talking to a representative.
- discussion, presentation of the city's image, solving some dilemmas.
- hearing an honest opinion about the task at hand.
- obtaining interesting information about the city.
- getting feedback on our idea – is it good or bad, should something be changed.
- direct information from the representative regarding the idea/project

- hearing about the city's activities and the solutions they plan.
- getting advice.
- the view on the problems that appears in the city and professional visions for solving the problem.
- If I had to indicate what was the most valuable for me during the real case in Ruda Śląska, it would be ... (please finish the sentence briefly).
- Opportunity to explore ideas, other groups, and the possibility of supplementing your own project with suggestions from other people.
- Synthetic exchange of observations between groups and the possibility of consulting regarding doubts in the project work with a representative of the city (obtaining information whether a given project would be physically possible to implement in the city or not).
- Possibility of translating the theory developed so far into practice.
- Seeing the city and the area we are working on with our own eyes.
- Seeing the places, we worked on live. Talking to other groups.
- Conversations with other groups about our project (I was the group leader).
- The opportunity to meet with a representative of the City Hall.
- Getting acquainted with the ideas of other groups for the prospective area of the city; conversation with a representative of the city and the opportunity to present our ideas to him; joint brainstorming about valuable elements in the city and what can be done.
- Getting to know the vision of other groups.
- Discussion.
- Obtaining new information and assessing the credibility of the collected data.
- The presentation of representatives of the city and a study visit.

- Conversation with other representatives of the groups, presentation of ideas for changes in the city by a representative from Ruda Śląska.
- talking to other groups about the project.
- Comparison of our work with reality and city plans.
- Outdoor activities.
- I have a clearer approach to the topic we learn on the city prospective areas.

6. Facing societal challenges in real case situations. Hackathon on biodiversity in cities

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6.1. The idea of the real case

Collaboration of students and experts/ practitioners in environmental issues to deal with the challenge of deteriorating biodiversity in an urban environment.

6.2. Objective

The objective was to increase students' awareness about diversity loss and encourage them to be involved and active by ideating creative solutions to help conserve urban biodiversity. The pedagogical objective of the Hackathon was to train entrepreneurial skills among students, primarily creativity, ethical and sustainable thinking, taking initiates, working with others, and learning through experience.

6.3. Context

The Hackathon was a part of the course Sustainable Development, the curriculum of which was innovated in the framework of the project DIGI-SOC. To enable students to work on real-life projects and train entrepreneurial skills, we incorporated the hackathon in the course assessment.

The Hackathon was the last and the most significant assignment of the course at the end of the semester. The students were informed about the Hackathon, its general objectives and evaluation at the beginning of the semester (February 2023).

To organise it professionally, we cooperated with the business partner EurActiv Slovakia, who included the hackathon in the framework of their project. Therefore, we had the financial sources

for the event (e.g., costs for renting the conference venue, coffee breaks and fees for presentations of experts).

Hackathons usually provide a valuable tool for developing entrepreneurial skills because they foster collaboration, innovation, and problem-solving abilities. Also, our students were exposed to real-world challenges and were required to think creatively, adapt quickly, and work to develop feasible solutions within a limited time frame. The Hackathon also encouraged networking because students had the opportunity to build connections with professionals from the local and regional government, NGOs, and other organisations (botanical garden, museum).

6.4. The nature of societal challenges addressed

The challenge of the Hackathon was to propose innovative solutions to increase biodiversity in the urban environment, especially on the university campus and its neighbourhood.

The loss of biodiversity in urban environments presents a significant challenge due to its far-reaching ecological and societal implications. The diversity of flora and fauna is usually associated with the countryside, and the topic needs to be addressed in the public debate in Slovakia, where the number of urban citizens exceeded half of the population only recent years. Urbanisation, characterised by the expansion of cities and the conversion of natural habitats into built environments, leads to the destruction and fragmentation of ecosystems. This loss of biodiversity disrupts crucial ecological processes, such as for example pollination. Additionally, the loss of biodiversity in urban environments can have adverse effects on human health, as it contributes to air and water pollution. Moreover, the decline of diverse plant and animal species in urban areas diminishes the aesthetic and cultural value of green spaces, depriving residents of opportunities for recreation, relaxation, and connection with nature.

The biodiversity makes cities not only more beautiful and unique but impacts the urban ability to adapt to climate change and mitigate the negative effects of heat islands. Preserving and restoring biodiversity in urban areas is therefore crucial for ensuring the sustainability, resilience, and well-being of both urban ecosystems and the urban communities that depend on them.

6.5. Real case description

The Hackathon was organised in three phases.

PHASE 1
25th April 15:30 – 18:30 University Library TUKE
Lectures of the experts
In the first phase:

- Experts and professionals hold lectures about different perspectives on urban mobility.
- The challenge for the hackathon was introduced to the students.
- Students got basic instruction about the design thinking process.

The experts included in their presentations the main biodiversity challenges in the city of Košice to inspire students to look for solutions.

Involved organisations and presentations:

Organisation	Presentation
NGO Mill drive	Mill Drive on the river Hornád in Košice – living water in the city
East Slovak Museum in Košice, Department of Natural Sciences	Biodiversity in the city as a new biotype and what affects nature in the urban environment
Department of Urban Greenery, local city part KVP	What has changed in the management of urban greenery in Košice in recent years?
Municipality of Košice	The strategy of the city of Košice in the field of biodiversity
Botanical Garden Košice	Increasing biodiversity in cities – examples from best practices
NGO Novozem	Biodiversity in a different way

The aim was to involve stakeholders from the different sectors with a practical experience in the field. During lectures, students were educated about biodiversity loss from different perspectives and about the potential implications on the various aspects of ecosystems and human life. Speakers also explained the current situation in Košice and how the stakeholders approach them. But they

also presented inspirational examples of best practices to inspire students to think outside the box.

After the presentations the challenge for the students was introduced:

Challenge Description:
The main goal of the projects should be to increase biodiversity in the city of Košice. Therefore, the proposed solutions should directly contribute to improving the living conditions of animals such as birds, insects, or pollinators in the urban environment. However, your participants can also focus on the development of urban greenery, or you can address fauna and flora simultaneously.
In addition to direct actions, we are also happy to see projects aimed at raising awareness of the vulnerability of animals or plants in the urban environment, projects aimed at motivating residents to contribute to solutions, or projects aiming to collect or make better use of urban biodiversity data.
Ideally, projects should be tailor-made to the specific local environment. This means they will respond to a local problem and offer an effective and feasible solution.
Solutions should be based on three main principles:
1. Severity (problem prioritisation)
2. Effectiveness (how much the solution will help)
3. Feasibility (how feasible it is to implement the solution)

Fig. V.6.1. Presentation of experts in the University Library.

Students were asked to create teams of four. Each team proposed a name for the group, which helped to support their connection to the team and encourage a collaborative spirit. Seven groups of students participated all together with 29 students (1 group had five students). We tried to motivate the students also by announcing the winning prizes sponsored by local partners (e.g., voucher to the bookstore, voucher to the escape room, voucher to the local bistro).

PHASE 2

26th April – 1st May

Work of students and mentoring

Hackathons are for the most part organised in a relatively short period – 24 or 48 hours – when the participants must create collaboratively and rapidly innovative solutions under time pressure. But the design of our hackathon was different since we needed to respect the students' schedule during the semester. Therefore, we extended the phase for creating projects to seven days. During these days, the students had their duties at the university, and there was also a weekend.

The students got the video developed by the professional design thinking trainer, who provided them with the process phases. Students were asked to brainstorm ideas, organise fieldwork in the locality they wanted to focus on, ideate about the solution, choose the best one, and test it.

Each team had the opportunity to contact mentors during the week to consult with them about their ideas. The mentors were experts from the Museum of Eastern Slovakia, the NGOs Novozem and Mlynský náhon, amateur ornithologists, as well as representatives from Košice City – Department of Strategic Planning and Department of Urban Greenery – and teachers from the Faculty of Economics.

PHASE 3

2nd May 15:30 – 17:30, Technicom, Scientific Park of Technical University of Košice

Final presentations in front of a panel of stakeholders and awards ceremony

The hackathon's last phase was the final concepts pitches in front of the stakeholders. Students had 5 minutes for the presentation in PowerPoint. All members of the team should be included in the presentation.

The students' projects were mainly focused on the locality of the university campus and the dormitories since they spend most of their time in Košice. They tried to develop solutions that could improve the living conditions of species present in these areas, for example, squirrels, birds, insects, and frogs. Most of the projects worked with expanding green areas, including vertical and horizontal green roofs. Ideas were presented ideas for greening the roof of the TUKE University Library, creating a community garden, and inventing green street lighting poles. The jury deliberated for a long time over the winner and finally selected two winning projects developed by the teams 2DKM and We Four.

The team We Four presented a design for a vertical green wall at the Jedlíková TUKE dormitory. Next, team 2DKM focused on helping the birds in the hot months and prototyped a homemade bird watering hole which could be in the Jedlíková dormitory. They also presented a plan for how the community could care about the bird watering hole to keep it safe and clean.

In the jury were: Adriana Šebešová from the Košice City Council, Martina Gregorek from NGO Mlynský náhon, Zdenko Lipták from NGO Novozem, Peter Krišovský from the East Slovak Museum, and Peter Breyl, General Director of the Innovation Centre of the Košice Region. They posed students questions and gave constructive feedback.

The jurors were asked to complete a simple assessment form (1–5 points for each criterion).

Relevance	How relevant is the problem which the project addresses (in terms of importance and timeliness) for the challenge of the hackathon? For example, does the project correctly identify the needs of the site or target group (plants, animals)? To what extent does the identified problem contribute to improving biodiversity in the selected locality?
Efficiency	Is the solution effective/ ecological/ innovative/ better than other alternatives?

Feasibility	To what extent is the proposed project feasible? Is the budget realistic? Were potential barriers identified, and ways of addressing them proposed? Will the project be workable in terms of the identified target groups?
Presentation	What is the quality of the project presentation? The clarity, structure, coherence, attractiveness of graphic design and layout of slides? Were all members of the team involved in the presentation? Is the team able to respond promptly to follow-up questions?

Fig. V.6.2 . The winning teams with the jury.

6.6. Organising the real case

From the organiser's perspective, the huge advantage was the opportunity for financial support from the project of EurActiv. It was much easier to contact the stakeholders and ask them for their capacity to prepare a lecture, provide mentoring or participate in the final pitches when I could offer them a fair financial reward. Therefore, it would be useful if the faculty could allocate some financial sources to support the implementation of these techniques into education.

Maybe the most challenging task was identifying the relevant stakeholders because I didn´t have professional contacts in the field before. But I used the snowball method, and the first contact

recommended the next other stakeholders. In the end, it was easy to get references for people who could be rich in knowledge but also accessible to students and inspiring.

The stakeholders looked open and happy to collaborate with the university and promote the topic in front of students. During the event, we also discussed the possibilities of further collaboration (e.g., future common projects with students).

From the students' perspective, even if they were informed about the hackathon at the beginning of the semester, they were quite surprised by the amount of effort required later. Therefore, next time I would invest more attention in better explaining the benefits of the hackathon, so they can better plan their time allocation for it.

Students were asked to share their insights and discuss with their peers or mentors in MS Teams, which was used as a supportive online tool for the event.

6.7. Real case learning outcomes

- The student knows societal challenges that determine the deterioration of biodiversity in urban areas.
- Students can put knowledge into practical use and at a basic level reflect on the problems of biodiversity in the urban locality and propose some solutions and best practices.
- Students can explain suitable solutions and present them in front of practitioners in the field using professional language.

The hackathon provided an enriching experience for the participating students, allowing them to develop and enhance valuable skills.

