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No transition without transformation: *Educating Sustainability*

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Abstract:

Sustainability transition is not new for higher education. Universities around the world have discussed about the topic since the 70s, publishing series of reports and declarations of intentions. These documents kept calling for transdisciplinary approaches and the implementation of Education for Sustainable Development competences. However, a few decades after, HEIs struggle with the operationalisation of an educational vision on sustainable development into the practicality of a faculty programme or curricula. This paper calls the academic community to explore new learning contexts that facilitate moving to higher orders of learning that can sustain the integration sustainability approaches. Moving to deeper levels of learning means the transition from educating *about* sustainability towards educating *for* sustainability and the final destination: educating *as* sustainability.

Keywords: living labs- sustainability- learning environments- transdisciplinarity- innovation- transformation

Introduction

Since the 70s universities around the world have had several attempts to integrate Education for Sustainable Development (ESD) in higher education. Throughout these decades, some of the documents published by universities associations and consortia (Education Council EU, 2001; Rio+20 Education Group, 2012; Taillores, 1990; Tbilisi, 1977;) concluded that training the educators as well as top down policies that facilitate and incentivise the development of new educational practices to integrate sustainability, were the key factors in the final and fully integration of ESD. Due to the global acceptance of the Agenda 2030 (Sustainable Development Goals, 2015), in the last years, universities have dedicated more attention to the integration of methodologies, competences frameworks and learning environments that could their students to learn how to approach the complex global challenges covered by the SDGs framework. The relevance and impact on global policy of the Agenda has become a catalyst for ESD integration, leading to the publishing of new competences frameworks directly linked to the Agenda, such is ESDG (Education for Sustainable Development Goals, 2019) or most recently the Inner Development Goals (IDGs, 2022), which proposes a set of competences clustered in 5 pillars that cover transversal and soft skills defining the character needed to approach the levels of complexity contained in the SDGs. Furthermore, the climate urgency of the moment and the biodiversity loss, have been a topic of central discussion in the context of the global pandemic that has affected us in the last two years. In this context, frameworks of competences related to sustainability and complexity, have received loads of attention from the academia and we have seen a flourishing of publications and literature reviews on the topic (Albareda-Tiana, Vidal-Raméntol & Fernández-Morilla, 2018; Hallinger & Chatpinyakoop, 2019; Lozano *et al.*, 2017; Lozano *et al*., 2019; O'Flaherty & Liddy, 2018; Thürer *et al.*, 2018). However, a more systemic approach to ESD is needed, contemplating not only the ***what***, meaning the competences themselves, but also other factors as the ***how*** (methodologies and methods of learning) and ***where***, the learning environments that could facilitate the integration of ESD.

1. The global context: From a SPOD world to VUCA and BANI

At the end of the 1980s, the UN report *Our Common Mission*, also known as the Brundtland report (1987) - released by the World Commission on Environment and Development (WCED)-, defined sustainable development as a kind of development which "meets the needs of the present without compromising the ability of future generation to meet their own needs" (Brundtland, 1987). The report was the first systemic approach to understand the interconnections among economic growth, environment and social development and the potential devastating consequences of anthropocentrism. The unlimited growth perspectives of our traditional economic models, environmental protection policies and social structures back then, were already announcing a catastrophic end in the centuries to come if we were not able to transform and change the

abusing behaviour against our planet. The first discussions around sustainability took place in what Korsakova (2020) describes as a SPOD world: Stable, Predictable, Ordinary and Determine. However, post-cold war era changed the rules of the game in the global arena. While for politics and business the context of operations of the SPOD world came to an end (Korsakova, 2020), educational settings in higher education have mostly maintained the same organisation for learning environments that we did during the SPOD time.

In the context of sustainability, the international community intended to set targets to stop environmental abuse and start projecting a more sustainable future throughout different global agreements. The Brundtland report inspired the global sustainable development agendas to come: Agenda 21 (UN, 1992), the Millennium Development Goals Agenda (UN, 2004) and the actual global agenda: the Sustainable Development Goals (UN, 2015). Since then, the global community has engaged in a common effort to plan, design and implement the transition towards a more sustainable society. Even if some aspects have improved considerably, the scary 85% rate of biodiversity loss in the last two decades (Oliver, 2016), and the lack of relevant steps taken to mitigate climate change, leaves small room for hope.

Private and public sector leaders also confirm the rapid escalation of complexity and describe this new context as the biggest challenge confronting us in this new era (IBM, 2010). More recently, in the business world, the originally US army term VUCA (Volatility, Uncertainty, Complexity and Ambiguity) is emerging to describe this unpredictable and complex times (Bennet & Lemonie, 2014) that took over our comfortable SPOD context. Most of the problems that our society, organizations and governments have to deal with nowadays have no single solution and occur in a context with high degrees of uncertainty and ambiguity.

Raghuramapatruni and Kosuri (2017) explore characteristics of the VUCA world using what different scholars have highlighted in their studies:

- Technology brings advances and innovation yet also increases complexity (Sarkar, 2015).
- We have megatrends that we can only understand to a certain extent; most of them can suddenly shift unpredictably (Manurani, 2013).
- This is our new normal, living in a time of constant dilemma (Kumar & Ara, 2014).
- Boundaries are fluid, permeable and we will have to learn to let go (Betof, Owens and Todd, 2014).
- We will have to deal with the tension between new challenges and letting go of old methods (Petrie, 2014).

The problems we have to solve in a VUCA world are no longer tamed. We refer to this grade of complexity as *wicked problems* (Rittel and Weber, 1973). These have new dimensions and characteristics in comparison to tamed problems: they are unstructured; they have multiple, overlapping and interconnected layers of stakeholders involvement; they have a social, political and cultural transcendence; and they are relentless (Weber & Khademian, 2008). Furthermore, complexity scholars from the last decade have introduced a new term to define hypercomplex problems: "*super wicked*", which refer to a new class of wicked problems that have to do with global environmental issues and the global challenges targeted in the global agendas. These new "super wicked problems" have extra levels of complexity: time is running out; those who caused the problem also seek to provide a solution; the central authority needed to address them is weak or non-existent; and irrational discounting occurs that pushes responses into the future (Levin *et al.*, 2012). The complexity of the SDGs is at the level of wicked and super wicked challenges, and we need to address them in the context of this VUCA world.

The Covid19 pandemic; the emergence of new technologies at rapid pace of change; the new global order leading to conflicts and unexpected geopolitical dynamics; the urgency of climate change; and the anxiety and distress created in a post-Covid19 world, is defining a new world context that anthropologist, futurologist and historian Jamais Cascio defines as BANI world: Brittle, Anxious, Non-linear and Incomprehensive (Godoy & Ribas, 2021). BANI as context requires education to rethink learning environments that can operate in a world lead by chaos (Cascio, 2021). The complexity of the world today is demanding to move from multidisciplinary settings to more inter and transdisciplinary ways of thinking, designing, collaborating and creating. However, most universities are still disciplined oriented and their education is mostly organised in silos. In the age of raise of Artificial Intelligence (AI), human capabilities and life related skills are emerging as key elements for the 21st century (Dede, 2009). This does not necessarily mean that foundational literacies linked to specific

professional field are not important, yet the speed of technological development has had a great impact in a rapidly diminishing knowledge lifespan (Niewiadomski & Anderson, 2020). Where before knowledge life and foundational literacies were stable variables for a few decades, nowadays, in many professional fields, lifespan of knowledge is measure in years or even months. This new reality has important implications for higher education. HEIs need to incorporate in their curricula sets of competences that can help the students to thrive in a complex world, and to develop the capacity for lifelong learning. Universities are witnessing the transition from knowledge as a goal to knowledge as a tool (Siemens, 2007). Where universities before used the same book edition for several academic years, nowadays, updating the readings for students is almost a weekly routine. Furthermore, Sandris Zeivots, lecturer in Educational Development at the University of Sidney concludes in his research that up to 80% of university students do not read their assigned readings. Among other reasons, the impact of the digital culture and the power of "technology, media and apps have affected students reading patterns" (Zeivots, 2021). In an era of complexity, rapid change and instability, universities maintain the learning environments we designed to learn in a SPOD world and this means that if we do not transform, university will become obsolete as learning space.

