EDUCATORS' COMPETENCES IN

Environmental and Sustainability Education: theoretical and practical perspectives towards transformational education in times of global crisis

Doctoral thesis by
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DEDICATION

To the invisible force that some called love, others God being behind the biggest hopes and dreams of all, for inspiring me towards contributing to a more loving, just, and peaceful world.

To my dad, who encouraged me so much to start this journey, although this virus took his physical presence, I keep feeling his love and encouragement to seek my dreams towards another possible world. I know you are proud.

To my mom and brother, who have believed in my ability to finish this doctoral project, being present despite the physical distance, but also taking flights to remind me there is no ocean wide enough, nor pandemic frightening enough to keep us apart.

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To all educators that, as Sowers, every day nurture the seeds of a more sustainable world for humans and the more than human world.

ABSTRACT

The main research subject of this thesis is understanding the competences that educators in Environmental and Sustainability and Education (ESE) working in diverse learning settings (i.e., formal and non-formal) need to develop to make education more transformational in a global crisis context. This thesis contributes to this field of research by shedding light on how the different ways ESE competences are understood at the theoretical level and operationalized in practice can shape educators' transformational capacities in ESE while analyzing potential intrinsic and contextual influences in educators' competences. The thesis also deals with the recent COVID-19 pandemic that forced educators to increase the use of digital technologies (DT) by examining how the resulting opportunities and challenges connected with their competences in ESE.

First, I conducted a systematic review of competence frameworks and models for educators in ESE to explore the conceptual approaches defining educators' competences and particularly those addressed to promote transformational education. Additionally, the most common competences in the reviewed documents were *Critical Thinking*, *Participation in community*, and *Connections*. However, other competences highly associated with transformational education in the literature, such as *Emotions Management*, *Futures*, and *Achieving Transformation*, received less attention from the reviewed frameworks regarding both theoretical and pedagogical levels.

Next, during the COVID-pandemic, I implemented a case study in the Barcelona Metropolitan Area, where diverse ESE settings co-exist. Here, I conducted 18 online interviews with ESE educators working in formal and non-formal settings. Two separate analyses took place from the collected data. For the first analysis, I conducted a content analysis of the interviews qualitatively and quantitatively to explore the main competences these educators perceived as needed for their role as well as the interlinkages between these and their motivations for ESE and their teaching challenges. Across both contexts, *Transdisciplinarity* was particularly relevant, while also associated with their motivations and challenges perceived. *Systems* and *Participation* were differently perceived as crucial for their teaching practice depending on the educational setting. While formal educators' discourses highlighted the relevance of *Systems* and connected this competence with their motivations and challenges, non-formal educators provided more value to *Participation* and barely associated it with their challenges. Interestingly,

Empathy was reported as less relevant for their role in both settings, but it was especially interlinked with their motivations and challenges in non-formal settings.

The second analysis of the interviews' data focused on how ESE educators perceived opportunities and difficulties related to the forced adoption of digital technologies during the COVID-19 lockdowns and how these connected with their competences in ESE. My findings show that both formal and non-formal educators perceived motivational challenges. Non-formal educators reported a broader range of DT than those in formal settings and highlighted the difficulty of sustaining the impact on environmental learning when replacing face-to-face methods with DT. Educators' experiences seem to be less related to their previous use of DT and more to mastering specific competences in ESE that can help them deal with emotions, such as *Empathy*.

Overall, the findings of this thesis show that educators' competences from the cognitive and behavioral dimensions of learning, such as *Systems* and *Participation*, are receiving more theoretical and practical attention than those competences from the socio-emotional dimension, such as *Empathy* and *Transdisciplinarity*. My empirical evidence also shows that these last two competences are interlinked with the teaching challenges educators experienced, particularly in the non-formal setting, also during the COVID-19 pandemic lockdown when most of them were forced to increase the use of DT. Thus, my findings point out a dual necessity when developing educators' competences in ESE for a more transformational education: to strengthen the conceptual approach towards competences from the socio-emotional dimension of learning that are now theoretically unaddressed and, to guide more tailored and suitable future training developments for promoting these competences while considering the different educational contexts and particular challenges.

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Ph.D.-related publications:

Corres, A., Rieckmann, M., Espasa, A., & Ruiz-Mallén, I. (2020). Educators Competences in Sustainability Education: A Systematic Review of Frameworks. *Sustainability*, *12*(23), 9858. https://doi.org/10.3390/su12239858

Corres, A., & Ruiz-Mallén, I. (accepted). Digital technologies and the COVID-19 pandemic: opportunities and challenges for environmental educators in Barcelona. *Journal of Environmental Education*

List of Abbreviations

Presented here in alphabetical order.