During the teamwork, students were trained to communicate effectively, delegate tasks, and leverage each other's strengths to achieve shared goals. Problem-solving skills were also honed, as students were required to think critically, analyse problems, and propose creative solutions to enhance biodiversity in specific sites. The hackathon encouraged innovativeness and out-of-the-box thinking and enabled students to use their imagination.

Students needed to plan the sources realistically and outline the budget draft to prove the feasibility of the solution, so they used financial literacy. In the final phase, the hackathon helped them to train their presentation and pitching skills, communicate their ideas effectively, articulate their vision, and persuade others. In addition, they received valuable feedback from judges and mentors, enhancing their ability to refine and improve their concepts if there was an opportunity.

According to the taxonomy of EntreComp Framework, there were trained in the following entrepreneurial skills:

1.1. Spotting Opportunities: Use your imagination and abilities to identify opportunities for creating value.
1.2. Creativity: Develop creative and purposeful ideas.
1.3. Vision: Work towards your vision of the future.
1.4. Valuing of ideas: Make the most of ideas and opportunities.
1.5. Ethical and sustainable thinking: Assess the consequences and impact of ideas, opportunities, and actions.
2.3. Mobilising sources: Gather and manage the resources you need.
2.4. Financial and Economic Literacy: Develop financial and economic know-how.
2.5. Mobilizing others: Inspire, enthuse, and get others on board.
3.2. Planning and management: Prioritise, organise, and follow up.
3.4. Working with others: Team up, collaborate and network.
3.5. Learning through experience: Learn by doing.

During the hackathon the following digital skills were trained:

1.1 Browsing, searching, and filtering data, information, and digital content.

6.8. Feedback about achieved learning outcomes in action learning

From the perspective of a teacher

Action learning, in brief, is learning from concrete experience and critical reflection on that experience through group discussion, trial

and error, discovery, and learning from and with each other. (The DIGI-SOC agreed definition elaborated by the TAMK Team.)

A hackathon is a great tool for action learning, and I could see that also, in our case, the hackathon enabled a unique experiential learning environment. Students were actively engaged in problem-solving about the different biodiversity issues, and their awareness and interest in the topic increased immensely.

They worked on real-world challenges linked to well-known localities rather than passively absorbing theoretical knowledge. They learnt by doing and gained practical experience in ideation, planning, and presenting a project. The self-learning of students was forced, but they also experienced group discussion and peer-learning.

But I can also see the shortcomings. I can see the weaknesses in the quality of feedback. Even if the confrontation with practitioners brought students valuable insights, there wasn´t so much space for trials and errors. Next time I should follow the hackathon design more strictly and organise the joint session for the ideation, prototyping, and testing phase. It is important to facilitate the process of creating ideas for projects and give students the opportunity for feedback from the mentors in all stages of the creative process, so they can experience more productive discussions, trials and errors and react on them flexibly.

Although students had the video about the phases and processes of design thinking, some said they didn´t watch it. These students missed the substantial understanding of the creative process. Therefore, some solutions were imitation rather than innovation. But still, it was a valuable application of their new gained knowledge on the real-life problem.

The pitching session was at the end of the semester. After the final session, I discussed with several individual students and two teams their opinions and feelings about the hackathon.

Unfortunately, there wasn´t any other time available to have the opportunity for deeper reflection with all students and all groups. Therefore, next year I need to improve the timing, allocate the last lecture for the group feedback, and give a chance to critically reflect on the results within the student teams.

The challenge is how to design an appropriate assessment tool that could effectively assess if the learning objectives were achieved.

From the perspective of stakeholders

We had a group discussion with the stakeholders. They were supportive and constructive. As the main benefit of the hackathon, they emphasised the increasing awareness of the students about the topic.

From the perspective of students

Results from the interviews and survey

The best thing at Hackathon:

- It was useful for me because I learned about real-life problems and how to solve them.
- I liked the idea, our "mentors" were also great.
- Working in a team, searching, and grouping information into one unit.
- The opportunity to work with real professionals and contribute positively to the change of the region.
- New knowledge about biodiversity.
- Teamwork.
- Presentation.
- Collaboration with other students.
- Consultations with experts and their advice.
- Improving relationships between classmates and the best thing was that we thought more about the various problems of biodiversity in cities and about the possibilities of solving them.
- We learned something new.

The worst thing at Hackathon:

- The time. It would be better at the beginning of the semester when we are not dealing with so many mid-term exams and we could allocate more time to the presentation.
- The week – ... if it would be organised in the second or third week of the semester, the quality of the projects would have been higher.
- Not enough time for projects.
- A relatively small amount of time.

- Tight deadline for projects.
- The shortness of time to prepare the project and the timing, as the hackathon was held the week, we had the most credits for the whole semester.
- There wasn´t enough time because, at the end of the semester, we had much workload for every course.

Which unique new competences did you learn (not so usual for other courses)?

- How to communicate and solve problems in the team.
- I liked the level of seriousness, it's also nice that we got prizes, I think it motivated the students.
- Since this was my first project presentation after a long time (the last time was in the primary school!), it was a challenge for me, as I didn't know how to present it, but somehow, I managed :)
- Practical and constructive thinking.
- To present projects in front of a bigger group of people.
- To use my imagination.
- How to use your ideas to develop really feasible projects.
- For example, I presented something in front of such a large audience and a professional committee for the first time.
- Communication in the team.

7. Facing societal challenges in real case situations. SPRINT Hackathon

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7.1. Objective

To develop a process for capturing the most promising ideas from a hackathon and ensure a continuation path up to a working prototype. Identify potential collaboration models between university and local start-up operator (Platform6 https://platform6.fi/).

7.2. Context

Hackathons at the educational institutions are a typical way to foster interdisciplinary activities and collaborate with companies. The purpose is to benefit both parties: students learn in action and companies get fresh ideas. The project team at the Tampere University of Applied Sciences (TAMK) asked themselves what is the real impact of a hackathon? How many real implementations do either the participating companies or students get out of a hackathon? During the intensive days at the hackathon, it is common procedure to suggest teams to continue working on their idea and develop it further. However, based on our 10-year experience, very few students carry on. We wanted to find answers to what can be done to the good ideas after a hackathon. We organized two separate workshops to ask university lecturers, students, and start-up ecosystem operators about this. Participation was voluntary and people were self-motivated to discuss the given theme. The sessions were moderated, and notes were taken.

7.3. The nature of challenges addressed

The societal challenges we face require versatile competencies and collaboration skills – often via digital tools. This action learning event addressed nurturing the growth of cross-domain entrepreneurial

competences and understanding how different stakeholders (students, start-up service operators, teachers) can support individual learners in the best possible way. Entrepreneurship is often part of elective studies that limits the number of students qualifying in it. This is the case even if the entrepreneurial value creation and entrepreneurial learning can take place in any sphere of life – from managing own study path or hobbies to establishing a company. Entrepreneurship can in a larger context be seen as transforming ideas and opportunities into value for others (EntreComp 2016). When taking this to a cross-domain level, the ideas and opportunities may be very innovative and ground-breaking. That may enable us to solve the wicked problems the society requires.

7.4. Real case description

A transnational scope of collaboration was implemented through the online preparations and planning the session with TAMK and Mittuniversitetet. Exchange of experiences on programmes and curricula among the involved institutions give valuable insights to renewal of projects and plans. That kind of peer-learning is best achieved in a project setup that can continue more than just one semester.

The workshop implementation was organized on purpose out of the university campus at Platform6, the local start-up house, which supports entrepreneurial activities. At the workshop, Platform6 introduced their services and premises to the participants. The idea was to make the services more familiar and lower the threshold of joining some of the events organized by the Platform6. This is one of the places where new ideas can grow to future companies.

The second objective of placing the workshop outside of the everyday environment was to create more relaxed setup for students to share their experiences and propose new ideas. We also offered them morning coffee with snacks to make the session more appealing.

The university is one of the places where new, innovative ideas are born. It is important to ensure good and functional collaboration with a start-up ecosystem within the city/ municipality. This ensures the continuation for potential start-up companies, that they

will to have place and support in addition to that the university can offer.

During the workshop, students shared their experiences on participating in the SPRINT Innovation Festival in November. They participated in a dialogue facilitated by project team members. The whole team shared experiences, ideated potential new procedures, and commented on other people's proposals. We used video material about the innovation festival as a reminder of the event and to take students and operators back to the atmosphere of the event.

To succeed and engage people in dialogue it is important to ensure four elements: Voicing (speaking from the heart), Listening, Suspending and Respecting. (See the book by William Isaacs, 1999: Dialogue – The art of thinking together). The purpose of dialogue is to build learning and thinking together. It is not about finding answers but to enrich participants' thinking and to pursue creating shared meanings by bringing together and expanding viewpoints, experiences, and thoughts. Dialogue is complementary sharing of accumulated knowledge and experiences.

Students build their knowledge on their own experience of participating in the SPRINT Innovation Festival in November 2022. Building the team has a very important role in this process because all members were from different fields. After that was time for inspiration. We had for students 20 different brainstorming techniques and ideations techniques for problem-solving. They use example design thinking and ask from themselves five times why and tried to come up with solutions for the case they were given. After one week of working they had to pitch their idea in five minutes and give a report. There is a risk that a good idea can be hidden behind a not so perfect presentation. That's why we would like to give a second chance and the possibility to continue working with all potential ideas before the hackathon. The follow up session is a way to continue with any ideas.

We made the advertisement (please see it below) and tried to catch from teams we were coaching earlier in November. Even though we contacted them directly it was difficult to get answers to participate in that follow up meeting. Maybe it should be a little bit earlier after the hackathon event when we still remember our good ideas better. The time take cares this if it's too long a delay.

We give the chance to continue with the same idea as earlier, and it was also possible to continue with other teams. We didn't want to define the topic of idea in any way.

Workshop execution:

The first workshop was targeted to staff members and gathered about 20 participants from different fields of study e.g., International Business, Environmental Engineering, Sustainable Entrepreneurship etc. The participants were divided into two groups and the following questions were given as starting points for discussion:

1. How to take the hackathon ideas into use?
2. What needs to happen/ be in place to get the ideas to grow?

The second workshop was targeted to students and start-up ecosystem operators (coaches and program coordinators). The aim was to understand how the intensive hackathon had performed in increasing the innovation and ideation skills. We also wanted to ask if some of the ideas had been developed since the hackathon. The workshop was organized at the local start-up house, Platform6, to promote the services and facilities of the city of Tampere. The atmosphere was designed to be relaxed and easy going to encourage

students to share their experiences and hopes for the future. Below are two images from the event.

Summary of taking the ideas into use: Ideas generated at hackathons can be forwarded to potential funders for investment or used as case studies in various courses. They can also be categorised into themes and forwarded to R&D teams for future projects. It's important to find the right organisation or individual to take the idea forward and build a team around it. Third-party follow-up, such as from TAMK, can also help in reviewing and planning the next steps.

Summary of structures that need to be in place: To maximise the potential of hackathon ideas, it's important to have a follow-up process with milestones in place to track progress. Additionally, combining potential ideas can create a stronger solution. A model for copyrights and a contract between students and companies can help to ensure that the ideas are protected and can be developed further. Resources such as consultants or experts can be used to take the idea to the next level. Regular follow-up events, such as after 2–3 months, can help support teams in building a minimum viable product (MVP) or prototype.

During the follow-up, we heard that from the students' perspective SPRINT is mostly focused on coming up with ideas and creating a good pitch, not so much on taking anything further. Mia, a female student who attended the follow-up, said that if the students could work with problems that companies really want to get solved, then perhaps that could lead to more ideas being taken further. The students also expressed that working in English added an extra level of challenge.