2. The challenge for education: leading transformation in highly complex transitional contexts

Frameworks of competences started to pop up during the past decades trying to address the challenges of the VUCA world. Education professionals made the effort to identify and define competences and methodologies to integrate ESD in their curricula, but the lack of consistency among the different frameworks have contributed to the failure of the integration of sustainable development in their subjects, curriculum or competences system. Furthermore, universities tried to embed these frameworks of competences in the existing curricula, subjects and extracurricular activities; not considering that the traditional structures and learning environments may not be suitable for the development of those competences. Policy makers and agendas through these decades have recognised the power of education, but more from a quantitative than a qualitative perspective. While in Agenda 21 education was mostly seen as a tool to empower woman, achieve equality and share knowledge to improve environmental policy making (articles 5.41, 5.48, 5.50); the Millennium Development Goals (MDGs) set quantitative goals to increase the access to education around the world, especially for girls. For instance, the MDG 2 called for the achievement of universal primary education by 2015, while the MDG 3 called for the promotion of gender equality and empowerment of woman across all educational levels by 2015. The indicators to measure achievement in these two goals were mostly quantitative putting more attention to the number of children and woman accessing education than on the quality of education itself. That is probably the most important change in approaching the role of education in the new agenda of the SDGs (2015). This agenda has not only set a specific goal on Education (SDG 4), but it also considers the quality of education as a fundamental tool to achieve other of the 17 goals in the agenda. Moreover, the SDG agenda highlights the importance of education for sustainable development (ESD), and the responsibility that educational institutions have to integrate these principles in the years to come:

"By 2030, ensure that all learners acquire knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and nonviolence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development" (SDG 4.7).

Since the launch in 2015, educational institutions around the world have embraced the SDG agenda in different ways: by signing the SDG charter, by embedding the narrative of the SDGs in their learning outcomes, or by including the thematic of the agenda in their curricula, and creating awareness among staff and students around the SDGs. Less actions have been taken in rethinking the university learning environments to create spaces where these competences develop in an organic manner. HEIs professionals still struggle on how to design these new spaces making them fit in the existing organisation. Reimagining new pedagogical possibilities for universities took more relevance in the post Covid19 society, moving scholars to call universities to challenge the status quo and start rethinking even the basic purpose of educational institutions by developing new pedagogies and learning environments that better fit the world we live in (Peters et al., 2020). The Covid19 pandemic forced universities to adapt in no time to a new setting of learning. The campus as space of learning lost power and lectures were teaching from one day to another from the private sphere of everyone's living rooms. However, this transition from offline to online settings was not constructed on a new

paradigm of learning pedagogies. Most of the institutions moved online with the same settings and structures they had offline, thinking they were doing something new, while the truth is that what was taking place was remote emergency teaching. All universities in Europe suspended face-to-face teaching and moved the traditional methodologies of "chalk and talk" to digital environments such Teams, Zoom or Gather. The classroom space digitalised, but the teaching remains the same, bringing stress and disconnection to students. Universities once more fell in the pitfall of implementing technology focusing in the hardware and ignoring the importance of the social impact and opportunities that technology can bring to rethink learning environments and pedagogical models (Warschauer, 2010).

The Covid19 pandemic scenario would have been a good opportunity to take this wicked problem as example, and to design new learning spaces that could help us move further into the mandate of the SDG 4.7. One important question highlighted by Peters *et al*. (2020) is "what kind of sociality is possible when students and their faculty only meet in the digital space?" (Peters et al., 2020, pag.3). This could be an opportunity to address global challenges in our university spaces such impact of technology, inequality, multi culturalism, etc. The urgency of the digitalisation left faculty stressed and students lacking with motivation for engagement. The BANI world is demanding to move to practices of transformative learning and create learning spaces to develop meta-competences such empathy, compassion, resilience, adaptability, etc.

Higher education is still organised in a disciplinary way. Most of the teaching models are focused on transmission and transactional learning, facilitating the acquisition and measurement of knowledge and skills (see Figure 1). For these formats, the safe learning space of traditional classrooms with lines of tables could be a good scenario for learning. If we take a look at the model of education for sustainability, we can see that ESD mostly operates in the area of transformative learning, and deals with competences such curiosity, resilience and adaptability. These character qualities, sometimes labelled as soft skills, have been so far a challenge for education. For transformative learning new pedagogies and learning environments are needed as these competences cannot easily be trained but these learning environment can create conditions for them to grow. In this sense, we need to create new soil components that can be nurtured in order for these competences to grow.

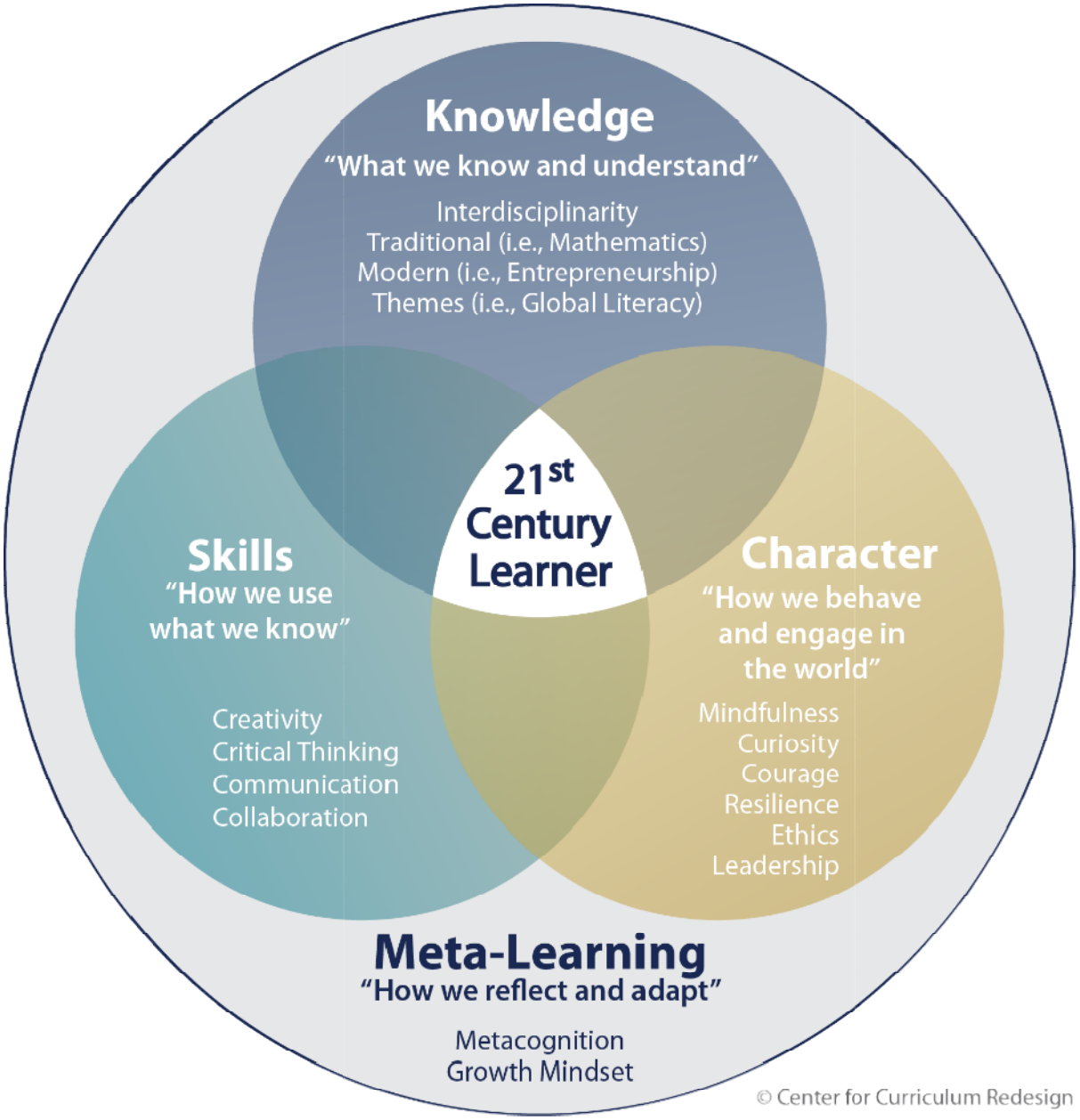

Figure 1 Meta learning model Center for Curriculum Redesign. Note: From A Review of Four-Dimensional Education (p.43) by Fadel, Bialik & Trilling, Center for Curriculum Redesign (2015). Reprinted with permission.

This new complexity around makes us question how we can re-orientate educational systems and create new learning environments that can help HEIs students meet the demands that our society requires. When dealing with these highly complex problems there is no knowledge structure or rational and logical processes to help solve the problem as for tamed problems (Gosseling & Tindemans, 2016). We tend to see in education system that students are increasingly required to work in teams to solve complex projects and questions (Brandler & Roman, 2015; Feltovich *et al*., 1996; Gibb, 2002; Sears & Reagin, 2013). Students at universities are learning outside the classrooms and start to collaborate with other social agents (transactional learning), creating meaningful value for them and for the society. This has led to the development and incorporation of new learning methodologies such problem solving and project based learning (PBLs). Later in this paper, we will discuss the limitations of both in the new world reality. The capacity to adapt to a changing environment resulting in chaos and anxiety is more relevant than ever. The special characteristics of *super wicked problems*,

demand as well other set of competences, attitudes and mindsets from the workforce of today and our near future.