B/D: Be and Do (bridge group of the Typology of Competences)
CESC: Education for Sustainability from the perspective of Complexity
ConSus: Connecting Science-Society Collaboration for Sustainability Innovation.
COVID-19: Coronavirus disease 2019
CSCT: Competencies for ESD teachers
D1-D14: Documents reviewed 1 to 14
DT: Digital Technologies
E1-E18: Educators interviewed 1 to 18, anonymized.
EDINSOST: Education and Social Innovation for Sustainability
EE: Environmental Education
ESD: Education for Sustainable Development
ESE: Environmental and Sustainability Education
EU: European Union
F/NF: Formal and Non-Formal Education
HEI: Higher Education Institutions
IEEP: International Environmental Education Program
K/B: Know and Be (bridge group of the Typology of Competences)
KOM-BiNE: Competences for ESD in Teacher Education.
LtB: Learning to Be
LtD: Learning to Do
LtK: Learning to Know
LtLT: Learning to Live Together
NAAEE: North American Association for Environmental Education
NGO: Non-Governmental Organization
OECD: Organisation for Economic Co-operation and Development
RSP: A Rounder Sense of Purpose
SCEA: Societat Catalana de Educació Ambiental (Catalan Society of Environmental Education)
SD: Sustainable Development
SDG: Sustainable Development Goals
UN: United Nations
UNECE: The United Nations Economic Commission for Europe
UNEP: United Nations Environment Program
UNESCO: United Nations Educational, Scientific and Cultural Organization

Table of Contents

Tables Index

Figures Index

CHAPTER 1. Introduction

"In the end, we will conserve only what we love;
we will love only what we understand
and we will understand only what we are taught."
-Babe Dioum

1.1.Research context

A teacher in Mexico told me a couple of years ago that every year, at the beginning of the course she asked her students at the primary school level: *What is your dream for the world's future? How do you imagine the future?* She expected similar answers to the ones she had been listening to over the years, like: "there will be flying cars", "people will teleport" or "there will be robots in restaurants". But that didn't happen. Instead, students answered: "there will not be a future since there will not be a planet". Surprised and saddened, she asked their students at the secondary school level the same. They stated in different words but with the same essence: "Teacher, there will be no future. Why should we bother?" This teacher confessed to me that deep inside her, she was starting to have the same feelings and perceptions as her students. She wondered if it were not better to live for today since tomorrow, she wouldn't be able to enjoy life due to the environmental situation. In Greta Thunberg's words, one of the most famous voices in environmental activism nowadays*: "Why should we study when our future is being taken from us? That is being sold for profit"* (Carlisle, 2019, p. 6).

Intending to contribute to a more transformational education (UNESCO, 2021a, 2022; Yacek, 2020), at the beginning of this thesis research, I broadly wonder what kind of competences an educator in Environmental and Sustainability Education (ESE from now on) needs in order to overcome these and other challenges at the time of this global crisis that prevents ESE from being truly transformational? What does the scientific literature tell us about these competences? Then, as the doctoral research continues developing, the questions became more complex: How individual factors, as their own motivations, could be related to their competences to pursue environmental and sustainability education? How are other contextual elements, such as being in a formal or non-formal institution, and their differential teaching challenges, associated with the competences they need to overcome these? After the hit of the COVID-19 pandemic, further questions emerged, such as: How have environmental educators' teaching

practices been supported or challenged by the forced use of digital technologies during the lockdown period? And how their competences in ESE mediated this immersive digital experience.

Generally speaking, to be an educator is not an easy task since it demands mastering a diverse set of skills and attitudes, from being able to talk in front of an audience or dealing with digital technologies to having knowledge from specific disciplines to exercising a constant critical awareness of all the complex elements causing injustice situations in the nearer school context and inside of this (Pereira, 2019). Notably, this thesis discusses the teaching task from a transformational education perspective that aims to evoke transformative experiences among students that eventually could bring about societal change and/or different ethical and cognitive-related learning (Yacek, 2020). Such an approach emphasizes motivating and empowering healthy and joyful learners that could allow them to decide and act on the individual, community, and global scales (UNESCO, 2021a). Thus, an educators' role in fostering transformational education should be far from developing unreflective conformity; instead, it should be close to developing critical thinking and independent judgment (UNESCO, 2015). By doing this, educators must also learn to work collaboratively with other societal actors. In other words:

> *The individual talents and abilities of teachers need to be bolstered by collaboration and support. Teachers have, and must continue to have, a central role in reconfiguring the social contract for education for our shared futures. Their abilities to do so are directly impacted by the degree to which cooperation and collaboration are woven into their modes of working.* (UNESCO, 2021b, p. 81)

This is especially true in the field of ESE, which covers an inter- and transdisciplinary set of knowledge to understand and transform global and local issues related to climate change, social and geographical disparities, conflicts, and economic reconfiguration, to name a few (Rieckmann, 2012). Given that ESE topics are not associated with a single discipline (Mulder, 2014) but, on the contrary, are inter- and transdisciplinary (European Commission, 2022), educators in ESE need to develop competences of such characteristics.