SPRINT is a compulsory course for some students at TAMK. How about making the next steps of the process (towards creating start-ups) compulsory as well? This was an idea suggested by Petri during the follow-up session. The start-up ecosystem operators participated in the Follow-up meeting to share what kind of observations they made and what kind of cooperation they hope for in the future.

It was good to hear the students who participated Sprint Innovation Festival about their experiences and why or why not they continue with the ideas which were born in Sprint. It is also important to think about how to engage the students better during and after the event. Together our network could bring stronger support to the students. It is important for students to work with their own ideas

and explore topics they truly care about. It is a solid starting point for getting them more interested in developing these ideas into something bigger.

7.5. Our key observations and learnings from the discussion

1. It is important for students to communicate the winning solution with rationale.
2. All solutions to be brought together, offered a continuation option by picking out the best bits.
3. It is essential to tell everyone to come and listen to each other's solution proposals. Encouragement to participate and learn from them as well.
4. Could there be some restorative joint program during the SPRINT days? Also, the hybrid participants to be encouraged to network and collaborate through playful interactions.
5. The most important lesson for students (1): The ability to brainstorm: to go crazy and offer even raw ideas.
6. The most important lesson for students (2): How diverse ideas are generated through collaboration.
7. Brainstorming is most fruitful when starting from some irritation that you want to solve ("frustration-led-innovation").
8. The most rewarding thing for students would be to see their own idea tested/ prototype/ in action. "It lights me up!"
9. Ideas can enter the "Smart Machines2 course" or similar, where trans-disciplinary collaboration is encouraged. Timing to be considered and made smooth for the students.
10. Guidance to the Platform6 community: pre-accelerator (3weeks online), with further development of your own idea.

Hackathons are great platforms for innovation and ideas, but it's important to ensure that the energy and effort put into the ideation process contributes to making a real impact. By taking the right steps, such as finding the right organisation or individual to take the idea forward, creating a follow-up process with milestones, and

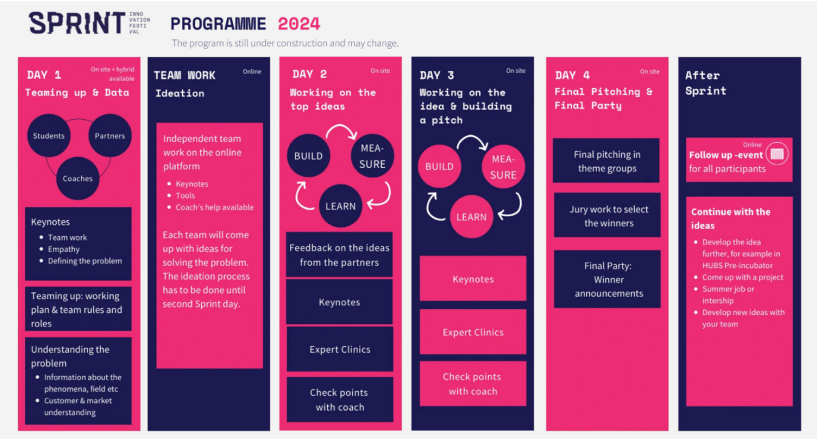
combining potential ideas, we can maximise the potential of hackathon ideas and bring them to life.

Action learning elements like group discussions, critical reflection, learning from each other and taking the time for discovery have guided us both in creating the actual learning event (SPRINT) and now when evaluating the impact of the results. This work is resulting in renewing the concept of our hackathon by taking the learning of these two workshops into use. The next paragraph will introduce the ideas of the new SPRINT 2.0.

Sprint Innovation Festival's future

The TAMK team has taken all the feedback and development ideas and created a refreshed concept for the SPRINT Innovation Festival. The core idea is to encourage through ideation and give students more freedom to choose the challenge they want to solve. With this we aim to create more commitment to the topic and therefore ensure the continuation after the hackathon. A big part of the new concept is also the inclusion of a follow-up event in the program. This new concept will be piloted in November 2023.

In the Digi-SOC project, the Follow up event/ meeting was tested and according to the discussion and feedback, it felt to be a necessary part of the event. In the future, we also want to strengthen cooperation with different operators, such as Platform 6 and RedBrick.



Picture from Sprint Innovation Festival future program where the Follow up event will be part of the official program for students.

8. Facing societal challenges in real case situations. Challenge-based development of an innovative business idea under the course on innovation & entrepreneurship UAB summer school

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8.1. Context

The present initiative is undertaken once a year under the course named 'Innovation & Entrepreneurship' that is part of the Autonomous University of Barcelona's summer school (July). In this course, around 30 students from universities with which UAB has agreements participated. They usually include students from the 6 continents and from a broad range of backgrounds, including business and economics, engineering, arts and humanities, sciences, etc. Some characteristics of the course:

- UAB students can participate, but they usually constitute 20–25% of the total number of students. Upon completion of the course, they can certify the ECTS acquired as optional courses of the programme in which they are registered.
- Number of teaching hours: 49.5, corresponding to 6 ECTS, according to UAB's correspondence hours – ECTS.
- Organisation of the course. Two parts, approximately 24.75 hours (3 ECTS) per part, including:
  - Part I: Innovation. This part of the course covers topics on how to transform a challenge-based idea into a specific product or service that can offer a solution to that challenge. It includes aspects of:
    - Innovation process management.
    - Property rights.
    - Innovation development funding (public and private).
    - Current trends in the R&I top domains.

  - Part II: Entrepreneurship. This part of the course covers every aspect from the moment in which the innovation-based product or service has been defined until the company is ready and/or in a growth stage. It includes aspects of:
    - Company development funding and financial elements.
    - Human resources and collaborations.
    - Marketing.
    - Process organisation.
- Course's assessment, evaluation. Elements.
  - Two tests (50%): innovation part (25%) and entrepreneurship part (25%).
  - Development of the project (as defined in the upcoming sections) and presentation (50%).

8.2. Objectives

The objective of the activity is, in teams of (usually) 3 students (see groups composition in the next section), identify a social challenge for which potential innovation-based ideas can be considered to provide solutions, and develop the project for which a product or service is designed. A business plan is also developed for that specific product/service. In pedagogical terms, the objectives of the initiative are:

- Foster the entrepreneurial mindset of students, ensuring that they can identify a business possibility to develop a project/idea.
- Connect social challenges (especially, if possible, territorial ones in the territories of the involved students) with business ideas, developing products and/or services which can serve as a solution to those.
- Enhance the synergies of students from different academic backgrounds, nationalities, cultures, and experiences.
- Develop teamworking as a key asset to foster the entrepreneurial mindset of students, presenting the development of innovation-based ideas as the result of the collaboration instead of isolated initiatives alone.

- Support the development of the curiosity of students to understand the societal challenges around them.
- Teach students methodologies to turn ideas into practical projects, making use of their knowledge and new tools, especially digital ones.
- Provide the instruments for students to learn how to present their ideas and projects to a broader audience, engaging them.

8.3. Building teams

The first step in the process to design the team projects is team building. Following the methodology in the course, it is the professor who is the person in charge of shaping them, considering different elements. To do so, the professor (having access to an exhaustive list of the characteristics of each student) will build teams of (usually) 3 students, considering the following elements:

- Students with different backgrounds. The usual composition of the students list usually allows for this standard composition (in terms of background):
  - 1 student from business/economics
  - 1 student from engineering/sciences
  - 1 student from other backgrounds (humanities, communication, psychology, etc.).
- No students from the same university should be in the same team. For instance, UAB students are split among the different groups.
- Different nationalities. A first division of local (Barcelona-Catalan), other European, and international (third countries) students is created. To the best of the possibilities, teams include diversity in this regard.
- Academic and/or professional experience: Also considered is the number of years students have spent at a HEI and/or whether they have previously worked (even if it is just part-time, during summer, etc.).

It must be reminded that the characteristics of this specific course allow for this classification of students and subsequent composition of teams; other courses (for instance, those within just one

faculty) would have to consider the group building process in a different manner.

The objective is for students to make use of the synergies that are developed when working with other people with different background, experiences, knowledge, etc.

Professors encourage students to identify the best way to use these synergies. For instance, an example is usually provided in which student A (miscellaneous background) identifies the societal challenge, student B (engineering) proposes a solution, and student C (business) leads the process to turn that solution into a business. Throughout the whole process, the 3 students collaborate under this synergic logic.

8.4. Selecting challenges

Once teams have been built, students are requested to spend time defining the topic of the project on which they will be working in the following days/weeks. Following the instructions given, students are to select a challenge that relates to some societal need and propose solutions in that regard. The definition of 'challenge' can be as broad as considered; we would understand it here under the logic of what is being understood under the DIGI-SOC project. For the edition 2023 of the course, students were given some options, even if it was not mandatory to select one of them (just a recommendation):

- Climate change, global warming
- Energy crisis in Europe
- Waste management and circular economy
- Ageing societies
- Digitalisation of public services

Several activities can be done to (1) bring the teams together and develop some teambuilding, and (2) support students when choosing the right topic for them, given the experience and common interests of the group. These are the activities that are usually undertaken (at the very beginning of the course) to support students in this direction:

- Quiz game: aimed to bring students together, an initial quiz (to be played in the same teams) is undertaken. The objective is for students to get to know each other and learn about their potential complementarities. Quiz

questions can cover many topics; in this course we usually include questions about current research and innovation topics, global challenges, and other related miscellanea questions.

- Idea building time: students are given time to discuss a specific solution to their selected challenge, based on their own imagination. Usually, they are given around 1 hour to discuss a project (innovation-based) under which they can feel comfortable working together. They should consider their backgrounds, experience, and complementarities. This should end by choosing a specific project.
- Initial presentation: one their solutions is defined (what they want to do within their project), they present this idea to all the other teams (and the professor(s)). They explain the challenge they have selected, and they discuss their idea for a solution, whether it is a device, an application, a specific service, etc. The professor and the other students ask questions to help them be as concrete as possible, which will help the team start working in their specific project.

Students are invited to undertake research before presenting their initial idea (usually on the second day of the course). That is, students are required to show data and other pieces of information that proves that the topic they have chosen does indeed connect to a specific social challenge that requires solutions. They are also requested to analyse local strategies, policies, and plans of the city/region/country where they want to develop their project to assess the complementarities between those and their selection; in other words, they should specify how their potential project is aligned to the priorities identified in local/regional/national policies/strategies.

8.5. Developing the innovation-based project

Once the project idea has been selected, students are given some general information on how to proceed:

- The final design can be totally imaginary, but it should be realistic, that is, they can think of any device, other product and/or service, even those that could be considered

futuristic or at the edge of known technologies; nonetheless, they should not design any element that cannot be considered impossible to make true.
- They can assume they may have access to a broad range of resources, but they will have to build a financial plan that is realistic; in other words, they can plan large amounts of the budget to be spent but they need to explain how they plan to obtain that amount, and this must be something that could be feasible.
- They need to make sure that their design has a commercial use, that is, that can be used by end consumers, and that it is capable to generate business opportunities. Even if they think that the only potential client could be the public sector, this is also considered for potentially relevant business.

Having this in mind, each team is expected to devote some time every day to work on their projects. During every session, the instructor discusses the primary theoretical components of the subject scheduled for that day. Following this, various practical illustrations such as case studies and readings are provided. To conclude, students are allocated a few minutes to incorporate the day's teachings into their projects, with the professor available for guidance if necessary. The main points covered in one or more sessions are:

- Steps to build the project idea.
- Collaborations needed.
- Private funding mechanisms.
- Public funding mechanisms.
- Property rights, intellectual/industrial property rights.
- R&I project management.
- Presentation of R&I project ideas.
- Suppliers of R&I.