However, in a society where complexity is increasing rapidly and we are confronted with an urgency to solve these *super wicked challenges* like climate change, loss of biodiversity, pandemics, etc., educational institutions struggle to move away from traditional teaching mostly focus on foundational literacies and skills linked to content and knowledge. Without the capacity to navigate the complexity around us, knowledge will become irrelevant. Companies increasingly rate their employees' interpersonal skills and systemic abilities as more important than their analytical. In the BIAC Survey (2015), leaders of international leading industries from different sectors, revealed that employers are increasingly recognizing the importance of these new set of competences for the workplace. Cross-sectorial industry actors call educational professional to integrate these competences in their existing curricula. In fact, 80% of the surveyed companies considered that competences that allow professionals to deal with uncertainty, ambiguity and address complexity are not only necessary today but they are to become more important for their organisations in the future (BIAC, 2015).

The challenge for education is complex: educate the future professionals for new jobs that may not even exists at the moment, and to make it even more difficult, do this in a context of uncertainty and ambiguity. Scholars have invite HEIs to challenge the status quo of education for decades, trying to shift the paradigms of an education system designed for the industrialisation age of standardisation (Berliner, 2008; Gordon *et al*., 2012) to create educational systems that lead the transition to the *Imagination Age* (Garcia Alvarez, 2019: Garcia Alvarez, 2020). The world contexts of VUCA and BANI have become as well the context for learning. While several universities have incorporated the SDGs in the projects and research done by their students, sometimes they seem to forget that these goals are per definition wicked and super wicked. They require a systemic and interdisciplinary approach and therefore can not be approached by traditional methods of teaching, mostly based in analytical approaches, and in the context of traditional learning environments. This means that next to foundational literacies (*Know-what*/disciplined related) and set of skills that facilitates the *know-how*, we need a new set of competences or meta-competences that overarch knowledge and traditional skills, by being relevant to a wide range of work settings and that in essence facilitate adaptation and flexibility in complex environments (*e.g.* Harden et al., 1999; Tubbs & Schulz, 2006). Despite the fact that different relevant educational frameworks of competences in the field of ESD also make some references to the role of those same competences in developing the ability of how we deal with complexity, ambiguity and uncertainty; there is not a clear consensus on the competences lists, terminology and definition. While same of the 21st century skills frameworks refer to them as soft-skills or interpersonal skills, others use the label of *character qualities*. In the frameworks specifically linked to education for sustainability, we find terminology such as *transformative competences* or *key cross-cutting competences*.

The following table illustrates these mixed narratives and terminologies:

Center for Curriculum Redesign (CCR, 2014): Character Education for the 21st century Term: ***character qualities***	They are described as the needed qualities to develop on how one engages with and behaves in the world. In this sense, the word character embeds all other concepts such as: agency, attitudes, behaviours, dispositions, mindsets, personality, temperament, value and social & emotional skills. In relation to foundational literacies and skills, these character qualities are distinctive and seeing as a pre-requisite for the others, because they represent the ability to use effectively what one knows.
World Economic Forum (2015): New Vision for Education 21st century skills Term: ***character qualities***	They are described as the set of meta-competences needed for students to be able to approach their changing environment. These character qualities will allow students to develop resilience and success in the face of obstacles; discovering new concept and ideas; and involve constructive interactions with others in socially, ethically and culturally appropriate ways.

UNESCO (2017): Education for Sustainability framework Term: ***key cross-cutting competences***	They are described as key competencies that allow students to engage constructively and responsibly with today's world. These cross-cutting competences refer to specific attributes that the students will need to develop for action and self-organization in various complex contexts and situations. Cross-cutting competences include cognitive, affective, volitional and motivational elements; and therefore embed knowledge, capacities and skills, motives and affective dispositions. In that sense, they can be understood as transversal competences, multifunctional and context-independent.
OECD (2019): Learning Compass 2030 Term: ***Transformative Competences***	They are described as those that students need in order to contribute to and thrive in our world, and shape a better future. These transformative competencies allow students to find a sense of purpose in an ambiguous and complex content, at the same time that helps them to take responsibility for their actions having a strong moral compass, empathy and respect for others and the planet.
UN SDSN (2020): Education for SDGs Term: ***cross-cutting skills and mindsets***	They are defined as the set of skills and mindsets that contribute to the transformations needed in society in a context of complexity, uncertainty, conflicts of values and contradiction. These competences are cross-cutting in the sense that they should be context-independent and facilitate and empower learners to create positive change collaborating across sectors. Developing these cross-cutting skills and mindsets will facilitate the development of interdisciplinary students and professionals and help them to become agents of change.
Inner Development Goals (IDGs) (2021) **Term: *transformational skill and qualities***	Transformational skills for Sustainable Development developed by an interdisciplinary team of international researchers in consultation involving more than one thousand professionals. This is a framework containing a set of 23 skills and qualities of human inner growth and development that they define as necessary to achieve the complexity of the SDGs agenda. As well as the challenges, the world is facing now. The framework groups the competences around 5 pillars: • BEING: Relationship to self • THINKING: Cognitive Skills • RELATING: Caring for others and for the world • COLLABORATING: Social Skills • ACTING: Driving Change

Table 1. Definition and labelling of competences by different frameworks

All these competences and skills are rooted in the common narrative of the complexity of global challenges and transformative learning. In general, their main objective is to allow students to thrive through uncertainty and ambiguity by addressing the complexity of the challenges we face today, in order to guarantee a better future. The narrative of the sustainability definition defended by the Brundtland report (1987) is implicit in these frameworks. However, the differences among the lists and the complexity itself of these competences makes difficult for educators to operationalise them in their curricula and educational activities. In the last decades, the number of revisions of these competences in the context of higher education has increased

considerably (Aznar *et al.,* 2011; Albareda-Tiana & Gonzalvo-Cirac, 2013; Gonzalo Munoz *et al.,* 2017; Solis, 2014). However, researchers have not reached a conclusion or made a clear selection of those competences to see which ones can better serve in the context of VUCA and/or BANI. Less attempts have been made to discuss new pedagogies or learning environments where these competences can best be developed or grown. To make things even more difficult, some of the developers of these frameworks, concluded that these competences can not be taught, but the learners themselves need to develop them by acquiring them through action and reflection based on their experiences (UNESCO, 2015; Wiek *et al*., 2011). This invites us to rethink the way we learn in the new world context and to explore successful educational concepts and methodologies for learning to find common elements that can help educators design learning environments and integrate competences which will allow the transition to higher orders of learning in ESD.

Stephen Sterling (2014) defines a three level model of progressive engagement and deeper learning in the context of ESD: moving from education ***about*** sustainability to education ***for*** and education ***as*** sustainability.

- **ESD I: Education "about" sustainable development and change:** This has an information and content emphasis and involves cognitive learning. There may also be a skills and technical solutions element. Through this stage of ESD, learner will acquire new knowledge but are not likely to experience value change or lasting behavioural change- the learning is often accommodated into their current frame of reference or mindset. This equates to "first order learning" (cognition).
- **ESD II: Education "for" sustainable development and change:** This builds on knowledge and understanding but includes deeper examination of existing assumptions, values and beliefs of individuals, communities, organizations and wider society to facilitate critical reflection on alternatives, given the urgency of sustainability. Through this stage of ESD, learners are likely to experience reflexivity -a critical questioning and expansion of their thinking -and deeper affective learning and sense of engagement. This equates to "second order learning" (meta-cognition).
- **ESD III: Education "as" sustainable development and change:** There is an emphasis on capacity building, empowerment and action competence, stressing the ability to engage creatively, to manage successfully in conditions of uncertainty, complexity and ambiguity, to reflect critically and learn iteratively over time from engaging with real world experience. This may involve "third order learning" where a change of mindset occurs towards one, which is more holistic, connected, agile and open in outlook (epistemic change). (Sterling, 2014, Box 3, p.98)

From the perspective of Sterling's model, one could conclude that the levels ESD I and ESD II could work in traditional learning spaces, with linear settings facilitated by transmission (lecturing) and transaction (project-based learning) of knowledge, around teacher and student centred educational models. However, for those institutions willing to transit to ESD III, education ***as*** sustainable development and change, more innovation settings and learning spaces are needed to create the soil for this "third order learning" that includes transformation, holistic approach and connection outside the walls of universities. From the perspective of Sterling only this "higher order learning can lead to the development of sustainability competencies characterized by such qualities as an anticipative perspective and future orientation" (Sterling, 2014, p. 91).