Precisely the competences approach in education offers a critical perspective that

demands a more potent relationship between knowledge and reality, thus being central to being capable of responding to the current problems and challenges of our world (Barbeito et al., 2018). But if this is vital for students, it is crucial to look deep into the educators' competences. Furthermore, according to Mulà, et al. (2017), ESE is associated with a unique set of capabilities or competences developed in the United Nations Economic Commission for Europe (UNECE) competences framework for ESE educators (see Chapter 2 for the definition of the UNECE framework), which should call educators to improve their ability delivering sustainability-related content, and especially to bring broader changes through competences such as critical reflection, participation, action, and transformative learning pedagogical strategies, to name a few.

Nonetheless, theoretical debates around the human-nature relationship in ESE exist, which shapes how competences in ESE are conceptualized. Different ideological and ethical roots that are related to various focuses of attention and representations of environmental and development issues (Sauvé et al., 2002) make it more complex to approach the idea of a single set of competences. According to Girault & Sauvé (2008), the sustainable development definition generated a conceptual discussion between Environmental Education (EE) and Education for Sustainable Development (ESD). They claim this was mainly due to the conception that ESD underlies the idea that growing development is possible. Meanwhile, EE asks for a transformation of the economic system towards a real sustainable one, a system that acknowledges the bio-physical limits of the planet and not the continuation of the development.

Furthermore, other authors (Vilches et al., 2010) state that beyond entering into the never-ending debate on choosing EE or ESD that accuses the first of reductionism and the second of defending the depredator growing, it becomes more relevant to look to what extent any effort from both EE and ESD aims to the construction of a new mentality, a new ethic, and a new praxis toward the human relationship with nature. Thus, for this thesis' purposes, I use ESE (i.e., Environmental and Sustainability Education) to refer to all efforts towards building this new understanding that connects to transformational education.

In this same line, beyond these theoretical debates surrounding ESE, it is also relevant to critically analyze the different ways in which theoretical frameworks of competences in ESE respond to various barriers and obstacles educators face toward

making ESE truly transformational. Some of these obstacles could be found inside the very structure of traditional educational models. According to Jickling, some strategies in ESE are based on educating from a sense of duty that often can turn into guilt and ultimately result in a poor motivator to transform reality (Jickling, 2013). On the contrary, education should be about "*doing the seemingly impossible, then imagination and experimentation will be infinitely more appropriate than flirting with dogma and doctrine"* (Jickling, 2013, p. 168).

Besides, Jickling (2017) has also highlighted that one of the most significant challenges that ESE is facing is the fact that it challenges education itself, especially considering how, for decades, one of the clearest goals of education was in line with ensuring a growth model that was sold as a model providing well-being for all but that the current global crisis has put into question. This raises the need for new practices, but more importantly, new perspectives reconsidering how learning and competences are recognized, validated, and assessed (UNESCO, 2015). As explained in a recent UNESCO report regarding the need to redefine the purposes of education, a particular emphasis is put on the need to embed long-term sustainability and environmental justice in the core of transformational education:

> *Education systems have wrongly instilled a belief that short-term prerogatives and comforts are more important than longer-term sustainability. They have emphasized values of individual success, national competition, and economic development to the detriment of solidarity, understanding our interdependencies and caring for each other and the planet. Education must aim to unite us around collective endeavor and provide the knowledge, science, and innovation needed to shape sustainable future for all anchored in social, economic and environmental justice.* (UNESCO, 2021b, p. 11)

In this sense and following Rieckmann (2018), ESE needs to be framed within an action-oriented pedagogy, while transformative. This means characterised by self-directed learning, participation and collaboration, orientation to the problem, and inter and transdisciplinarity. Additionally, ESE needs to carry out alliances with formal and non-formal education. Indeed, to achieve these pedagogical principles, it is fundamental to understand transformative experiences and to promote emotional engagement, relying on learning emotions such as care, empathy, and identification but also learning to deal with sadness, disenchantment, and anguish (Jickling, 2017). This also means grasping

local meanings and understanding the individuals' perspective. In other words, exploring through qualitative inquiry, which indeed has been helpful in educators' research to understand their field experiences better while shaping the theory and policies around their training (Pipere et al., 2015). Some of these ESE studies have explored the association between educators' competences and individual elements, such as educators' motivation behind engaging in ESE (Timm & Barth, 2021), as well as their challenges related to the educational context (Rauch & Steiner, 2013; Scherak & Rieckmann, 2022). Significantly, ESE educators face numerous challenges associated in dealing with socio-emotional aspects of teaching (UNESCO, 2021c), tightly related to the so-called eco-anxiety (Pihkala, 2020b), to name some that are underexplored in association with the educators' competences in ESE.

As contextual factors are relevant to compare and better understand these relations, settings with diverse ESE educators could offer a broader awareness of their needed competences. It is for this reason that the Barcelona case is examined, considering that in Spain, ESE educators work in a variety of settings, such as public administrations, companies, NGOs, and educational systems, to name some (Soto, 2007). More specifically, in Catalonia, ESE educators not only work in different formal and non-formal settings but also perform a diverse set of activities, including: *"plan and perform ESE interventions, design educational resources, provide guided visits to natural spaces, design information campaigns, and teach in a classic classroom format"* (Generalitat de Catalunya, 2020, p. 19) for which they may need different competences while experiencing diverse challenges and motivations. Thus, I find Barcelona an interesting study case to explore how these settings relate to specific competences considering their specific pedagogic challenges, but also the role of individual elements.