8.6. Building the business plan

Once the product has been presented, as well as its use and potential for business, it is now time to build the business plan. The logic is the same as in the previous section: in each session, the professor presents the main theoretical aspects of the topic that is being covered that specific day; after that, some practical examples are

given (case studies, readings, etc.); finally, students get some time to integrate that day's learnings into their projects with the assistance – when needed – of the professor. The main points covered in one or more sessions are:

- Market analysis.
- Organisation and management aspects.
- Human resources.
- Financial plan.
- Marketing and sales strategies.
- Growth strategy.

8.7. Fostering synergies with other teams

Complementarily, activities can be undertaken together with the other teams in order for them to exchange ideas, discuss potential collaborations, and learn from each other. To be more specific, the following are 3 activities that are being carried out in most editions of the course:

- Presentations:
- Parallel activities/games:
- Analysis of other projects: teams can be requested to analyse the work of their peers, whether it is the whole project or parts of it. Teams can be requested to provide feedback and even specific ideas to support their colleagues' work. This is also aimed at creating a collaborative environment, rather than just a competitive one.

8.8. Closing and results

The initiative ends by:

- Submitting the business plans.
- Presenting the highlights of the business plan, as if the audience (professors and other students) were potential investors.

While it is not part of the formal evaluation, other students also provide their feedback by rating (from 0 to 10) how good they think the projects of their peers were, considering different aspects (resources used, detailed presentation, relevance, quality of the

presentation, etc.). This assessment by the other students helps making the whole experience as realistic as possible.

Each year students rate this activity very positively, an activity which supports building their entrepreneurial mindset, a key competence in most (if not all) higher education programmes.

Annex – Executive summaries of 2023 projects (examples) (written by students)

1. HEALTIC

Healthcare is an integral part of every country. A strong and accessible healthcare system is essential for promoting health, delivering prompt medical interventions, and resolving healthcare disparities. This can help lead to better outcomes for individuals and communities. The Spanish healthcare system, however, faces challenges such as long waiting times to seek treatment for medical conditions which can lead to potential health risks and frustration. For example, it was reported that there was an average waiting time of 9 days for a doctor's appointment in Spain. In addition, hospitals struggle with shortages of healthcare professionals especially in certain regions. The resulting high workload results in burnout among the healthcare professionals and can also lead to a decreased quality of care of patients. In addition, the aging population places additional strain on the system as more resources and care is needed to meet the needs of the elderly. Furthermore, in certain regions it is difficult for people to access healthcare as they need to travel long distances even for simple consultations. Other issues faced include physical disabilities and monetary problems.

In this business model, we are developing a telemedicine platform that leverages the power of Artificial Intelligence to offer healthcare services, particularly to those who have difficulty accessing quality healthcare due to their geographical location, physical disabilities, or monetary problems. This would help ease the pressure from healthcare professionals and provide convenience for users. Ultimately creating a healthcare system that is efficient and accessible. The platform would include the following features:

- Virtual Consultations: The platform could enable remote consultations with doctors and healthcare professionals. Video calls can be scheduled, and consultations can happen in real time.
- AI-Powered Diagnostics: Implement AI algorithms that can analyse patient symptoms and medical history to aid healthcare professionals in diagnosing illnesses. This can provide preliminary assessments for patients and help doctors prioritize cases based on urgency.
- Health Monitoring: Using IoT devices, the platform could continuously monitor patients' vital statistics (like heart rate, blood pressure, and blood sugar levels) and automatically upload this data to the platform, allowing healthcare professionals to remotely monitor patients' health and provide timely care.
- Predictive Analytics: With accumulated health data, our platform could use AI to identify trends, predict potential health issues, and give personalized health and lifestyle recommendations to prevent diseases.

2. SkinGuard

As we all know, skin cancer is a major global health concern. There are thousands of people who die from just melanoma every year and many people go undiagnosed because of the inefficiency of health care systems. To give some perspective, in the United States there are 9,500 people who go undiagnosed with skin cancer every day and more than two people die of skin cancer every day (Skin Cancer Foundation). As a company, we recognize the importance of early cancer detection and improving the diagnosis process for doctors across the world. We acknowledge how our current healthcare system is constantly failing all types of patients of different ages, races, sexuality, and disabilities. We want to put a stop to this cruel system that is not as effective as it should be.

Using SkinGuard is intuitive and seamless. By simply capturing high-resolution images of suspicious moles, spots, or lesions using a smartphone camera, doctors can upload and analyse these images within the app. Our advanced algorithms then compare the images to a vast collection of medical imagery, enabling doctors

to identify potential signs of skin cancer with remarkable accuracy. In addition, since we made the application strictly for doctors to have access to, we still wanted a way to incorporate the voice of patients. The patients themselves won't have access to the data from the application, however, every time a doctor uses the application with a certain patient, that patient will be able to put down their experience as a note. The way the patient will be able to do this is by using their code number given by their doctor and a phone number in which all the patients can express what went well during the use of the application and what didn't. SkinGuard is about making people feel seen and heard, we're not simply an AI person-based application, rather a company that wants to improve their services and process innovation. We want to capture emotional experiences that will engage the patients as well, something that current health systems ignore, along with other health scan applications. Lastly, the doctors can customize their account according to the type of patient they have. A lot of patients are under a lot of stress and fear when they are going to get potential lesions checked out, so making the doctor's application customizable with different themes and colours can help alleviate the stress that the patients feel, as they will be distracted by the theme of the application rather than looking at an intimidating AI based application. Some patients might be younger, so their perspective of being at the doctors can be intimidating. Children love to have colourful applications that help with sensory stimulation. Ultimately, it is about helping the diagnosis process run more smoothly, rather than having a child cry in fear and confusion.

3. TrashCan

According to the EU's waste hierarchy, landfilling accounted for 24% of all municipal garbage generated in the EU in 2018. This can be hazardous to both human health and the environment. Leachate production may pollute groundwater and create methane, a strong greenhouse gas. Furthermore, if recyclable garbage is landfilled, materials are lost from the European economy unnecessarily. Therefore, we can see that there is a crucial demand for a better waste management system. In our project, we will mainly focus on developing an automatic trash that can identify and sort garbage

according to its characteristics such as texture, taste, and size. Applying different kinds of sensors and Artificial Intelligence technology on our product, it can recognize garbage such as metal, plastic, paper, glass, and food waste. After that, it can automatically divert them to the corresponding bins inside the trash can. Our product aims to improve waste sorting, making it more convenient and efficient, and thus to mitigate waste pollutants such as toxic substances through air and water during the incinerator process.

Implementing efficient waste sorting can reduce waste disposal costs in response to the effectiveness of incinerators. After the garbage is sorted, the amount of garbage can be reduced, and thus the cost of garbage transportation, incineration treatment and equipment maintenance can be greatly reduced. On the other hand, by sorting the garbage automatically and accurately, more recycling resources can be found and so it can also reduce energy consumption and pollution during the incineration process. In the light of this, there is a great potential for us to cooperate with the government to carry out our project. When the government widely promotes our automatic trash can, replacing the traditional trash can, it can strongly reduce the garbage's storage in landfills and its huge environmental impacts.

Our start up totally embodies the ESG values, identifying itself with a lot of effort in the environmental sector, as well as in the social and governance ones, aiming to develop a fundamental product sustainability-wise, but also by guaranteeing equal salaries without any kind of distinction. The governance will also be developed with ethically correct practices, with transparency in the decision-making field and in the publication of financial statements and reports. TrashCanTech is totally open to the challenging aspect presented by ESG, the mismatch between ESG strategy goals and market demands, particularly in terms of time horizons. As a matter of fact, if the ESG strategy aims to invest in the long term, the market often rewards companies that achieve quarterly targets. Our start-up will strongly work to channel these two opposites in the right direction while remaining successful in the production field.

4. LearnAI

Current news coverage on AI tends to focus on general uses, providing only a limited understanding of its possibilities. Moreover, mainstream news outlets often spread fears of a potential AI takeover, perpetuating a narrative where computers control the world. This fear-mongering approach is detrimental to the advancement of the next revolution in AI, as it instils unnecessary fear and stifles productive conversations surrounding its potential. To fully embrace the AI revolution, it is essential to foster an environment of education, exploration, and collaboration. By promoting accurate and comprehensive information about AI, we can empower individuals to unlock its vast potential and explore its diverse applications. Instead of dwelling on dystopian scenarios, we should encourage discussions that highlight the benefits and address the challenges associated with AI implementation. By doing so, we can ensure that AI is utilized ethically, responsibly, and for the betterment of humanity.

AI is growing at such a fast rate in its capabilities as well as its integration into general society. It is imperative that the right information is being shared for the further development of AI usage. We believe that this is a serious problem that needs to be addressed. No company or news outlet has properly shared AI to truly combat the narratives that it currently faces. Like what was mentioned before, news outlets are only sharing general information regarding AI as well as choosing fearmongering over education or practical uses.

Because of the problem with AI implementation and misinformation about AI in news outlets, we feel that the best approach to combat this problem is to create a new app that specifically focuses on AI. This platform would operate to the likes of Twitter or Instagram where news would be shared from our platform to educate the public about AI, share how to use AI safely, and share specific content related to their interest through an algorithm. From there, a specialized platform will be created according to your interest.

5. SocialEats

SocialEats is an application to help users find sustainable restaurants near them. Users of the app can search their area for food options

which are listed with a sustainability score. This score is determined on the basis of 5 criteria (corporate culture and responsibility, locally sourced ingredients, minimizing food waste, fair compensation, and communication) related to UN 2030 Agenda's Sustainable Development Goals, and will help people make more environmentally friendly choices when eating at restaurants, ordering food, (etc.). In a society, where making sustainable choices is increasingly important, we wanted to create an app that helps people make these sustainable decisions easily in their everyday eating habits. Restaurants are registered in the app by presenting some mandatory documents analysed by our auditors. SocialEats, as we said in the first part, collaborates with different organizations and companies, such as Sustainable Restaurant Association (SRA), GreenKey Program, Michelin Guide (Michelin's green star), Patagonia (outsourcing), local partners and reforestation organizations, charitable organizations and obviously restaurants. SocialEats offers a variety of additional services including food delivery, food booking/take away, table booking, and purchasing products that were prepared earlier in the day or the previous day for a reduced price. This feature helps reduce food waste produced by restaurants.

There are multiple incentives to participate that we offer to users of the app. For example, we are committing to planting 1 tree (mainly Hura Crepitans) for every $50 spent through SocialEats. Users will also earn bonus points from their orders which they can accumulate to win prizes. These prizes (a courtesy of our collaboration with Patagonia) include tote bags, t-shirts, water bottles (travel tumblers), and more which will be made from 100% recycled materials. Additionally, 2% of all profits generated from the app will be donated to charitable organizations dedicated to sustainability. The idea is to try to get people to adopt more sustainable behaviours, in an indirect way. For example, there are a lot of people that care about planet Earth but don't want to spend money directly, for example, for planting trees, so basically, we are allowing them to plant trees and to donate to charitable organizations, simply by spending their money for food. It could be said that we are trying to "educate" the population, for example, directing them towards the purchase (with our bonus points system) of products made of 100% recycled and 100% recyclable materials. We also want to try to address all the restaurants towards the adoption of more sustainable policies.

6. RECYCLUE

The main objective of the proposed project is to maximise the waste diversion rate by minimising contamination of bins. Although many people are familiar with recycling and can feel confident about what bin certain items belong in, there is a lot of ambiguity around certain items, i.e., disposable coffee cups, milk cartons, tetra packs, tissues, etc… The goal of our project is to provide clarity about what bin to use in a user-friendly way. The key strategy behind the project is adapting the app to each local government area (LGA) to ensure the advice given (as to what bin to use) is accurate, and that the bin is available. For example, if some LGAs have an organics bin and others do not, the app will not tell you to put your banana peel in an organic bin if there is not one available. Another key component of the strategy is ensuring the app is user friendly. As this app is likely to be used firstly by the younger generation, making it easy to use and accurate is a key priority.