From this perspective, Sterling (2014) invites HEIs to reorient the education starting by questioning what they want to ***retain***, what needs to be modified or ***revised***, what needs to be abandoned or ***rejected*** and what new ideas need to be brought, ***renewed***. The innovation also includes the space and shape we want to create for this new higher order of learning which involves profound transformation and change.

In the search for renewal and new spaces for learning, universities have been experimenting with other learning contexts that help them move beyond the first level of ESD described by Sterling (2014). Innovative learning environments could lead to the following outcomes (Sterling, 2014, p. 99):

- "Unlock and foster creativity, enterprise, resourcefulness and resilience
- Build competence, confidence and willingness to engage
- Raise awareness, build understanding and shift attitude and values in favour of sustainability
- Promote reflection on behaviour and facilitate practical change
- Help build social capital and promote partnerships and collaboration

- Promote participation and engagement among target groups and stakeholders
- Create mandate both for policy development and implementation"

These aspects could also be considered as pre-conditions to create of innovative learning spaces in the context of sustainability. Traditional educational learning spaces can work for the transmission (teacher centred), transaction (student centred) of knowledge and practice, and to raise awareness about sustainability. However, in order to develop deeper learning around sustainable practices, we may need to think about more innovative contexts and spaces that enable agency for change and reflective action. This will require moving from teacher and student centred visions towards a more world oriented vision of education, opening the experience of learning to other relevant actors next to teachers and students.

3. Learning spaces in university: the medium is the message

Traditionally, universities have been designed without taking pedagogy as key element of the architectural design of the space. University buildings were created to last for centuries and show status of power through landmark buildings and location. On the contrary, a rapid changing society and the rapid advanced of technology are forcing curricula to renovate and adapt to the demands of industry and society within each decade. In this sense, the physically context for learning served to other purposes but learning, without realising that where we learn shapes what and how we learn (Barret et al., 2017; Middleton, 2018; Zandvliet & Broekhuizen, 2017). Sometimes, universities used existing buildings, which were designed with other purposes. This is the example of the Faculty of communication sciences at the Universidad Complutense in Madrid, which was designed to become a prison for women. There has not been an intentional pedagogy embedded in the architectonical design of university as spaces for learning, less attention was even put in their sustainability. As David Orr says "it is paradoxical that buildings on college and university campuses, places of intellect, characteristically show so little thought, imagination, sense of place, ecological awareness and relation to any larger pedagogical intent" (Orr, 1993, pg. 226). Following in this observation from David Orr, it is interesting to see that while teachers are mostly limited with access to creative and inspiring spaces, most of university managers have bigger and more welcoming rooms, becoming the space more a symbol of status and power than a tool to support education.

In the last years, however, more attention has been given to the relations between the space or spatiality and learning, and how the space can hinder or enhance the experience of learning. When taking a look at universities, the design of the spaces is still following the standards of the industrialisation age. Classrooms are mostly design with a line of tables facing the podium or space where the teacher stands for a "chalk and talk" setting. This is still the reflection of a teacher centred education. In these settings, asking lecturers to create innovative learning spaces or moving to student centred education is challenging. Moving tables around to facilitate group work is the closest we get to student centred education in such traditional spaces. We encounter the same paradox when while creating more innovative spaces, some lecturers still use teacher centred education, manifesting the tension between space and pedagogy (McNeil & Borg, 2018). While the relation between the university and the space it takes in the city has been widely research and is known by its own terminology of *towns and gowns relations*, more is needed to understand the relation among space and learning inside of the university. Some scholars point out that learning has been always situated and embodied not just in material space, but further more in a social, cultural and political context (Boddington & Boys, 2011). Both constructions, the socio political space and the physical space, have an impact on learning (McNeil and Borg, 2018; Zabalza, 2012).

In the context of sustainability and more specific the impact of the Sustainable Development Goals agenda in Higher Education Institutions, we are seeing how the social-political space is leading to new institutional policy by demanding universities to integrate ESD and therefore challenging the capacities and knowledge of their teams. Universities are engaging in progressive ways with it and this includes the exploration not only of the *what*, which competences related to ESD do students need the development and the *how*, but also the *where*. This *where* embeds not only the physical space as such, but also references the format and design of the learning environments we are creating (online/offline) to facilitate the development and flourishment of ESD competences that can help our students to cope with higher levels of complexity. Most of the universities still

struggle to operate in the first level of ESD described by Sterling (2014), how to teach *about* sustainability in any given discipline or how to introduce some subjects that help illustrate their majors from the context of sustainability of sustainable development.

Traditional views on the process of learning will mostly take a look at the learning action from the perspective of acquisition of skills and knowledge. However, in the context of education for sustainable development, probably the most fundamental goal of learning is *sense making*. If traditional forms of education depart from ***know what*** and ***know how***, ESD invites the actors in the learning process to move beyond disciplines and approach learning from the perspective of their societal role. In this context, the focus is on the ***know why*** (challenge status quo) and ***know how to be*** or ***how to become***. We should now only develop the capacity for learning (long life), but also the capacity to unlearn and relearn. Therefore, most that through study, learning requires space for experimentation, and this space does not necessarily have to be located inside of the campus walls. Furthermore, new learning environments need to flourish beyond the disciplinary organisation of space.

These *super wicked challenges* addressed in the SDGs agenda are illustrating systemic illness of a system that has been traditionally explored and studied by the fragmented view of disciplines. We need to understand that in such high levels of complexity given by the complex of the interactions among all elements in the system, we can only learn to dance with the system (Poli, 2013). Roberto Poli, UNESCO Chair for Anticipatory systems, invites us with this metaphor of the dance, to create new moves, new dynamics in the systems that eventually will lead to change. In this dance, universities may need to invite other actors to participate in the choreography of learning.

In the last years, universities are more open to the integration of learning environments, which could facilitate the transition towards a more world centred education, moving away from teacher and students interactions only. This is inviting HEIs to break the walls of campus and engage more with all the active actors of their local communities. This implies moving to inter and transdisciplinary practices and break the mono discipline orientation of the university faculties.

4. Inter and transdisciplinarity, the biggest challenge for siloed structured HEIs

In the last decades, transdisciplinarity has almost become a *buzzword*, unfortunately sometimes misused to describe what in reality are traditional multi-disciplinary settings. A lot of universities believe that putting different research departments from their existing silos to work around the same topic can be already considered inter or transdisciplinary practices. The need for education to move towards transdisciplinary approaches is not a new recipe. Back in the 70s, the Club of Rome suggested that high complex problems would require to move beyond the disciplined siloed approach which was actually causing the problems. As a respond, a lot of universities in the US started to develop interdisciplinary practices, especially in the area of urban studies. Dutch-American philosopher, Joseph Kockelmans (1979), while writing about interdisciplinarity, as groups of multi-disciplinary scientists working together with the intention of find new solutions for complex problems, defined transdisciplinarity as the step forward, on how these scientists also “can take into consideration how to mitigate the side effects of the limitation of each discipline to find together new ways to make education and research more socially relevant” (Kockelmans, 1979, p. 128). Therefore, transdisciplinarity was presented as a third order research that was essential to tackle societal complex and wicked problems that will required scientific and non-scientific collaboration of different actors inside and outside the academia (Rieckmann, 2018; Steiner & Laws, 2006; Stoltenberg & Burandt, 2014; Yarime *et al*., 2012). The characteristics of the VUCA and BANI world we live in, requires from universities to move to deeper levels of collaboration. In these new world contexts, transdisciplinary approaches may become the key factor to thrive, cope and create in this complexity.

The impact of this highly complex and interconnected world and the different forms of socio-economic and cultural globalisation, more clearly felt and seen after the end of the Cold War, brought new relevance to the transdisciplinary debate. Complicated problems become hypercomplex in a society more interconnected where space and time boundaries were challenged. Those problems, which used to affect or were easily contained in a specific geographic area, start expanding through interaction of so many different factors

beyond previous constrains. Pablo Freire (1970, 1981) had already warned about the short-term recall of education due to a mono discipline based vision. Yet, little has changed since then, as universities maintain a discipline based education with curriculums of 4 to 5 years, when knowledge life spam is less than a decade. By the time, our students leave university with their degrees, they need to start unlearning what they have learned and start learning again.