It is essential to highlight that the conditions to develop my thesis research dramatically changed in March 2020, when the pandemic caused by the COVID-19 virus started. Around the globe and during the first months, strict mobility restrictions, especially lockdown measures, that necessary involved education transited to an online format (Corbera et al., 2020). The use of digital technologies was familiar within ESE and within sustainability and environmental activism since we were already immersed in a complex network and information society that uses these technologies to shape policies and debates around sustainability through global networks (Huckle, 2012). Regardless of

these, there were potentially new challenges to address in ESE, where outdoor learning is particularly relevant (Carvalho et al., 2020), raising the need to explore the opportunities and difficulties experienced by ESE educators during this unusual time (Quay et al., 2020). That is why I changed my initial planning and decided to focus the last part of this thesis on exploring new debates around educators' skills to change their pedagogical means in ESE in a fast manner when the use of digital technologies was not simply an option, but the only way to continue with their teaching.

In sum, with the aim to promote more transformational education perspectives in different learning settings, this thesis navigates the competences that educators in ESE need to master. I do so according to the theoretical developments in the scientific literature and also considering how these competences are shaped in practice by intrinsic factors, such as their motivations toward ESE, as well as the teaching challenges they face in their corresponding educational setting. Part of these, included unexpected situations resulting from the global crisis, such as the forced use of technologies because of the COVID-19 pandemic lockdown.

Maybe the Mexican teacher of my story, as well as many other ESE educators around the globe, are submerged in an educational system that does not provide enough reflective spaces and tools for education to be truly transformational. We may need to rethink the competences that an ESE educator should hold to deal with the current global crisis and resulting challenging situations. The pandemic may have given us opportunities and not only limitations when it comes to pedagogic innovations to transformation. This thesis research represents an effort in this direction by trying to answer the following general research question: *How can educators' competences in ESE be strengthened to navigate toward transformational education in times of global crisis?*

1.2. Research objectives

My main objective is to contribute to the understanding of the competences that educators working in diverse ESE settings need to develop for moving towards transforming education into a more holistic and emancipatory education in the light of theoretical and practical evidence, including individual, contextual and global circumstances. This is done by analyzing the frameworks and models on educators' competences in ESE offered in the scientific literature, as well as through a case study in

Barcelona that explores the association between educators' competences and their individual and contextual elements, to finally focus on the forced adoption or adaptation to the digital technologies due to the COVID-19 pandemic and its interlinkages to educators' competences in ESE.

This thesis has three specific objectives that contribute to this overall objective and the corresponding research question:

Specific objective 1: To unravel how competences in ESE are conceptualized and defined in the frameworks and models for educators in the academic literature, and the way these promote a more transformational perspective in education.

Specific objective 2: To comparatively explore the interlinkages between those competences in ESE that educators perceive as relevant for their practice, motivations, and teaching challenges across different educational settings in Barcelona.

Specific objective 3: To analyze how educators' competences in ESE are connected to the pedagogic opportunities and challenges they experienced by the forced use of digital technologies during the lockdown period, comparing different educational settings in Barcelona.

Each specific objective has been developed through a methodological phase (as Chapter 3 explains in detail) and is linked to a specific results section (see Chapter 4). Further, the research conducted to solve the first specific objective was published in the international and peer-reviewed journal *Sustainability* (IF: 3.889, Q2) in 2020: Corres, A., Rieckmann, M., Espasa, A., & Ruiz-Mallén, I. (2020). Educators Competences in Sustainability Education: A Systematic Review of Frameworks. *Sustainability*, 12(23), 9858. https://doi.org/10.3390/su12239858

Additionally, the study related to the third specific objective *has been* accepted in the *Journal of Environmental Education* (IF: 2.957, Q2), also an international and peer-reviewed journal: Corres, A., & Ruiz-Mallén, I. (accepted). Digital technologies and the COVID-19 pandemic: opportunities and challenges for environmental educators in Barcelona. *Journal of Environmental Education*.

1.3.Dissertation structure

The thesis has six main chapters described as follows and includes six appendices with complementary data.

CHAPTER 1. The Introduction: It presents an overall idea of the research undertaken, as well as a general justification of the concept and approach of the thesis.

CHAPTER 2. Theoretical approach. It details the theoretical background linked to the theoretical and conceptual aspects underpinning this thesis.

CHAPTER 3. Methodological approach. It sets out the research design and methodology employed that, as advanced, is structured into three phases. It also provides detail on the ethical procedures followed and methodological adjustments caused by the hit of the COVID-19 pandemic.

CHAPTER 4. Results. It shows the research results of this thesis presented in three sections according to the thesis phases and specific objectives.

CHAPTER 5. Discussion. It presents the discussions raised regarding the main findings of this thesis, as well as possible methodological limitations.