We would most likely trial it in an LGA in Germany, as Germany is known for their commitment to environmental protection, and many Germans are environmentally conscious. If this was to trial well, we would expand it to other countries who are known for their environmental efforts, as the uptake is likely to be more successful. Gradually, we would expand to countries that may be struggling with their environmental efforts after they would have seen the success of the project in other countries. Our role is to sell it to LGAs and government bodies as environmentally and economically beneficial, and it is their role to sell it to their people to get it to work.

The app should be easy to understand and to use. The goal is that everybody can use it, even people who aren't that familiar with smartphones. The different steps for using the app are mentioned in the following. After logging in, you must sign in first. You identify yourself and choose the LGA suitable for you. After that, you're ready to go. The use of the app always consists of two steps. Firstly, your camera opens so you can scan the waste you want to throw away. After that, the app will show you which bin you need to use to reduce contamination and optimise recycling for your LGA.

7. OuDA Wellbeing

According to psychologists, depression is a common mental disorder, which involves a depressed mood or loss of pleasure or interest in activities for a long period of time. And today we will discuss the risks of not being treated on time. In addition, there is an increase in the number of people who say they feel or have felt depression. Globally, approximately 280 million people suffer from depression. It is estimated that in Europe 6.4% of the population suffers from depression and Spain has more cases. According to the EESE (European Health Survey in Spain) in 2020, 16.3% of women and 8.9% of men (both over 15 years of age) will present depressive symptoms. Additionally, we add anxiety disorder, which affects 3.6% of the population worldwide. This is why we have decided to create OuDA (out of depression and anxiety) an app that seeks to create a safe space for people between the ages of 12 and 20 to talk freely about their emotions and receive advice from a professional psychologist. How do we make it happen?

- Mental Health Checkups: The app will offer a set of expert mental health checkups to spot potential psychological issues and hidden concerns. These checks will cover emotional management, anxiety, depression, self-esteem, and more. Results will be shown visually to help users grasp their own psychological state better.
- Personalized Psychological Guidance: Based on users' test results and app usage, we'll provide personalized guidance. Users will get advice and solutions tailored to their unique challenges, such as emotion regulation tips, stress-relief techniques, and more. Our team of certified psychological counsellors and psychologists will collaborate with AI technology to optimize these recommendations.
- Online Counselling: We'll partner with certified counsellors to offer online counselling. Users can schedule appointments and engage in voice/video calls through the app to receive in-depth psychological support and counselling whenever and wherever they need it.
- Emotional Diary Feature: The app will have a diary function for users to jot down their emotions, feelings, and

changes in their psyche. Keeping a diary will help users gain insights into their mood swings and the root of their issues. Our psychological counsellors will use these entries to provide more personalized guidance.

- Supportive Online Community: Our app will build a tight-knit community for users to connect with other teens facing similar psychological challenges. Sharing experiences with others can ease feelings of isolation and offer understanding and support. Our professional counsellors will also be part of the community to provide expert guidance. Additionally, we'll collaborate with social organizations and companies for offline activities to promote mental well-being and foster friendships.
- Educational Resources: Users will have access to a wealth of psychological education resources, including articles, videos, audios, and more. These resources aim to boost users' knowledge of mental health and improve their ability to cope with daily emotional struggles.
- Parental Involvement: We recognize the crucial role of family in a teenager's mental health. With user consent, we'll share some mental health information with parents. This will allow parents to understand their children's psychological well-being and receive relevant guidance, fostering a supportive and positive family environment for mental health.

By combining these features, OuDA APP aims to provide comprehensive support for teenagers' mental well-being, helping them navigate life's challenges with resilience and empowering them to lead emotionally healthy lives.

Epilogue

Through the contents of this handbook, we have aimed to provide a comprehensive and complete overview of the significance of developing digital skills and entrepreneurial competencies in higher education to address the social and economic challenges of the contemporary world, particularly those affecting the regions where universities are situated. These challenges are diverse and impact a multitude of stakeholders and fields of knowledge. The examples provided are indicative of the challenges affecting most territories in the European Union and much of the rest of the world. This is why the development of competencies should not be viewed in isolation within a specific institution, city, or region, but rather as a necessity in relation to the evolution of the university's role in its local and global ecosystem.

As discussed in the handbook, the mastery of digital skills lies at the heart of students' academic and subsequent professional lives. It is challenging to envision a context in higher education where the use of digital tools is not an integral part of the system. However, reality demonstrates that there is still a need for substantial strides in integrating the ongoing advancements in the digital world into higher education. Activities such as those proposed can serve as inspiration to incorporate or strengthen the use of these digital skills in university education. In the medium term, pedagogical models will be required to adapt subjects and programmes to the continuous evolution of digitisation in all aspects of life. Hence, gradually but steadily moving towards more digitalised models becomes a pivotal element in ensuring that the higher education system is prepared for this ever-evolving transformation.

Utilising new digital tools also necessitates possessing the skills to employ them in addressing local and global challenges and needs, which we define as an entrepreneurial mindset. Higher education institutions must educate students in identifying these challenges and needs, and using the resources around them to develop and initiate projects that can provide solutions. These projects can take various forms and are found in both the private and public sectors, often linked to the challenges outlined in the handbook. However, in some cases, a traditional educational model

Epilogue

limits students' opportunities to learn methodologies for fostering their entrepreneurial mindset. Through the discussion of this field and the practical examples provided, the handbook has sought to present the extensive possibilities offered by universities and other higher education institutions in this domain.

In both the development of digital capabilities and an entrepreneurial mindset, as we have mentioned, the institutional role is crucial. Aspects such as challenge-based learning, multidisciplinarity, the integration of universities into their local ecosystem, along with other factors that encourage collaboration, are key elements in adapting the logic of higher education institutions to new educational paradigms. The handbook has aimed to provide a comprehensive perspective based on these principles, also dedicating a chapter to discussing this aspect. This institutional transformation is arguably one of the most complex challenges these institutions must confront, given the idiosyncrasies of the academic world, which has seen how, within a limited timeframe, it must adapt to a rapidly changing world, where the traditional educational model appears to be primarily heading towards obsolescence.

In the handbook we are now concluding, developed with the support of the DIGI-SOC project (co-financed by the Erasmus+ programme of the European Commission) and its partnering organisations, the aim is to provide assistance to those higher education institutions, particularly their teaching and technical staff, who are in the process of moving towards a contemporary educational model, taking into account the considerations we have discussed throughout the various chapters. Since the inception of higher education, universities and other institutions have sought to be at the forefront of social and economic change; this is why, now more than ever, these institutions are once again moving in the direction of such changes, which require tools and resources. Initiatives like those described in the handbook, as well as thousands of others taking place in the EU and around the world, contribute to advancing higher education towards the future, also taking into consideration the needs of learners with fewer possibilities.

Last but not least, we robustly endorse individual creativity and learners' open mindset, positioning artificial intelligence as a supplementary tool. Acknowledging the evolving dynamics and emerging functionalities, we recognize AI's potential to redefine

the learning process into a more enlightened educational journey. This transformation can be facilitated by AI's ability for swift and streamlined knowledge acquisition. However, its application requires careful handling, adherence to ethical standards, and, crucially, a focus on a learning-centric approach. The temptation to replace traditional reading of books, journals, group deliberations, and teamwork with AI chat-like applications must be firmly rejected. While acknowledging the factual evolution of traditional learning practices, a comprehensive exploration of this intricate subject merits a discussion beyond the scope of this text.

Addendum

Courses offering insights into societal challenges. The descriptions were taken from the websites and the links were valid as of October 2023.

Aging as the societal challenge

Worth looking at:

National Institute on Aging (NIA)

NIA, one of the 27 Institutes and Centers of National Institute of Health (NIH), leads the federal government in conducting and supporting research on aging and the health and well-being of older people. The Institute seeks to understand the nature of aging and the aging process, and diseases and conditions associated with growing older, to extend the healthy, active years of life.
The Institute's mission is to:
Support and conduct genetic, biological, clinical, behavioural, social, and economic research on aging.
Foster the development of research and clinician scientists in aging.
Provide research resources.
Disseminate information about aging and advances in research to the public, health care professionals, and the scientific community, among a variety of audiences.
https://www.nia.nih.gov/

Program on the Global Demography of Aging at Harvard University

The Program on the Global Demography of Aging (PGDA) at Harvard University, led by David E. Bloom, received funding from the National Institute on Aging at the National Institutes of Health to carry out research on important themes related to global aging and health, with an emphasis on issues in the developing world.

The PGDA's research focuses on five main themes:
Measurement of the global patterns of disease, mortality, and morbidity in aging populations.
Socio-economic determinants of population health and aging
Impact of health care services on the health and well-being of older persons
Determinants of mental health and cognition for the elderly (including Alzheimer's Disease and Alzheimer's-Related Dementias)
Long-term care institutions
https://www.hsph.harvard.edu/pgda/

The Oxford Institute of Population Ageing

The Oxford Institute of Population Ageing was established in 1998. Based on the US Population Center, it was funded by a grant from the National Institute of Health (National Institute on Aging – NIA) to establish the UK's first population centre on the demography and economics of ageing populations. It achieved Institute status in 2001.
Our aim is to undertake research into the implications of population change. We are a multi-disciplinary group with demography as our main disciplinary focus.
https://www.ageing.ox.ac.uk/

The Barcelona Aging coLLaboratory (BALL)

The Barcelona Aging coLLaboratory (BALL) was created in response to the need to develop innovative solutions that make progress towards active, healthy ageing and regard old age as an opportunity for both achieving a more inclusive society and boosting the economy.
The project operates within a so-called quadruple helix innovation framework, in which different organizations and members of a community (civil society, industry, academia and government) come together to build solutions capable of promoting a territory's socio-economic growth.
BALL's first project, unveiled today at Barcelona's Pere Virgili hospital, is a humanoid robot that can assist patients unable to feed

themselves on their own, providing them with a solution tailor-made for their needs.

https://www.uoc.edu/portal/en/news/actualitat/2022/267-uoc-behind-barcelona-living-lab-ageing.html

https://ballaginglab.org/

MSc in Ageing and Public Policy at University of Galway

This Masters in Ageing & Public Policy critically examines demographic ageing from a public policy perspective and is driven by a commitment to research-led interdisciplinary education. It assesses existing approaches and future directions to secure effective and fair ageing societies.

Why Ageing, Why Now:

With the world's older population projected to double by 2050, population ageing is recognised as a global challenge for sustainable development, and one of three major transformations facing the European Union, and the social, economic and health systems of its states.

The Sustainable Development Goals 2030 Agenda and the forthcoming European Commission Green Paper on Ageing testify to how ageing can create sustainability and equity challenges in every major policy domain – social protection, health, finance, housing and environment, employment, etc.

Despite extensive political commitment to finding innovative means to adapt to demographic change, existing efforts are often uncoordinated and ad-hoc with increasing evidence of growing inequalities amongst older populations. The COVID-19 pandemic has only further not only exposed weakness in ageing-related policy, but also the neglect of the diversity of needs and preferences of the ageing populations.

There is a marked gap in graduate labour force skills, and capacity, to help public agencies, civil society organisations and private companies to address these challenges and to capitalise on the opportunities within ageing societies.

https://www.universityofgalway.ie/courses/taught-postgraduate-courses/ageing-public-policy.html#

Master's programme in Ageing and Social Change at Linkoping University

In the first and second semester, students will follow mandatory courses that contain an historical and theoretical introduction of the ageing societies. Moreover, the course content provides insight into policy-oriented ageing research and introduce students to data and methods for policy oriented social science research on Ageing and Social Change. The courses inform about increasing economic inequality and accelerated population ageing as key features of contemporary societies between regional and global perspectives by looking into intersections between gender, social class, and ethnicity.