As Julie Thompson Klein *et al*. (2001) highlighted, the turning point around sustainability debates and in this context transdisciplinary approach as key factor, took place during the 92 conference in Rio de Janeiro, calling for action and collaboration of different actors, among them academia working together to find new solutions and change paradigms of thought that can lead us to more sustainable practices. Therefore, the focus in transdisciplinarity is not new and it has been historically linked to sustainability practices. The wicked challenges we are facing today and above them all the urgency of the climate crisis, have made transdisciplinarity re-emerged within the context of collaboration and multiple stakeholder involvement, as we need more creative solutions and engaged and socially responsible research and science (Berstein, 2015). We cannot talk about sustainability, sustainable practices or sustainable forms of education without implying transdisciplinary approaches in teaching, research and collaboration settings. This is why the essence of education **for** and **as** sustainable development practices should be transdisciplinary. A common understanding for all about what transdisciplinarity is could facilitate the transition to this form of collaboration inside of the university setting. While *multidisciplinarity* is just the juxtaposition of disciplines collaborating together but maintaining their own visions and methodologies, *interdisciplinarity* invites to take a step further in the integration of methodologies, and *transdisciplinarity* is the complete integration not only of methods, but concepts and axioms that create a new paradigm or ways of thinking (Apostel *et al*., 1972; Cummings *et al*., 2013). In this context, transdisciplinarity moves beyond the environment of academia and involves non-academic actors (human and nonhuman). The OECD Seminar in Paris on Transdisciplinarity (2011), brought a new definition forward: "Transdisciplinarity is a new form of learning and problem-solving involving co-operation between different parts of society and science in order to meet the complex challenges of society" (Klein *et al*., 2001, p.7).

In a highly complex VUCA world where political and economic decisions are taken globally and concentration of power is in the hands of transnational companies, only transdisciplinary approaches can move us forward. Most recently, we have seen the need for these forms of approaches with the Covid19 crisis, and the lack of skills and capacity of our political, economic and health institutions to move inside this high order form of collaboration. Furthermore, some scholars, in the context of this new BANI world, are also proposing Transdisciplinary Education (TDE) as a new form of education that transgresses system boundaries and empowers the new generations (Kubisch *et al*., 2021).

This new form of education takes place in community collaboration settings, where students learn at the same time they are active participants in changing their communities with innovative societal solutions. By moving away the limitations of campus and engaging with transdisciplinary networks -involving non-academic actors-, universities could create more transdisciplinary teaching and learning spaces. This collaboration of academic and non-academic actors, working together, could act as cataliyst of transformation inside of the university and accelerate the transition towards more sustainable societies (Hoinle, Roose & Shekhar, 2021). Concepts such the *living lab* have profiled as innovative learnings spaces for sustainable practices where different networks of professionals and academic work together generating knowledge and new practices, facilitating that universities regain a goal as driver for progress towards more sustainable societies. The biggest paradox is that learning is not the main objective of a living lab setting. Innovation and experimentation are the driving force. However, living labs format seem an adequate context to foster and enhance transdisciplinary practices that can also be used in other learning contexts inside of the university.

5. Living Labs at the university: innovation and experimentation as drivers of learning

The concept of living labs was first developed by Professor Bill Mitchel from the MIT, father of the *smart cities* research. Since then, living labs have been always been considered ICT driven and city linked, as spaces for observation of interactions among human and technology in a given context. In the last decades, we have seen living labs presented as places for innovation and development of new knowledge and products, as result of

the collaboration of multiple actors. Yet, there is not a common understanding or definition of what a living lab is inside of a university. However, there is common ground in using living lab as a terminology to define innovative spaces inside of universities, which may have common characteristics.

The European Network of Living Labs (ENLLs) understand the living lab as an open innovation platform of collaboration of public and private partnerships (PPP) which create, prototype, validate and test new products and values for societies. In this context, university serves as the host of living labs by leading research and dissemination of knowledge and providing a platform for learning. However, it is not learning but innovation, which is the contract among partners participating in these living labs. Innovation is translated not only in new products or devices, but new worldviews, new insights to look at the complexity that imply to let go in order to let in. Disciplinary approach and multidisciplinary approach stay outside the door. In this sense, learning is not the driving force in the context of the living lab, but a result of processes and interactions among interdisciplinary partners motivated by innovation and experimentation with new products, focusing or ways of thinking.

Therefore, the essence of collaboration inside of a living lab is not the learning journey of the students. Living labs in the context of sustainability intend to foster innovation and shift paradigms through transdisciplinary collaboration. Learning is seen as a consequence of the processes leading to innovation, where change leads to new insights and learnings or learning together (inter and transdisciplinary approaches). Aligned with the main pillars of connectivism theory (Siemens, 2006), knowledge as such is not a goal but a tool for living labs settings. Paradoxically, universities have adapt living labs as a tool for learning for their students, and therefore, continue implementing pedagogies of transmission and transactional forms of learning which still are teacher and student centred, not world centred. In a living lab setting, the search of innovation throughout inter and transdisciplinary collaboration is central to all stakeholders involved. Next to this, a fundamental condition is that all stakeholders feel in equal partnership of engagement, agency and empowerment (Sterling, 2014). In this form of collaboration, the development of knowledge and skills is not central, but as stated in the third order of learning, or the higher order, attitudes and worldviews are challenged and transform throughout interactions with each other and seeing with new eyes outside the discipline constrains. Adaptability and responsiveness which are fundamental elements of purely ICT driven living labs, are also essential characteristics in more social or business oriented living labs contexts (Følstad, 2008).

Through a throughout analysis of 40 different cases, Westerlund, Leminen & Habib (2018), identified key constructs of living labs (objectives/governance/culture/values/funding/tools/spaces/methods) as innovation platforms that can help us summarize the main structure or characteristics of living labs:

- Objectives of living labs are mostly (social-economic) impact and innovation oriented.
- Organisation and management of the living lab is serving the innovation (not the learning).
- Driven by a culture of innovation and collaboration.
- All participants have value to the living lab and have a clear role or contribution.
- Funded by private and public money/ living lab business models emerging.
- Actors involved create together new values that lead their process of collaboration (network, knowledge transfer, validation, business development).
- Development of own tools for communication (online channels, digital communication).
- Sometimes they share online spaces or physical facilities where they have also offline interaction. There is a common space for the living lab.
- They develop in transdisciplinary collaboration new methods of collaboration, co-creation, gathering of data, etc.

In the cases reviewed by Westerlund, Leminen & Habib (2018), some living labs contained as one of the active actors one or more universities and consequently, faculty staff and students were as well active actors inside of the living labs. However, students and teachers actively participating in living labs, should have an equal role as the rest of stakeholders. Furthermore, their role only makes sense in the interaction with the others and their contribution to the common purpose of the living lab. Teacher or student centred models have no space inside of the living lab context. Yet, it is usual to encounter this paradox inside of universities, which take the lead in creating living labs to enhance the learning experience of their students (student centred approach)

and not with the intention of creating spaces for innovation where learning occurs as the result of interactions among all stakeholders as equal participants. It could be interesting for universities to review all the key elements highlighted by Westerlund, Leminen & Habib (2018) and to clarify what is the learning experience they want to provide to their students, which is an essential question to choose the learning methodologies that can be most appropriate for the context of the living lab they are creating. Universities need to consider as well that living labs may not be the solution for all learning experiences they are trying to design for their students.

The problem of living lab settings in the context of universities is that higher education institutions are still hierarchically organised. Living labs are by nature non-hierarchical and have a horizontal leadership, holding the space for creativity and innovation. Living labs are mostly result of a shared commitment for continuous experimentation and creation of tangible outcomes (products, methods) or intangible ones (shared values). In the moment universities are creating living labs as tools to meet own agendas (such are the learning of their students), they may be misusing the term of have a wrong understanding of the concept. Most of the collaborations sustained by universities in these contexts have mostly the aim to enable the students' learning processes and not the process of transdisciplinary knowledge co-creation with external communities (Hiler & Keil, 2021). The living lab concept is by nature inter and transdisciplinary, and these terms are still uncomfortable for higher education, mostly using multidisciplinary forms of collaboration that allows them to still move inside of the comfort zone of silos of disciplines. Breaking beyond discipline views is a struggle of traditional universities.

6. Learning methodologies for conscious learning environments

The fact that living labs as new learning environments are not driven by learning or knowledge as a goal, have forced educators inside of universities to implement different forms of learning methodologies when participating in living labs settings. In a living lab setting, fostering inter and transdisciplinary approaches, and with non-hierarchical structures, the levels of knowledge, mastery of competences and skills and character qualities are so different. The capacity of finding the necessary knowledge (knowledge as tool) and critically filter information, has become more relevant that the production of new knowledge. This differs from traditional forms of organising education per age, discipline orientation, levels of knowledge and skills, and learning outcomes with specific sets of knowledge and skills. In order to guide the participation of the students in living labs settings, educators need to rethink pedagogical approaches and find new learning methods that can help them thrive and recognise the learning processes resulting of the primary goal of innovation and experimentation. Despite the fact that some living labs inside of universities choose the project or problem based learning approach, in the context of living labs working with sustainable development and therefore addressing complex global issues, these two methods of learning present some limitations.