CHAPTER 6. Conclusions. This last chapter summarizes the overall findings of the thesis, as well as provides insights on further research lines and implications in practice, particularly regarding educators' trainings.

CHAPTER 2. Theoretical approach

"There's no such thing as neutral education.
Education either functions as an instrument
to bring about conformity
or freedom."
Paulo Freire

2.1. Environmental and Sustainability Education: The origins.

As stated in the introduction of this thesis (Chapter 1), ESE has a variety of conceptual backgrounds. In order to understand these differences, it is necessary to comprehend how the environmental crisis has been conceived differently. According to official sources such as UNESCO (1990), the first voices alerting about the damage in the ecosystems that brought the intense process of industrialization after the second world war came from the global north. Here, acid rain started to cause forest to disappear, threatening their biodiversity and natural landscapes. As a consequence, some governments in the global north took measures to limit emissions. In the global south, the general perception among governments was that such measures were a new excuse from industrialized countries to impose more restrictions on commercial trade and limit their growth (UNESCO, 1990). Meanwhile, indigenous and rural communities across the global south increasingly mobilized and protested against extractive industries that destroy or restrict their access to natural resources, which they need to secure their livelihoods. Thus, the understandings and visions of such environmental situations were polemic and multifactorial since the beginning.

In this historical context, one of the first attempts to formulate an EE definition was from Bill Stapp in 1969, who was considered the founder of the field in the United States. He defined it as the education that *"aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to solve these problems and motivated to work toward a solution"* (Stapp, 1969, p. 34). In sum, an education seeking to increase knowledge about environmental issues emphasizes fostering positive environmental attitudes. Arias Ortega and González Gaudiano (2009) explained that EE took an international perspective within the United Nations (UN) as a socio-cultural effort to confront environmental problems and their consequences. These authors documented how there was a general agreement to develop

a worldwide education program about environmental matters by 1972 at the United Nations Conference on the Human Environment in Stockholm, Sweden. Shortly after that, in 1975, UNESCO in cooperation with the United Nations Environment Program (UNEP), started the International Environmental Education Program (IEEP). It was around IEEP that the foundation of EE began to develop, mainly through debates around its nature and different emphases (Arias Ortega & González Gaudiano, 2009).

As a result, three types of EE were categorized by Arthur Lucas in 1979, which were especially relevant for guiding the future conceptual development of the field: *I. Education about the Environment*, close to natural sciences, *II. Education in the Environment*, referring to outdoor activities (i.e., outside the classroom), and *III. Education for the Environment*, related to civic, political, and citizenship education (Lucas, 1979).

Nevertheless, there have been many theoretical debates around these categories of the human-nature relationship, including discussions about the proper name for the field. This is because the interest in EE has come from diverse streams of thought and practice, holding ideological and ethical roots related to different focuses of attention and representations of environmental and development issues (Sauvé et al., 2002). To address sustainability issues, it is necessary to discuss a wide range of topics that are related to the ways EE is conceptualized:

> *"(...)issues of sustainability involves addressing ethical questions, for instance, regarding the injustice in sharing the use of the world's resources (...) looking at issues of development, justice peace and conflict, human rights and dignity, and intrinsic value of other special, and indeed, whole ecosystems."* (Wals & Jickling, 2002, p. 223).

For instance, the mainstream terminology of Education for Sustainable Development (ESD), as the name indicates, comes from the Sustainable Development (SD) concept. The most widely accepted SD definition was formulated in the World Commission on Environment and Development, better known as Brundtland Commission: "*Sustainable Development is the development that satisfies the needs of the present generation without compromising the future generations' capacity to satisfy their own needs*" (Brundtland, 1986, p. section 49). Thus, following Sauvé (2014), ESD

originates in the UN initiative “Agenda 21”, generated at the Earth Summit in 1992. Here it was stated that the purpose of ESD is to promote sustainable development, assuming economic growth and human development as inseparable from the conservation of resources and the equitable distribution of resources (Sauvé, 2014). In this manner, the educational reforms in the 90s emphasized the worldwide political and economic project oriented to continuous, growing development (Girault & Sauve, 2008). More recent ESD efforts are reflected in the UN Agenda 2030, which contemplates 17 Sustainable Development Goals (SDGs) and emphasizes the promotion of sustainable growth through ESD in target 4.7 of goal SDG 4. More specifically, SDG 4 concerns with ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all, described within target 4.7 of this goal (UNESCO, 2017).

For Girault & Sauvé (2008), the theoretical ground around the SD has generated a conceptual discussion within the field between those advocators of the EE (as understood initially) and those of ESD, mainly due to the ESD underlying conception that sustainability can coexist in a compatible manner with economic growth. By contrast, these authors argue that EE asks for a transformation of the economic system towards a real sustainable one, a system that acknowledges the bio-physic limits of the planet and understands that economic growth is not possible anymore. Other authors (Vilches et al., 2010) state that the never-ending debate on choosing EE or ESD does not help the field to move forward and does not find any of the trends appropriate because of the reductionism of EE and the defense of growth of ESD. Moreover, more recently, post-sustainability debates have launched the idea that any form of ESE is an opportunity for enhancing ethical reflection on growth, development, and other socio-economic, political, cultural, and ecological issues shaping sustainability. It has been argued that:

> *(…) Sustainability Education does not signify an a priori image of sustainability nor defines what the education pathway towards achieving sustainability should be. Instead, it opens up possibilities for critical discussions on sustainability and suggests a process that is always in-becoming* (Le Grange, 2017, p. 96).