In the third semester, the programme leads to individual specialisation through studies abroad, internships, intensive research and reading courses as well as elective courses on an advanced level in the field of ageing, policy analysis.

The fourth semester is devoted to the composition of the master's thesis and to the participation in regular thesis colloquium meetings. The master's thesis regularly involves a small-scale research study. In addition to their thesis and course work, students will follow a schedule of thematic seminars.

https://liu.se/en/education/program/f7mag

Designing for an Aging Population at Royal College of Art

The UK's population is ageing, and this older population is holding an ever-increasing percentage of national assets and household spend. So, why do so few organisations – public, private, and charitable – not design for what older adults want, rather than what they perceive them to need?

The masterclass aims to provide a unique insight into the ageing marketplace, looking at how to design products, services and experiences that are not limited by the pervasive medical discourse of ageing as decline, frailty, and burden.

Course structure:

- Session 1 – Demography and Ageing: Discover the make-up of the ageing economy in terms of demographics, psychographics and purchase behaviours. Dig into the latest research from Oxford University's Institute for Population Ageing.

- Session 2 – Being User Centred: Understand the important role design can play in solving some of the common problems of ageing, and its role in exacerbating them, by taking a human centred, inclusive design approach and considering how to design for your future self.
- Session 3 – Healthy Ageing Innovation: Explore the barriers that prevent potentially valuable health benefiting products, services and activities either getting to market or being adopted by their intended audiences.

You will come away from this course with:

- a deep insight of the ageing economy,
- an understanding of design thinking and age inclusive design,
- a framework to understanding the innovation process,
- a tool to evaluate good and bad design.

https://www.rca.ac.uk/study/programme-finder/designing-for-an-ageing-population/

Poverty as the societal challenge

Worth looking at:

The Abdul Latif Jameel Poverty Action Lab (J-PAL) at Massachusetts Institute of Technology

The Abdul Latif Jameel Poverty Action Lab (J-PAL) is a global research center working to reduce poverty by ensuring that policy is informed by scientific evidence. Anchored by a network of more than 295 affiliated researchers and 550 invited researchers at universities around the world, J-PAL conducts randomized impact evaluations to answer critical questions in the fight against poverty.

J-PAL co-founders Abhijit Banerjee and Esther Duflo, with longtime affiliate Michael Kremer, were awarded the 2019 Nobel Prize in Economics for their pioneering approach to alleviating global poverty.

J-PAL is based at MIT in Cambridge, MA and has seven regional offices at leading universities in Africa, Europe, Latin America and the Caribbean, Middle East and North Africa, North America, South Asia, and Southeast Asia.

https://www.povertyactionlab.org/

Oxfam

Oxfam is a global movement of people who are fighting inequality to end poverty and injustice. Across regions, from the local to the global, we work with people to bring change that lasts.

We are working across regions in 87 countries, with thousands of partners and allies, supporting communities to build better lives for themselves, grow resilience and protect lives and livelihoods also in times of crisis.

Oxfam International was formed in 1995 by a group of independent non-governmental organizations. They joined together as a confederation to maximize efficiency and achieve greater impact to reduce global poverty and injustice. The name "Oxfam" comes from the Oxford Committee for Famine Relief, founded in Britain in 1942. The group campaigned for food supplies to be sent through an allied naval blockade for starving women and children in enemy-occupied Greece during the Second World War.

https://www.oxfam.org/en

Stanford Center on Poverty and Inequality at Stanford University

The Stanford Center for the Study of Poverty and Inequality has five objectives: to monitor trends in poverty and inequality, to support scientific analysis of poverty and inequality, to develop science-based policy on poverty and inequality, to disseminate data and research on poverty and inequality, and to train the next generation of scholars, policy analysts, and politicians.

The Center is committed to evaluating and developing public policy relevant to poverty and inequality. In collaboration with Stanford University Press, the Center sponsors two book series, titled "Studies in Inequality" and "The Big Questions", that expose looming policy decisions about poverty and inequality and develops innovative approaches to addressing them.

The Center sponsors a variety of programs for Stanford graduate and undergraduate students focused on poverty and inequality, including:

- Graduate and undergraduate research fellowships
- Undergraduate Minor in Poverty, Inequality, and Policy
- Undergraduate Certificate in Poverty and Inequality
- America: Unequal course (SOC 3)

- Inequality Workshop for doctoral students (SOC 341W)

https://inequality.stanford.edu/

MSc Poverty, Inequality and Development at University of Birmingham

The relevance of sociological categories of class, religion, ethnicity, and gender in both disaggregating levels of poverty and inequality, and in understanding the processes which foster poverty and inequality in development will be explored in modules which give this program its particular identity and focus. Issues examined include:

- definitions and indicators of poverty
- inequality and development
- causes of poverty and inequality
- poverty reduction strategies
- cross-cutting issues such as gender and conflict
- practical policy, programme, and research skills.
- The programme has three 20 credit core modules:
- International Development
- Social Analysis of Inequality, Poverty and Development
- Poverty, Inequality and Development

https://www.birmingham.ac.uk/postgraduate/courses/taught/govsoc/poverty-inequality-and-development.aspx

Master's Degree Programme in Social Exclusion at Åbo Akademi University

Students on this program learn the principles of coexistence and explore tools for analysing social exclusion from a multidisciplinary and global perspective. They also evaluate strategies that promote better social awareness and inclusion. At the same time, the program looks in-depth at the conditions that lead to social exclusion, its negative effects on society and to what degree different cultures are affected.

The master's degree programme in Social Exclusion is especially suited to those looking to pursue careers in areas such as research, politics, equal opportunities policy and human rights institutions or organisations. As this course equips students with the skills needed to work in both national and international settings, graduates can find employment in a diverse range of opportunities in either the private or public sector, as well as in non-governmental organizations and

civil society. Additionally, skills developed within this programme are highly relevant in arts, writing, and media careers.
https://www.abo.fi/en/study-programme/masters-degree-programme-in-social-exclusion

Industry 4.0 as the societal challenge

Worth looking at:

Industry 4.0 Technologies at AGH University of Science and Technology in Kraków

The Industry 4.0 Technologies major is designed to train an engineer who will find himself in a modern manufacturing plant. Therefore, education includes issues related to automation, computer science, production management, materials engineering, and manufacturing technologies. This interdisciplinary focus in cooperation between the Faculty of EAIiIB and the Faculty of Foundry Engineering has allowed us to offer a unique offering. Using the laboratory base and the competence of the staff of both departments allows us to educate students not only from the IT side but also from the technology side.
https://www.eaiib.agh.edu.pl/en/industry-4-0-technologies/

International Master's Degree In Computer Sciences at L'École Nationale d'Ingénieurs de Tarbes (ENIT)

Our Industry 4.0 Computer Sciences Master's degree offers a 1-year, full-time postgraduate program, aimed at providing solid scientific and technological foundations in order innovate, design, and develop future digital organisations based on the new Smart Anything Everywhere (SAE) paradigm. It is suited for students with engineering background planning both an academic or an industrial career and provides the theoretical basis and the practical expertise required to pursue in research or R&D organisations. The master is fully taught in English, providing a main common curriculum and two options named Digital Manufacturing and IT Digital Transformation. This master is hosted by the College of Sciences and Technologies for Energy and Environment (STEE) of the Université de Pau et des Pays de l'Adour (UPPA) in Anglet (France) as well as The National Engineering School of Tarbes (ENIT) of the National Polytechnic Institute of Toulouse. This master is supported by the prestigious French

Initiative of Excellence label I-SITE (Initiatives Sciences, Innovation, Territories and Economy) and profit from the territorial synergy of the Aerospace industry located in the southwest valley of France. The program is carried out in close collaboration with the LIUPPA research laboratory and Production Engineering Laboratory (LGP) as well as several R&D organisations, where scientific and experimental practices will be performed.

https://www.enit.fr/fr/formations/masters/master-industry-4-0-1.html

M.Sc. Smart Production Engineering at RWTH Aachen University

Become a production engineer and shape the digital transformation in industry and companies. In our highly interdisciplinary M.Sc. Smart Production Engineering (M.Sc. SPE) you align your studies with your personal research interests and specialize in one of three trend setting future topics that are already significantly changing production technology today: Additive Manufacturing, Smart Factory, Electric Mobility Production.

https://www.academy.rwth-aachen.de/en/programs/masters-degree-programs/detail/msc-smart-production-engineering?gclid=Cj0KCQjwjryjBhD0ARIsAMLvnF-vR28IZUZp2wmx1Tx4e2ckRXVf3SMMg9Z_yDgYGtDg51K4dJW87EAaAuQ1EALw_wcB

"Bridging the i4skills gap" initiative at Manchester Metropolitan University

We are a great modern university, in a dynamic global city, here to make an impact on Manchester, our nation and beyond, with a driving ambition to discover and disseminate knowledge. We are ahead of the disruptive curve and leading the way in Industry 4.0 education and innovation. From creative industries to sport and from engineering to fine art, we collaborate with businesses big and small to promote sustainable growth and develop the next generation of talent. Our experts work on digital manufacturing, business systems, cyber security, big data, clean energy, coding, artificial intelligence, smart cities and much more. Discover how we're using Industry 4.0 technology to improve lives, enhance businesses and shape our world – and how we can work with you to bridge your skills gap.

https://www.mmu.ac.uk/industry-4.0/

Master's degree programme Materials Engineering for Industry 4.0 at Politecnico di Torino

Our world will have to undergo radical changes in production methods in the future, and the conceiving and successful introduction of efficient and appealing products, manufactured via sustainable processes, will be an essential step. This is the paradigm of the fourth industrial revolution – Industry 4.0 – and the innovation of materials is one of the key pillars of such a revolution. This calls for engineers who are skilled in how materials work and how they can be entered into the value chain of products. Materials Engineering for Industry 4.0 is an inter- and multi-disciplinary master's degree programme whereby you will learn how to design more performant, cost-competitive and sustainable advanced materials and how to produce and process them with the most recent advanced manufacturing techniques.

https://www.polito.it/en/education/master-s-degree-programmes/materials-engineering-for-industry-40

Professional Certificate Program in Industry 4.0 at MIT Professional Education

This certificate program provides you with the necessary skills in leading technologies such as the internet of things (IoT) and artificial intelligence while understanding the fundamentals of smart manufacturing and product platforms. The new Professional Certificate Program in Industry 4.0 is designed to prepare professionals to tackle challenges head-on and will provide them with the knowledge and tools to succeed in the digital age.

https://professional.mit.edu/course-catalog/professional-certificate-program-industry-40

A Framework for Developing Educational Industry 4.0 Activities and Study Materials by Lasse Christiansen and co-authors

The advent of Industry 4.0 is changing the role of human labour towards a more supportive function in the production system, requiring new digital-, technical-, interdisciplinary-, collaborative- and communicative competencies. This challenges educational institutions to develop new teaching activities and materials to address ever emerging needs. To address this, this paper presents an Educational Framework to support educators in developing new teaching

activities and study material for Industry 4.0. The model distinguishes itself from other educational design models by combining an iterative approach toward problem-solving, with the concept of authentic task design, as the core elements. Based on 14 pilot cases, it is concluded that educational framework has increased the educational activities in the areas in focus.
https://doi.org/10.3390/educsci12100659

Preparing to Teach in the 4th Industrial Revolution by Intel

Education, in response to the 4th Industrial Revolution, must evolve to support teachers in developing individual student potential and preparing students to become self-learners so they can innovate the world tomorrow. Intel® technologies are shaping the world and modern classrooms. The Fourth Industrial Revolution (Industry 4.0 or 4IR) has given teachers what might be the greatest responsibility of our time: to evolve teaching strategies so they can unlock individual student potential and prepare students with the skills needed to shape the future through innovation supported by technology.
https://www.intel.com/content/www/us/en/education/teaching-strategy/teaching-4th-industrial-revolution.html