The nature of the challenges we are facing is hypercomplex. As previously discussed, these *wicked problems* (Rittel and Weber, 1973) have new dimensions and characteristics in comparison to tame problems. Most of the time a solution is not even possible. A problem solving approach does not seem enough to deal with this level of complexity. If *wicked problems* have mostly no solution, or at least not a defined one, a problem solving approach may sound paradoxical.

6.1. Project Based Learning and Problem Based Learning

Project-Based Learning (PjBL) and Problem-Based Learning (PBL) is a familiar methodology for university students. Entrepreneurial oriented universities have incorporated it in their curricula, facilitating transaction of knowledge among students and professionals (clients) working together in a given project. The issue for the format of the living lab is that there is no one client, no dominant agenda and there is no one specific project leading the experimentation. Project-based learning has proved to be a good form of transactional learning, yet in the context of education for sustainability, we need to move to transformative learning. By interacting with professional clients around specific products or deliverables, students can learn skills related to project management as planning, time management, accountability, deadlines, agile and scrum, etc. These are important skills yet we can discuss if they are the most relevant in the context of complexity. Some universities have developed programs with project-based curricula, as these studies are by nature project oriented, this

means that individual courses embed project based learning and students can directly apply the knowledge of the course in the project they are working on. They are more directed in comparison to problem solve learning where the problem is leading to consider different aspects (Mills and Treagust, 2003). In project-based learning, the project is the dominant activity and sometimes controlled and directed by one specific client, which can be an enriching transactional experience, yet it can limit the power of transformative education that implies self-reflection and less control of the learning environment.

Problem solving and project based learning have commonalities (Helle, Tynjälä & Olkinuora, 2006) and both required high levels of students initiative, as students are encouraged to develop motivation and organizational skills, which are fundamental in inter and transdisciplinary living labs settings. However, there are also some differentiation, while problem solve learning can take place sometimes at individual level, project based learning requires collaboration processes. The most fundamental difference is the focus of each approach. In problem-based learning, the focus is the learning around the problem, while in project based learning the focus is around the end product (Blumenfeld et al., 1991). It is the focus of both methodologies, linked to a natural constrain of time (usually present in education due to traditional organisation of curricula in terms, semesters, periods, etc.), that brings limitations to the use of these learning methodologies in the context of living labs working on sustainability issues.

Living labs for sustainability implied an intrinsically continuum on time, changing and adapting as innovation evolves and new problems arose out of new interaction of the complex systems they work with. Letting go on the focus of an end product and letting go on the focus on learning would be a precondition to a successful living lab on sustainability issues.

Sustainability education invites us to push the boundaries of learning to other experiential based forms of learning that take into consideration the nature of the challenges we are dealing with. These new methodologies should move away from fixing a problem or creating a specific product, and focus on sense making. In this context, we consider that challenge based learning, mission oriented learning and community based learning, could better match the living lab context or other ecosystems of collaboration around sustainable development issues. While problem and project based learning are not per definition linked to sustainability (yet have been used to address sustainable development issues), these three forms of learning methodologies pivot around the creation of societal value.

6.2. Challenge Based Learning (CBL)

Challenge based learning (CBL) addresses challenges of global importance with local impact. Students explore these challenges within the context around them, and need to develop flexible worldviews that allows them to move from global and local implication within a context of urgency. CBL was developed by the educational department of Appel at the beginning of this century. Therefore, technology plays a fundamental role in CBL, even though the methodology can also be implemented in the context of societal issues and not only addressing technological challenges. In contrast with Problem Based Learning, where problems can have different levels of complexity, CBL addresses complex challenges that need the involvement of different actors of the community beyond the academic world. Another main difference is the call for action. CBL requires that the challenge addressed leads to the final action of implementation.

Building in the practice of problem solve learning, CBL increases the demand for collaboration and interdisciplinarity due to the nature of the challenges that are explored. Inherited in the practice of challenge based learning is the call for action and advocacy, to find new ways of thinking or approaches to a known challenge, increasing also the focus in innovation. While problem based learning can be individual, CBL requires this form of inter and transdisciplinary collaboration, next to a feeling of purpose and sense making inside of high levels of complexity, and includes the use of nonhuman actors (technology), that is why mostly technical universities are more proactive in experiment with CBL.

The model of CBL includes three steps:

Figure 2. Challenge Based Learning Model from Challenge Based Learner User Guide (p.11) by Nichols, Cator and Torres (2016). Creative Commons Licence [CBL_Guide2016.pages (challengebasedlearning.org)]

Due to the technological aspect of CBL, most of the universities implementing this methodology are mostly technical. The diversity in the implementation among these universities as well has created a lack of standardization to define it. Recently, an exploratory literature review published in 2020 by Silvia Elena Gallagher and Timothy Savage has identify some common characteristics that can bring some clarity and help educators to implement CBL in their learning environments (Gallagher & Savage, 2020):

1. *Global themes*
2. *Real-world challenges*
3. *Collaboration beyond academia (external actors)*
4. *Technology*
5. *Flexibility*
6. *Multidiscisciplinarity*
7. *Innovation and creativity*
8. *Challenge definition: a central question*

The link with global challenges as described in the SDG agenda is central to CBL. Most of this challenges may have a local character or extension being translated as a real challenge that can be more tangible to address, yet the complexity of the global theme is central, acting as an umbrella or guidance through the challenge. The level of complexity invites to move beyond academic collaboration only, including and involving external agents who collaborate together in anon-hierarchical way. Despite the fact that multidisciplinarity is mostly common at the existing application of this methodology, its flexibility could increase moving to inter and transdisciplinary models of collaboration. Since CBL is mostly used by STEM related disciplines, this has make this methodology to stagnate in levels of multidisciplinarity and not moving forward to deeper levels of collaboration among diversity of disciplines. Innovation and creativity remain central and by introducing, inter and transdisciplinary approaches, the levels of creativity and innovation can also increase. The definition of the challenge is also important to make the complexity more tangible for all the actors participating in the challenge. Mostly the challenge departs from a question related to the global theme.

Finding common ground in the definition and implementation of Challenge Based Learning can facilitate the integration and implementation in settings like a living lab. Challenge based learning can be also further developed to be incorporated in other disciplines with stronger links to social sciences. This would also increase the inter and transdisciplinarity approaches to the challenges being now addressed only from the side

of STEM related disciplines. The technological aspect usually scares social sciences to integrate this method in their learning environments. However, technology can be used as tool to increase and facilitate the communication among different actors in a nonhierarchical setting. Gallagher and Savage (2020) refer to the use of virtual learning environments, online communication and collaboration tools, serious gaming, etc. and not only technology as a final product or innovation.

6.3. Community Service Learning

Community Service Learning (CSL) or Community Based Learning has been traditionally used by primary and secondary schools and is less known in the context of higher education settings. The focus of Community Based Learning is to develop (global) citizenship and community engagement for sustainable development. Learners work closely with their own communities addressing social or environmental issues and taking action together with different social actors directly involved in the community. The main goal is to empower citizens and communities to take informed decisions and lead them to action (Brief, 2017). In the context of the informed decisions, Community Based Learning taps into local wisdom, and therefore is a methodology used in the context of living labs or collaboration projects involving indigenous communities, inviting them to use and look into their own knowledge and wisdom (Brief, 2017).

CSL requires the collaboration of diverse social actors at intergenerational levels. Young and old people work together around a topic, which is relevant and important for the community, exchanging knowledge, ideas and visions. Community Learning Spaces evolve around this diversity of age, gender, social background and race to address issues of common interest and close to their daily lives. In comparison to Challenge Based Learning, Community Service Learning has a *glocal* character (reflecting or characterized by both local and global considerations). It deals by nature with local issues, clearly geographically identified, yet the social and environmental relevance of these issues makes them of global interest. The Unesco Institute for Lifelong Learning, describes in its Policy Brief 9 (Brief, 2017) three characteristics for the Community Learning Spaces:

A) Strong community ownership
B) Diverse learning vision and
C) Low costs of participation in learning activities (UIL, 2014)

Furthermore, one of the most important drivers of Community Based Learning is sense making. All actors participating have a purpose and a sense of connection and belonging with the community. In this sense, it pivots around a pedagogy of engagement and consciousness (Melaville, Berg & Blank, 2006). The complexity of the issue being address and its global dimension serves to develop the competences, skills and character that are needed to address multilayered and complex issues and to move from dream into action.