This thesis relies on the post-sustainability approach to contribute to the construction of a new mentality, a new ethic, and a new praxis toward the human relationship with nature (Vilches et al., 2010) that, at the same time, can offer critical perspectives toward live in sustainable ways (Huckle, 1999).

In doing this, and to avoid confusion when using EE or ESD, this thesis will refer to Environmental and Sustainability Education (ESE), which according to Jickling (2017), needs to challenge education itself. In other words, to be genuinely transformational (UNESCO, 2021a; Yacek, 2020), ESE needs to rethink the purposes of education towards cooperation, collaboration, and solidarity, where teachers' role is critical to achieving a more sustainable future, as also highlighted in a recent a UNESCO report (2021b).

2.2. Educators and Teachers Competences.

Since the 1990s decade, Jacques Delors (1996), in his UNESCO report within the International Commission of Education for the XXI century, already defined four education pillars or fundamental learnings in life. These were, in turn, identified as four kinds of key competences (Delors, 1996):

- Learn to know (to acquire instruments to understand, LtK),
- Learn to do (to be able to influence our own environment, LtD),
- Learn to live together (to participate and cooperate with others in all human activities, LtLT) and
- Learn to be (a fundamental process with elements of the other three, LtB).

More recent classifications have encompassed these key competences in three dimensions of learning (European Commission, 2022, p. 9):

- *Cognitive (relating to knowledge, understanding and critical thinking).*
- *Socio-emotional (relating to a sense of common humanity, values and responsibilities, empathy, solidarity, and respect)*
- *Behavioral (relating to skills development)*

Following this approach, contemporary education has been trying to make the transition between the understanding that learning is about acquiring specific knowledge as a result of a process of transmitting-receiving information towards constructivist and

sociocultural approaches that state that learning is a process of construction of meaning, where the social and dialogic aspects are essential (Diaz-Barriga, 2006). That is, a transition towards a competence approach in education. But when the competence approach pretends to be established as a technique prescription without conceptual reflection and theoretical framework, relying on a pragmatic and reductionist vision, competence design and evaluation are reduced to the domain of "know how to do" that is punctual and procedural, out of context, that is a way to define and register discrete and fragmented behaviors tasks (Díaz-Barriga, 2019). Furthermore, as a pedagogical perspective, competences have been criticized for having their origins in the economic sphere, as they can be seen as a way to shape our behavior as consumers within the capitalist system (Barbeito et al., 2018). Yet, these authors also argue that the idea of competence offers a critical perspective of education that demands a more potent relation between knowledge and reality and a closer connection with the different types of learning (to know, to do, to live, to be); being central, thus, to educate students to be critical citizens to respond to the current problems and challenges of our society (ibidem). In consequence, in the very core of this competence approach in education, there are elements, such as: *"self-regulated action, involving know, know to do and be, with social relevance, building situations of constructive, complex and collaborative learning towards real problem solution"* (Díaz-Barriga, 2019, p. 52).

Taking this background and evidence into account, this thesis agrees with the competence definition proposed by the European Commission (2013) in its report "Supporting teacher competence development for better learning outcomes"*:*

> *Competence is best described as complex combination of knowledge, skills, understanding, values, attitudes and desires, which lead to effective embodied human action in the world, in a domain.* (European Commission, 2013, p. 9)

This thesis is thus theoretically framed within the competence-learning approach and the transformational education perspectives, which are in line with the ESE perspective guiding this thesis. Both of these perspectives have common characteristics, such as educating students to be autonomous, critical, and active citizens, as well as that they rely on horizontality (dialog and openness toward the other), deep learning (reality understanding and transformation), and evaluation as a learning engine (Barbeito et al., 2018). Additionally, these perspectives relate with the conciliatory view of emancipatory

education (Rieckmann, 2020) and transformative learning theory (Ruiz-Mallén et al., 2022; Sterling, 2010) offer between ESE epistemological debates surrounding more instrumental vs. intrinsic/constructivist approaches. According to Vare & Scott (2008), the instrumental view of education seeks behavioral change towards sustainability and environmental participation, while the intrinsic approach places the attention on the autonomous learning process to critically examine and reflect on sustainability issues, and it does not necessarily look for a predetermined educational outcome. In agreement with the theoretical frame of this thesis, further recent and transformational views on ESE, such as the one proposed by the European Commission recently, offer such a conciliatory view:

> *"(...) as education that makes students aware of, sensitive to, and knowledgeable about the environment and its interconnectedness to social and economic systems, while encouraging them to develop attitudes of concern and motivation, as well as practical, complex systems and critical thinking skills to identify and solve environmental problems"* (European Commission, 2022, p. 7)

Having this in mind, when discussing competences within this thesis, I am specifically referring to the competences an educator in ESE needs. In this sense, back in the 1980s, UNESCO (1985) already stated that future teachers should possess adequate environmental qualities to be able to develop these in their students efficiently. These qualities comprehend knowledge, aptitudes, and attitudes that are part of the environmental sensitivity, as well as awareness and ability to conduct research and evaluate problems towards environmental action (UNESCO, 1985). Therefore, for the purpose of this research, an ESE educator could be an educator or teacher at every level of education in the formal or non-formal educational context that incorporates sustainability and/or environmental education into their educational objectives.

It has already been mentioned that being a teacher is a complex task shaped by various factors. Consequently, teachers' classroom management of knowledge, skills, and values is key (Pereira, 2019). Educators' trainings, from a competence perspective, represent a valuable tool to confidently achieve transformations since it makes learning a continuing practice where educators learn as well to adapt to a changing world (Venegas Jiménez, 2011). In other words, we cannot ask teachers to teach in a rapidly changing world where they themselves are struggling to understand it without formative spaces

since *"(...) what will be needed are ultimately competent and committed multipliers who act as change agents and not only have the wish but are able to bring about change in the different educational sectors"* (Bürgener, 2018, p. 821).

These emancipatory qualities are linked to competences (i.e., knowledge, skills, values, understanding, attitudes, and desires) that provide teachers and non-formal educators, as well as their students, with a way of both understanding complexity and transforming their realities while enabling them to make responsible decisions towards more sustainable futures (European Comission, 2013; Wals & Jickling, 2002). To develop these competences, specific pedagogical approaches are needed. Some of these are identified as:*"(...) child-centered learning, holistic approaches and head/hands/ and heart; rounded education; collaborative and active pedagogies (...)."* (Blenkinsop, 2018, p. 69) as well as *"an emphasis on personal experiences, inter and transdisciplinary, service-learning arrangement, self-organized engagement with knowledge, values and emotions; and living labs"* (Balsiger et al., 2017, p. 359). Holistic approaches, including innovative aspects related to emotional management, have shown to be of great importance in the particular case of climate change education due to considering feelings such as guilt, hopelessness, helplessness, and anger as relevant to make this education more transformational (Pihkala, 2020b).

In sum, an educator who makes ESE transformational (Yacek, 2020) frames their teaching needs within an action-oriented and transformative pedagogy characterized by elements such as self-directed learning, participation and collaboration, problem orientation, inter- and transdisciplinary work while carrying out alliances with formal and non-formal education (Rieckmann, 2018; UNESCO, 2017).

In this sense, academics and practitioners have been working on developing frameworks and models of ESE educators' competences to identify, examine, put in practice, and assess such competences needed in ESE. A review of professional development initiatives addressed to university educators in over 53 European universities, highlights that the UN Economic Commission for Europe framework (2012) identified 39 educators' ESD (See Figure 1) organized in three emphasized domains (*the need for thinking holistically*, *envisioning change* and *transforming learning systems*), as well as the four pillars of learning (*Learning to Know*, *Learning to Do*, *Learning to Live and Work Together*, and *Learning to Be*) (Mulà et al., 2017; UNECE, 2012). Some

scholars who are experts in the field of competences in ESE argue that teacher professional development in ESD *"should be informed and shaped by these competences [the UNECE competences], and support educators to develop, practice and assess them"* (Mulà et al., 2017, p. 805). Nevertheless, other models and frameworks for ESE educators have been developed. Because of the importance and usefulness of these competence frameworks in designing and developing training opportunities for ESE educators, it is relevant to analyze how the theoretical and pedagogical ground and the competences proposed to contribute to moving towards transformational education. Such motivation led to the systematic literature review of these frameworks in the first methodological phase of the thesis (see Chapter 3, *Phase I).*

Figure 1. The UNECE Competences

Note. From "*Learning for the Future: Competences in Education for Sustainable Development*, by UNECE, 2012 (https://unece.org/fileadmin/DAM/env/esd/ESD_Publications/Competences_Publication.pdf) In the public domain.

**Please note that due to an error in the original UNECE figure, the third box in the "Learning to Know" pillar of learning, is identical to that in the "Learning to do" pillar.*

2.3. Individual and contextual elements related to ESE educators' competences

Frameworks and models of educators' competences in ESE can guide their professional development by identifying, examining, and assessing the competences they need. However, my findings from the systematic review conducted in *Phase I* of the thesis (see Chapter 3 and 4 for methodological and results, respectively) shows that most of the reviewed frameworks (Albareda-Tiana et al., 2019; Bertschy et al., 2013; Cebrián & Junyent, 2015; Cebrián, 2015; De Kraker, 2017; Garcia et al., 2017; Meyer, 2017; Pipere & Mičule, 2014; Sánchez-Carracedo et al., 2018; Vare et al., 2019; Varela-Losada et al., 2018; Winter et al., 2016; Winter, 2016; Álvarez-García et al., 2019) are based in formal education contexts, more specifically in the Higher Education Institutions (HEI) sector (Corres et al., 2020). It seems, then, that there is a need to explore the applicability of these frameworks and models in non-formal settings and other educational levels different from higher education to unravel the particularities of each learning context and the needs and challenges of these educators in their teaching practice.