Fit for Industry 4.0. Innovative Learning and Teaching for Digitalization and Automation by Georg Spöttl

This publication introduces the current changes based on lean production and will create a deeper understanding of the impact on skilled work, thus creating awareness of the workforce required for Industry 4.0. It will also introduce the use of different data, the different safety systems, and the use of IT safety systems to make work safer. The impact and possible consequences of industrial changes because of Industry 4.0 on TVET and TVET management will be the focus of this training programme.
https://sea-vet.net/images/seb/e-library/doc_file/973/fit-for-industry-40-2021.pdf

Circular economy as the societal challenge

Worth looking at:

Circular Economy and Sustainability Strategies at University of Cambridge Judge Business School

This programme is designed to help you understand the growing business case for sustainable solutions and learn how to manage and lead a sustainable business by incorporating circular economy principles into your strategies to support sustainable growth. The six-week Circular Economy and Sustainability Strategies online programme is ideal for those seeking a future-conscious approach to: Leveraging sustainability for competitive advantage and driving long-term growth in the post-pandemic world; Creating innovative and sustainable solutions to business challenges; Gaining strategies that will help them achieve business goals while maintaining a culture of sustainability.

https://online.em.jbs.cam.ac.uk/circular-economy-sustainability-strategies?utm_source=Google&utm_network=g&utm_medium=c&utm_term=circular%20economy%20course&utm_location=1011536&utm_campaign=B-365D_WW_GG_SE_CCES_WW&utm_content=CCES_P1_All&gad=1&gclid=Cj0KCQjw7PCjBhDwARIsANo7CglJmSH-HD-tzuS61GQ7jgllkNIlflVRzaLa0wEvnqH6E8XMOLYlPk4aAumjEALw_wcB

https://www.jbs.cam.ac.uk/executive-education/open-programmes / environmental-social-and-governance-esg/circular-economy-and-sustainability-strategies/

Master of Science in Circular Economy by 8 universities

The Master's Degree programme in Circular Economy is a collaboration between universities from three continents and seven countries. Each student will spend at least one semester (30 ECTS) at two different EU partner universities. The international profile and academic acknowledgement of the study consortium ensures competences and skills of the students, increasing their employability. The universities participating in the Erasmus Mundus Master's Degree Programme in Circular Economy are University of Graz, Chalmers University of Technology, Delft University of Technology, Leiden University, Norwegian University of Science and Technology, Curtin University, Tsinghua University, Waseda University. The coordinator of the Erasmus Mundus Master's Degree Programme in Circular

Economy is University of Graz. Master in Circular Economy is for you who seek to make an essential contribution to the transition towards a resource-efficient and sustainable society. You get an interdisciplinary approach to environmental sustainability with emphasis on research and practical problem solving to achieve a circular economy. The programme includes a mobility scheme, allowing students to experience the international expertise in Circular Economy in Europe and beyond.

https://www.uni-graz.at/en/study/joint-programmes/international-masters-programme-on-circular-economy/

https://www.ntnu.edu/studies/msce

Circular economy resources and courses by Ellen Macarthur Foundation

Our Network brings together businesses, policymakers, innovators, universities, cities, philanthropic organisations and thought leaders to build and scale a circular economy. Our Network comprises Members, Partners, and Strategic Partners, as well as a wider community of more than a thousand organisations who we reach and engage through specific projects and initiatives.

If you want to deepen your knowledge of the circular economy, learn how to stay ahead of the game and be a part of the change, our courses could be for you. We offer a variety of learning opportunities and recommend circular economy courses from other institutions.

https://ellenmacarthurfoundation.org/

https://ellenmacarthurfoundation.org/resources/education-and-learning/circular-economy-courses

Master Circular Economy at HAN University of Applied Sciences

It's a no-brainer that companies and organizations must make the transition to sustainable business practices. With a masters in Circular Economy at HAN University of Applied Sciences, you know how to deal with sustainability issues in an international context. As a change agent, you don't just help international companies innovate. You also make invaluable contributions to preserving the environment and mitigating the climate crisis. This circular economy degree gives you invaluable knowledge and practical experience. You'll work on real sustainability issues in an international context.

Learn and work together with an international team of students, lecturers, and professionals. Gain the skills to help companies and organizations become future proof.
https://www.hanuniversity.com/en/programs/master/circular-economy/fulltime/#

Bachelor's Circular Economy Distance Degree Program for Adults & Professionals. at Bircham International University

This Bachelor's Degree in circular economy studies how to reuse, share, repair, refurbish, remanufacture and recycle products and services to create a closed-loop system, minimizing the use of resource inputs and the generation of waste and pollution. The circular economy aims to keep products, materials, equipment, and infrastructure in use for longer time, thus improving the productivity of these resources. Waste materials and energy should become input for other processes through waste valorisation: either as a component or recovered resource for another industrial process or as regenerative resources for nature. The regenerative approach of circular economy works in contrast to the traditional linear economy, based on a "take, make, dispose" model of production.
https://www.bircham.edu/bachelor-s-degree-circular-economy.html

Circular Economy: Transition for Future Sustainability part of Professional Certificate Program in Sustainability and Blended Professional Certificate: Chief Sustainability Officer at MIT Professional Education

By shifting your organization to a Circular Economy, you can ensure growth over time while treating waste as a design flaw. By doing this, we take the outdated linear system and make it circular with resiliency. Circular Economies are emerging as a necessity as the overexploitation of natural resources increases. In a Circular Economy, there are opportunities to create a sustainable economic growth model, as a specification for any design is that the materials re-enter the economy at the end of their use. Therefore, a Circular Economy increases profits while ensuring sustainability, longevity, and societal wellbeing. MIT Professional Education's online course Circular Economy: Transition for Future Sustainability presents an encompassing, quantitative, and qualitative portrayal of sustainable solutions from an economic perspective to reduce, reuse, and regenerate materials, leading to economic growth, sustainable resilience,

and improved society. The circular economy, when enacted, plays an essential role in addressing climate change, while also creating opportunities that ensure sustainable and ethical economic growth over time.

https://professionalprograms.mit.edu/online-program-circular-economy/

The Executive Programme in Circular Economy Management At Luiss Business School

The Executive Programme in Circular Economy Management prepares professionals to manage the transition of companies to the circular economy, innovating the business models, production systems and customer relationship management. The program offers specific business management skills in connection with matters like recycling, secondary raw materials, energy saving, sustainable mobility, water, and agri-food. It is also aimed at public servants involved in the implementation of environmental policies and the development of "eco-industrial" areas, including through complex forms of cooperation with private actors. With a highly operational focus, it is organised with the direct support of circular economy public-sector and private-sector managers, with a faculty composed of professionals, executives, and entrepreneurs with experience in this field. The main goal of this programme is to provide participants with managerial and professional skills to lead companies and organisations' transition to the circular economy, reaching economic success together with environmental and social value. The Programme is designed for those who carry out or intend to work in the circular economy, operating in private companies, public authorities, international institutions, and NGOs. Amongst the professional figures who can benefit from attendance are: entrepreneurs and consultants, environmental engineers, architects, energy and mobility managers, environmental managers, auditors, quality, commercial and environmental design representatives, marketing, communication and external relations professionals who are contact points for relations with stakeholders, managers of integrated waste cycle management companies and recycling plants, supply chain managers who are responsible for implementing the principle of producer responsibility, environmental lawyers.

https://businessschool.luiss.it/circular-economy-management/

Circular Economy Masterclass (online) at University of Exeter

Develop the skills and understanding to successfully introduce Circular Economy principles into your organisation and close the implementation gap. Delivered by the University of Exeter Business School's Centre for Circular Economy, and supported by the Ellen MacArthur Foundation, our Circular Economy Masterclass offers you the opportunity to learn directly from leading experts in the field of Circular Economy. This 6-week online course goes beyond the basics, giving you an understanding in value creation, capture and scaling and the capabilities required at different stages. Managers engaged in Circular Economy share insight into successful case examples and can give practical advice on how to overcome barriers and make the case for change within your organisation. Over a 6-week period, you will spend approximately 6 hours a week: Learning how to manage key stages in the circular value journey, close the implementation gap, and make the case for change; Linking core knowledge, examples, tools and discussion to the key challenges and requirements within your organization; Turning theory into practice, taking forward specific actions to departmental and location-specific needs; Building the confidence required to generate circular economy innovation within your organization. Points are awarded each week, and a final certificate of learning will be issued at the successful completion of the course.

https://business-school.exeter.ac.uk/test/executive-education/circular-economy-masterclass/

Energy and climate change as the societal challenge

Worth looking at:

The MSc Global Energy and Climate Policy at SOAS University of London

The MSc Global Energy and Climate Policy is the online version of the successful campus degree of the same name.
Housed within the Centre for International Studies and Diplomacy (CISD) this programme's focus is on policy and policymaking in the energy and climate space. The MSc introduces students to the key energy sources, their economic and technical bases and how they are regulated. It further analyses energy and climate governance at

the international level and discusses the geopolitics of energy. This programme places policy and policymaking as the key to enabling change and creating the requisite legal and regulatory environment within which the low-carbon energy system of the future can develop and grow.

The MSc Global Energy and Climate Policy online programme provides students with a detailed understanding of the transformative change in energy systems now underway around the world and equips them with the knowledge and skills needed to play a part in it. It treats energy and climate change policy as inextricably linked, taking an integrated approach to the study of the two fields. Case studies are drawn from around the world, accounting for different conditions in developed, newly industrialised and developing country contexts.

https://www.soas.ac.uk/study/find-course/msc-global-energy-and-climate-policy-online

Drive change towards sustainable energy at University of Westminster

The importance of transforming energy to sustainable, renewable solutions has never been so profound. The necessity of environmental change upholds the future of our society, health, and planet. To inspire and influence change on the most important issue facing our society, we need a holistic understanding of the global energy market.

Our Energy and Environmental Change MA does just that. Our students graduate with the skills, knowledge, and confidence to prevent the seemingly inevitable decline of our environment. The University of Westminster Energy and Environmental Change MA is one of the most innovative postgraduate courses on energy issues and climate change.

Our course is an interdisciplinary degree, combining the skills deriving from International Relations, Law, Business and Sustainability Studies. This pioneering course focuses on three fundamental topic areas: Energy security, Energy markets, Climate change.

You will gain an in-depth and global view of the energy sector to equip you with a comprehensive understanding of the political, legal, and economic factors associated with navigating environmental change. We want you to cultivate the ability to become key

contributors to the movement toward more sustainable, low carbon sources.
https://www.westminster.ac.uk/study/subjects/construction-management-and-urban -planning/transform-energy

Environment and Resource Management: Energy and Climate MScat Vrije Universiteit Amsterdam

The Environment and Resource Management Master's programme is organised by the Institute for Environmental Studies (IVM), which is considered to be one of Europe's leading research institutes in Environmental Sciences. Class sizes are relatively small, allowing a personal and open atmosphere that students enjoy. Institute for Environmental Studies staff members are always available to provide support and guidance.
Energy is central to nearly every major challenge and opportunity the world faces today. Be it climate change mitigation, job creation, security, food production or increasing incomes. Investing in renewable energy resources, prioritising energy-efficient practices and adopting clean energy technologies and infrastructure can accelerate the transition to an affordable, reliable, and sustainable energy system.
In the Energy and Climate specialisation, you will address the multiple dimensions of the climate-energy nexus from socio-economic and governance perspectives. The specialisation provides expertise to scientifically assess the transition to sustainable energy systems and to critically evaluate the range of policy options to accelerate this transition. Attention is also paid to regional, national, international, and transnational efforts to mitigate climate change.
https://vu.nl/en/education/master/environment-and-resource-management/curriculum?specialization=energy-and-climate%3Futm_source%3Dfindamasters&utm_medium=baseline

MSc – Environmental Bioscience in a Changing Climate at University of Warwick

Escalating rates of environmental and climate change are forcing us to re-evaluate our management of agricultural and natural habitats. The competing demands on agricultural land for food production and for bioenergy provision must be reconciled with environmental stewardship and mitigation of climate change.