The Coalition for Community Schools in the US recognizes four *common sense drivers* for Community Based Learning collaboration (Melaville, Berg & Blank, 2006, p. 3-4):

1. **We are all in this together.** The understanding of society as a whole system where different actors collaborate to live productive lives and share responsibilities. The real approach is fundamental in community based learning.
2. **Prepare for the future today.** The vision of regenerating and conserving for the future is central thinking as well that the young generations are citizens of today and will become as well parents, professionals and leaders in the future. Triggering their curiosity and positive engagement for their communities foster their global citizen involvement.
3. **Community-based learning happens everywhere.** Integration of community based learning in the curricula should happen as a natural step to close the gap between living and learning, inviting students but also other actors of the community to learn through living and living through learning together. Collaboration facilitates the integration based in the common interest of benefits for all.
4. **Make better use of what we know**. Community wisdom resides in different actors and this knowledge transfer happens through interaction and collaboration when focusing in a common goal important for the community. For teachers and educators community based learning can be a great resource for applied knowledge and teachers can learn on how to best make use of this methodology

by experimenting and applying these methods to trigger and motivate students in change agency and advocacy.

ESD is central to community based learning. The Unesco Institute for Lifelong Learning, describes in its Policy Brief 9 (Brief, 2017) recognizes that the reciprocal relationship between community based learning practice and national and local public policy should be guided by a shared vision on education for sustainable development (Brief, 2017, p.2). They recommend programs integrating community based learning to follow six action principles to be able to respond and take action on local contexts: Engaging/ Enabling/ Embedding/ Sustaining/ Transforming and Responding. These principles are also implicit in the narrative of ESD principles and can constitute a good framework of operationalization for living labs.

6.4. Mission Oriented learning

Mission Oriented Learning (MOL) does exist as such, meaning it is not a theoretical developed learning methodology. It is a model inspired in the mission-oriented policy models developed in the EU based in the work of Professor Mariana Mazzucato, internationally known by her book *The Entrepreneurial State: debunking public vs. private sector myths* (2013). She is the author of the European Commission report on Mission Oriented Research and Innovation (2018) where she lays the foundation for mission oriented policy making. In the process of elaboration of this report, Mazzucato sustained some discussions on defining hypothetical examples of missions for pedagogical use. However, more research is needed to translate all this work into a learning methodology. Therefore, there is not a didactical approach or development of this concept as in the other methodologies presented in this paper. It is more a political approach and an approach that directs thinking and actions towards a common achievement. We wanted it to be included here because to some extent, the methodology is embedded in the experience itself to work in a mission-oriented framework and it is implicit in the values of many living labs working on sustainability.

In fact, MOL could be a combination of the methodologies described in previous pages. It departures of a big challenge which describes the context of action for the missions. The missions in this sense are more tangible, more actionable and measurable. Mission oriented policy focus investment only on those issues that will create societal value. The report of Mazzucato (2018) defends that a mission oriented policy is the best instrument to reframe the way we tackle complex societal challenges. It highlights certain elements that a well-designed mission should have:

- One size does not fit all. Therefore, flexibility is needed.
- There is no waste: innovative spillovers from other (bigger) missions can be explored and reuse for others. Missions should be make use of existing resources (concepts of circularity).
- They are a hybrid model between a challenge (where do we want to create impact) and a project (clear objectives, measurable, actionable).
- Missions should be broad enough to foster cross-sectional collaboration but also be focused enough to allow measurement of success (transparence and accountability of public resources).
- Missions should foster experimentation through bottom up processes that nurture innovation while “getting there”.
- Facilitate spaces for new conversations and collaborations between fundamental research and applied research.

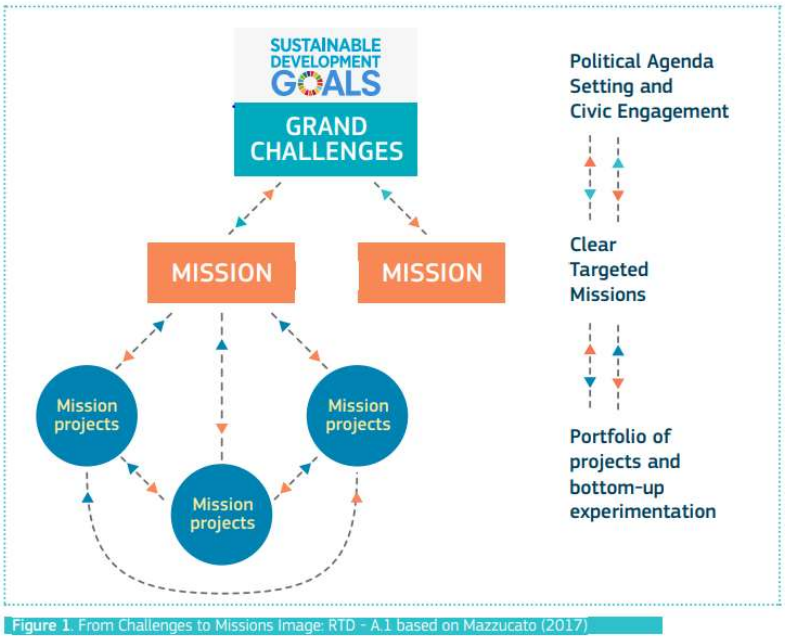

Figure 3. From Challenges to Missions. From Mission-oriented research & innovation in the European Union (p.11) by Mazzucato, M (2018). In the public domain of European Commission. [mazzucato_report_2018.pdf (europa.eu)]

While the challenges acting as umbrella for these missions have a direct relation to the Sustainable Development Goals agenda (see figure 6), the missions themselves have specific characteristics. These, described by Mazzucato (2018) can help educational institutions to develop specific missions in collaboration with local or regional actors:

1. Missions should be bold, inspirational and have societal relevance.
2. Should be Clear, targeted, measurable and time-bonded.
3. Ambitious but realistic research and innovation.
4. Cross-disciplinary, cross-sectoral and cross-actor. It should spark inter and transdisciplinary collaboration.
5. Multiple bottom up solutions addressed and open to multiple solutions.

The independent Research Innovation and Science Expert high-level group (RISE) revised the report from Mazzucato on Mission-oriented policy and provide some extra information that can lead to reflection on the incorporation of mission-oriented policies (European Commission, Directorate-General for Research and Innovation, 2018). These new insights can also help its application to learning contexts. The report of RISE (2018) makes the differentiation of two types of challenges (RISE, 2018, p.7): Type A) Those, which are solvable and can lead to verifiable goals and clear missions; Type B) Those where solutions are unknown as they are wicked challenges and therefore are difficult to define.

In the context of a VUCA or a BANI world, most of the challenges will fall under type B and this implies that the missions resulting from these challenges will only provide partial solutions and will struggle to define objectives or at least easy to measure. The options would be only focus on the parts of these complex issues that can be reducible to missions. Most of the challenges in this type B category refer to socio-economic and complex environmental wicked and messy problems that will require high doses of inter and transdisciplinary approaches and cannot be only solve by technological or infrastructural change, nor even policy making, but will be working on behavioral change. In this case, the problem solving approach of the mission will not work and the actors involve will need to aim sustainable transitions and new dynamics leading to change (European Commission, Directorate-General for Research and Innovation, 2018, p. 8).

The report of RISE concludes with some important remarks (European Commission, 2018, p.18) that for this paper we translate to narratives that can guide to the implementation of mission-oriented frameworks into educational settings and living labs:

- Missions need to be able to engage citizens (students and other actors). Engagement works even better if all actors are involved from the beginning in the design and definition of the mission trough social dialogue. Participation is a key element for all missions, but most specific for those addressing challenges of Type B.
- Missions addressing complex issues should be presented with a narrative that links to the global challenge and yet is able to be understandable and inspirational for (new) actor's engagement.
- Missions will require infrastructural and behavioral change in combination with scientific and technological innovation.
- Missions will need new forms of governance and organization (nonhierarchical) that can align inter and transdisciplinary collaboration, and foster leadership, teamwork and creativity.
- Missions will require frameworks for accountability and evaluation with short, medium and long-term targets, so despite the complexity deliverables are more than a promise. Impact should be defined and measurable.
- Missions will need new narratives that resonates with the dreams and expectations of the actors involved and builds on values that give them purpose and meaning.

Mission oriented frameworks can be translated into learning methodologies that fit the concept of living labs, contributing to enhance the goals of this collaboration environment.

All these learning methodologies have some commonalities as they all intend to address global issues from a local perspective inviting participants to take action for sustainable development. CBL, CSL and MOL or Mission oriented frameworks have as well in common that learning is not a goal but a result of the interaction. The main goal of these three methodologies we have discussed is to create social value at different levels. The focus may differ, for CBL is innovation (product; for CSL is the improvement of the community; and for MOL or Mission oriented frameworks is the creation of policy that improves society's welfare. These three also require, as opposed to PBL and PjBL, cross-collaboration among actors (academic and non-academic), disciplines (inter and transdisciplinary approaches) and meta-competences that move beyond foundational knowledge and disciplined related skills.

Experimenting with these methodologies inside of the context of living labs to introduce frameworks that foster (not lead) learning, could provide a tool for disruption in higher education. It is up to higher education institutions to take the lead in developing, reimagine or redesigning pedagogies and methodologies that can contribute to move to deeper levels of learning (consciousness). In this sense, paraphrasing Randy Bass (2012), the source for disruption in higher education will need to come from inside, from our own practices and bodies of experiential learning that can provide meaning to our students (Bass, 2012).

Conclusions

In order to move to deeper forms of learning in the context of education as sustainable development, we need to focus our attention not only on the competences, but also in the learning environments where these competences can be developed organically. Living labs can be a suitable learning environment for the ESD III level described by professor Sterling (2014) to flourish. The relations and interactions among different stakeholders from different disciplines and backgrounds will require the development of more holistic, connected, agile and open mindset. These are characteristics needed in education as sustainability context that should:

- Enhance capacity building.
- Empowerment of action.
- Stressing the ability to engage creatively.
- Manage successfully in conditions of uncertainty, complexity and ambiguity.

- Critically reflect and learn iteratively over time from engaging with real world experiences (Sterling, 2014).

If living labs can provide this type of soil, then they can be considered as great innovative learning context for ESD. Moreover, the key constructs from Westerlund, Leminen & Habib (2018) that living labs should have in order to foster innovation, could be used as models to rethink universities as spaces for learning. From this perspective, instead of universities focusing in creating multiple living labs disciplined oriented, in the context of ESD III, universities should be operating as living labs itself (Leal Filho, 2017; Leal Filho, 2019; Leal Filho, 2020), with the clear objective to contribute to the SDG 4.7 mandate, and therefore educating not only professionals that meet the demands of the job market, but global citizens that will become the leaders of the future.

Moving universities to act as living labs will have social and political implications. It will mean to work and learn in a more flat and inclusive environment that moves beyond mono and multiple disciplines towards more inter and transdisciplinary approaches, involving all actors in learning and creating processes where everyone is equal. This has also implications for the roles of the actors involved in higher education and, for example, teachers will have to move beyond the new roles of coaches and facilitators to become as well active actors as co-learners and co-creators in non-hierarchical forms of interaction.

In his Theory U, Otto Scharmer invites us to think in different levels of attention, creating matrix that can help us understand the systems where we operate. For Scharmer (2009) the level of attention determines the level of intention. As form follows consciousness, education needs to have a conscious understanding of where are we operating and where do we want to move forward. From the Theory U perspective, the *Presencing Institute* created the following matrix of evolution of education:

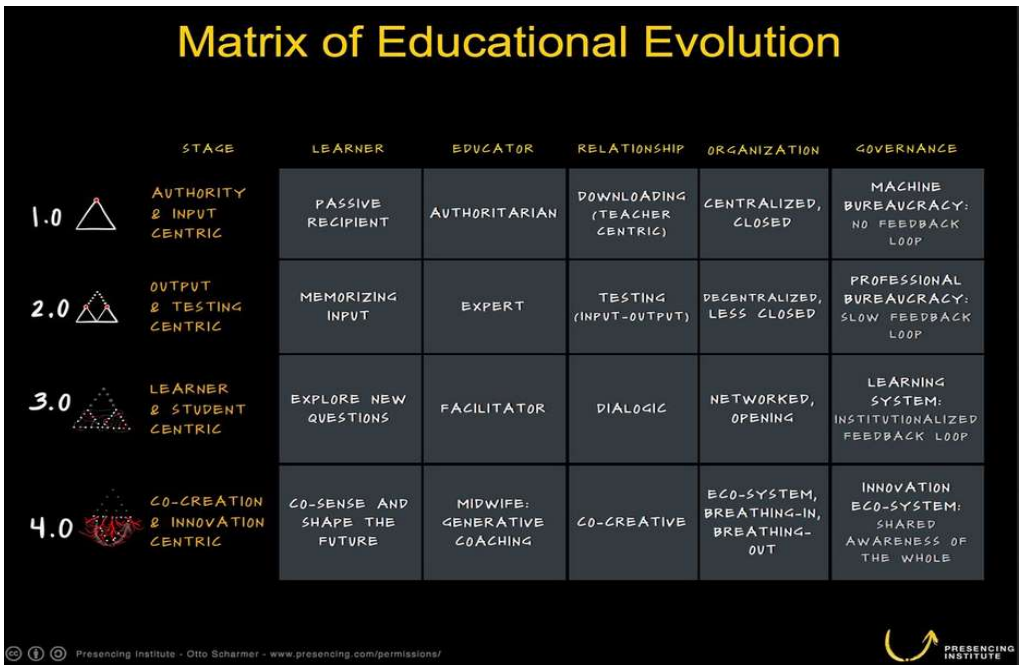

Figure 4. Matrix of Educational Evolution Presencing Institute, 2020. CC License by the Presencing Institute - Otto Scharmer. https://www.presencing.org/resource/permission.

This matrix serves as inspiration to create the one that summarizes the discussions in this paper. Having the world contexts as point of departure (SPOD, VUCA and BANI), how can we move to deeper levels of learning in the context of ESD as defined by Sterling (2014) and which learning modes and methodologies will contribute

best to enhance students learning and competences development depending of the level from which we operate:

World context	**Learning mode**	**ESD levels**	**Focus**	**Collaboration forms**	**Research**	**Methods**
1.0 SPOD	Transmission	Education ***about*** sustainability	Teacher	Mono/ Multi	Discipline focus	Project and problem solving
2.0 VUCA	Transaction	Education ***for*** sustainability	Student	Multi and Inter	Cross-pollination	Project and problem solving
3.0 BANI	Transformation		World/Society	Transdisciplinary	Paradigm shift and change	Challenge based
4.0 Sustainable World	Consciousness	Education **as** Sustainability	Ecosystems (planetary and interplanetary)	Transdisciplinary	Ecosystem consciousness	Community based Mission oriented

Table 2. Matrix Education operations in the world context.

To conclude, we cannot underestimate the impact of Covid 19 pandemic in educational learning environments. The pandemic has accelerated the process of hybrids formats of learning spaces, introducing concepts in education such hyper-hybridity and hyperlearning spaces (Nørgård & Hilli, 2022). Curricula around the world are changing creating new opportunities for cross collaboration in learning through projects that are time and space unbounded. Despite the fact, the online education in the beginning of the pandemic was more based in remote emergency teaching that innovative online learning environments, soon technology caught up providing more innovative platforms to create online learning spaces (see Gather, for example). It is true that online education has led to frustration and more feelings of isolation among students and this is also a characteristic of a BANI world (anxiety). However, it has help us as well to reconnect, crossing the borders of own spaces, such learning from the intimacy of our own homes, and allowing other stakeholders to enter in the private sphere of our homes. Hybrid settings have facilitated more interaction among students and professional networks. Most of the professional networks have moved their gatherings online, opening doors to more audience and facilitating free access to students. These new metaverse of collaboration has eased hierarchical organisation of power and status, moving from fancy venues or working rooms, to the cosiness of improvised home work spaces or living rooms. Offline learning spaces are forcing hyperstructure learning environments around classes, time slots and deadlines to change into new learning experiences not attached to time and space variables (Wardak, Vallis & Bryant, 2022).

We can take the post-Covid world as an opportunity to rethink the learning spaces inside and outside the university campus. If we want to move towards education as sustainability, we need to redesign, to rethink and reimagine the environments that will foster this transition.

Glossary:

Learning environments: ecologies, which include virtual and physical spatial concepts, designed to facilitate and enhance the learning of students and their development of competences and skills.

Living Labs: an open innovation platform of collaboration of public and private partnerships (PPP) which create, prototype, validate and test new products and values for societies.

ESD learning methodologies: Those learning methods or concepts that have elements to sustain the development of ESD related competences

Transdisciplinarity: Integration of methodologies, concepts and axioms that produces new ways of thinking shifting to new paradigms. A new form of learning which involves collaboration between different actors of society and science in order to meet complex global challenges.

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