This master's course provides a timely and integrated perspective on environmental bioscience, management, societal matters, and regulation as these relate to issues such as sustainable production of food and provision of ecosystem services.
Skills from this degree: 1) The ability to evaluate the impacts of climate change locally and globally, 2) The ability to understand and evaluate the factors contributing to soil, air and water quality and recognise their roles in food production and society values, 3) Understanding of the roles different land management practices have on local, regional and global ecosystems, 4) Transferable skills including team working, communicating with peers and sector specialists, organising, planning and oral presentation, 5) Research skills including scientific report writing, evaluation of environmental accounts, problem solving, data analysis and project work
https://warwick.ac.uk/study/postgraduate/courses/environmentalbioscience

Master's Local Environmental Change and Sustainable Cities at Radboud Universiteit

How to deal with issues regarding the energy transition, water, mobility, circularity, agriculture and nature conservation in a city or region? This specialisation focuses on the local level of sustainability transformations and the integration of policies.
The specialisation strongly focuses on the local level of sustainability transformations, in particular sustainable cities.
We will discuss the (policy) instruments that are needed for greening and climate proofing the city, combining spatial claims within cities and regions or collaborative governance with citizens on energy and water.
You will be introduced to numerous examples of how cities and regions all over the world are tackling environmental problems. Related aspects of spatial planning will be incorporated in this specialisation.
https://www.ru.nl/en/education/masters/local-environmental-change-and-sustainable-cities?utm_source=findamasters.com&utm_medium=profielpagina&utm_campaign=findamasters-portal&utm_term=local

Master of Science (Technology) in Electrical Engineering – Smart Grids at Tampere University

Smart grids for smart people and smart systems

Smart grids are a new way of designing and managing electrical power systems.
Electrification of energy system and whole society is the most important tool for mitigating the climate change. Increasing penetration of renewable energy sources like wind and solar power, electric vehicles and heat pumps is needed to reduce fossil carbon emissions and to reduce total energy usage. Huge investments and development are ongoing on these areas at the moment globally.
Smart grids are designed to enhance the effectiveness, stability, and reliability of the electricity systems and to integrate distributed energy resources into system management. They are essential for increasing the share of renewable energy sources without compromising competitiveness and system security.
The Master's Programme in Smart Grids develops systems thinking skills and provides students with a comprehensive range of technical design and analysis skills in electrical power engineering. Suitable backgrounds include Bachelor of Science (Technology) degrees in electrical power engineering, power electronics, electricity markets, energy management, renewable energy sources or similar.
https://www.tuni.fi/en/study-with-us/smart-grids-electrical-engineering?utm_source=findamasters&utm_campaign=courseid[62767]&utm_medium=courselisting&utm_content=textLink

Climate Change as a Societal Challenge at University of Antwerp Micro-credential

Learn to see climate change as a multi-actor governance problem.
Climate change is to a large extent driven by societal factors (causes). It has an impact on people's lives (effects). And it is influenced by decisions taken every day by individuals, companies, local communities, national governments, and international institutions (response). Because of the close interlinkages between our natural and societal systems, this micro credential on the societal challenges of climate change.
Even though climate change has gained importance on the societal agenda, it is still a challenge to put and keep climate change on the political agenda, and to move toward coherent policies. In this micro credential we try to explain why.
This micro credential will help you to see climate change as a multi-actor and multi-level governance problem, in which we must learn

and deal with scientific uncertainties, institutional inertia and various societal stakes.
The programme is designed for an international and multidisciplinary audience. It suits individuals, professionals, and students in developing their knowledge, skills, and professional career.
We welcome participants from universities, research institutions, public institutions, and private companies.
The diversity of the audience has proven to be a significant factor of learning, widening scope, and enhancing capabilities.
https://www.uantwerpen.be/en/study/programmes/all-programmes/climate-change-as-a-societal-challenge/

Urbanisation and technologization in cities as the societal challenge

Worth looking at:

Introduction to Technology and Cities (graduate) at MIT OpenCourseWare

This seminar is an introduction to the usage and impacts of information and communication technologies (ICTs) on urban planning, the urban environment, and communities. Students will explore how social relationships, our sense of community, the urban infrastructure, and planning practice have been affected by technological change. Literature reviews, guest speakers, and web surfing will provide examples and issues that are debated in class and homework exercises. We will examine metropolitan information infrastructures, urban modeling and visualization, e-government, collaborative planning, and cyber communities.
Students will attend a regular Tuesday seminar and occasional seminars of invited speakers during lunchtime on Fridays or Mondays.
During the past two decades, ICTs have become so pervasive and disruptive that their impact on urban planning and social relationships has begun to reach far beyond their immediate use as efficient bookkeeping and automation tools. This seminar will examine ICT impacts on our sense of community, urban planning practice, the meaning of 'place', and the nature of metropolitan governance. In each of the four areas, we will utilize readings, class discussion, guest lectures, and homework exercises to identify and critique key

trends, relevant theories, and promising directions for research and professional practice.
https://ocw.mit.edu/courses/11-501-introduction-to-technology-and-cities-fall-2002/

Smart Cities – Management of Smart Urban Infrastructures At Coursera

Learn about Smart Cities within the context of management of urban infrastructures. The introduction of Smart urban technologies into legacy infrastructures has resulted in numerous challenges and opportunities for contemporary cities and will continue to do so. This course will help you to understand how to make the best of these smart technologies in your cities' legacy infrastructures.
Over the past few years, advances in the Information and Communication Technologies (ICTs) have significantly challenged the traditionally stable land scape of urban infrastructure service provision. This has resulted in increasing interest from both technology vendors and public authorities in the transition of cities towards so-called "Smart Cities". Although such "Smart technologies" can provide immense opportunities for citizens and service providers alike, the ICTs often act as disruptive innovators of urban infrastructure service provision.
In this MOOC, you will gain a thorough understanding of the challenges and opportunities associated with the Smart urban infrastructures, namely Smart urban transportation, and Smart urban energy systems. Over the journey of this 5-week online course you will learn about the most important principles for the management of Smart urban infrastructures as well as the applications of these principles in the transportation and energy sectors.
https://www.coursera.org/learn/smart-cities

Technological challenges of participatory smart cities (in French) At France Université Numérique – the operator of the FUN MOOC platform

The course is a high-level introduction to the constituents of the smart cities' digital infrastructures, from the network up to the software layers. The proposed survey highlights the technical aspects to be taken into account to create practical services and to develop smarter cities involving citizen participation. In particular, it will impart information on privacy and interoperability aspects.

The course is designed for engineers or project leaders working for a company developing or willing to develop smart city projects involving citizen participation. It also addresses the challenges of professionals of a city government or a public institution who implement a smart city project which involves the deployment of digital technologies in the urban environment.
This course is available in "Archived Open" mode ": there is no animation of the teaching team (no forum or exercise noted like the quizzes) and the course does not issue any certificate of successful completion or certificate. However, you can access videos and text resources without limitation. This broadcasting mode therefore allows you, while waiting for the opening of a future "session animated", to train by having access to the main content.
https://www.fun-mooc.fr/en/courses/technological-challenges-participatory-smart-cities/

Digital Transition at URBACK moodle platform

This training aims to build the capacities of city-practitioners and policy-makers to understand the main concepts and challenges associated with digital transitions in a few key policy areas. The goal is to help them feel more comfortable in considering digital tools and new technologies as a way of delivering against policy goals.
The training isn't for seasoned 'techies'. Rather, it targets people who might self-define as tech 'newbies' and/or people from smaller and medium sized cities. This is because these are the places which have most to gain from understanding and embracing digital transition. The training has been developed by the TechPlace community, which is an online place for city practitioners and policy makers wanting to make a positive difference using tech. We're building a community of interest and a safe place to exchange, learn and ask stupid questions. We welcome practitioners from across all URBACT cities and beyond.
https://moodle.urbact.eu/course/view.php?id=2

Urbanisation and Development (graduate) at MIT OpenCourseWare

The course examines the causes and effects of rapid urbanization in developing countries. Using case studies from the world's four major developing regions, including (among others) Mexico City, Buenos Aires, Managua, Singapore, Hong Kong, Guangzhou, Kabul,

Beirut, Cairo, Kinshasa, Cape Town and Johannesburg, it explores the economic and political dynamics that grease the wheels of contemporary patterns of growth. In addition to examining both local and transnational forces that drive contemporary urbanization, the course focuses on key issues that emerge in rapidly growing cities of the developing world, ranging from growing income inequality and socio-economic exclusion, environmental challenges, and rising violence. Class sessions are discussion-based and focus on a critical analysis of the arguments presented in the readings.
https://ocw.mit.edu/courses/11-947-urbanization-and-development-spring-2009/

Introduction to urbanisation at The University of Adelaide

Urbanisation is one of the most profound demographic and social processes facing the world today. As places where demographic, economic, social, and environmental concerns are closely intertwined within urban systems, cities are critical in shaping the lives of current and future generations. This course will guide students through an examination of the key concepts of urbanisation and introduce students to ways by which we can research, understand, and synthesise urbanisation processes. During the course, students will be asked to consider the major causal factors influencing urban growth and change in cities, policy interventions used by governments to better manage population flows and increase adaptive capacities of diverse urban populations, and the socio-economic and environmental stresses of urban development. The course will address important concepts in urban studies, including demographic change and migration, social inequality, social justice, urban citizenship, green urbanisation, and environmental risk.
https://www.adelaide.edu.au/course-outlines/109513/1/sem-1/

Sustainable Urban Development at TU Delft

If you are interested in the challenges of the 21st century metropolitan regions and how these can be solved from within the city and by its inhabitants, then this Sustainable Urban Development course is for you!

There are no simple solutions to these grand challenges! Rather the challenges cities face today require a holistic, systemic, and transdisciplinary approach that spans different fields of expertise and disciplines such as urban planning, urban design, urban

engineering, systems analysis, policy making, social sciences and entrepreneurship.
This MOOC is all about this integration of different fields of knowledge within the metropolitan context. The course is set up in a unique matrix format that lets you pursue your line of interest along a specific metropolitan challenge or a specific theme.
Because we are all part of the challenges as well as the solutions, we encourage you to participate actively! You will have the opportunity to explore the living conditions in your own city and compare your living environment with that of the global community.
You will discover possible solutions for your city's challenges and what it takes to implement these solutions. Your participation will also contribute to wider research into metropolitan regions as complex systems.
https://online-learning.tudelft.nl/courses/sustainable-urban-development-discover-advanced-metropolitan-solutions/

Rethink the City: New approaches to Global and Local Urban Challenges at TU Delft

Learn about today's urban challenges focusing on developing countries, referred to as the Global South. We will debate the benefits associated with three different themes, going beyond traditional urban strategies and policies:

1. Spatial justice – Having fair, inclusive and healthy urban contexts is one of the greatest challenges of cities in emerging economies.
2. Housing Provision and Management – Increasing demand in the Global South calls for alternative approaches in housing provision and management.
3. Sustainable Urban Transitions – In order to transition from our current (unsustainable) system towards a fair and sustainable future we need to pay attention to the social, economic, and cultural context.

https://online-learning.tudelft.nl/courses/rethink-the-city-new-approaches-to-global-and-local-urban-challenge/

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