In this last regard, previous research on the teaching challenges educators face in ESE has shown how these challenges can result from three action fields in both formal and non-formal settings: *"1. Instruction (Classroom teaching or extramural activities), 2. Participation in the design of one's own educational institution; 3. Reaching out to society, to the institution's closer and wider environment."* (Rauch & Steiner, 2013). It is within these action fields where educators develop their teaching, where specific challenges and barriers towards achieving ESE objectives appear, but also where educators' development of competences in ESE trainings can be relevant.

Looking across these challenges, some broad institutional and social difficulties are experienced at the European level, such as the need for cross-sectorial collaboration in ESE, thus, sustainability still needs to become a cross-cutting issue in educational policies (European Commission, 2022). Similarly, this lack of cross-sectorial collaboration has been globally experienced by educators in ESE, as suggested by a recent international study (UNESCO, 2021c). The results of this UNESCO report indicate that the most profound system-level barrier to ESE teaching is the need for more ESE topics coverage in the curriculum. At the same time, overcrowded curricula can inhibit educators' ability to teach ESE. Educators interviewed in this report expressed the need for a whole-institution approach, and more involvement from the wider community,

among other demands. The whole-institution approach means that all stakeholders of the educational institution (internal and external) actively reflect and act towards a particular objective, as it could be ESE related projects (i.e., climate action) where many teachers take the lead towards its success (UNESCO, 2016).

Also, findings from the UNESCO study (2021c) evidence how teachers perceive themselves as less confident when addressing behavioral and socio-emotional perspectives than when fostering cognitive skills in their teaching practice. Hand in hand with this difficulty in teaching under a socio-emotional perspective is the so-called *'eco-anxiety'*, that is: *"anxiety and distress about the ecological crisis"* (Pihkala, 2020b, p. 1), which may represent for educators in ESE a challenge when causing feelings of helplessness, confusion, shock, and trauma (Pihkala, 2020b). It is relevant to explore the potential association between these challenges and those competences that help educators deal with emotions in both formal and non-formal educational contexts.

Additionally, case studies with educators in training have found that competences linked with the cognitive dimension of learning are prioritized over those associated with the behavioral dimension of learning. For instance, a study with school teachers in training in Vietnam (Kieu et al., 2016) found that the use of top-down teaching pedagogies instead of active and cooperative pedagogies, together with the dominance of content-based teaching, emphasized memorizing concepts rather than developing other competences. For instance, it could undermine educators' ability to promote students' participation and sense of action (behavioral dimension) (Kieu et al., 2016). A Spanish study (Varela-Losada, 2018) also found that pre-service school teachers developed poor critical thinking and action-oriented skills (Varela-Losada, 2018).

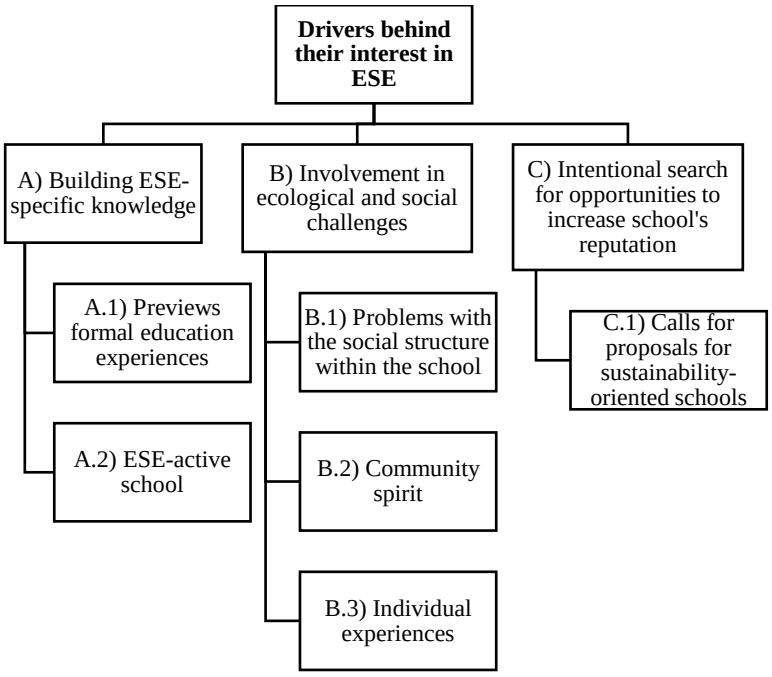
Furthermore, previous research in higher education suggests that teachers used to have a positive predisposition to teach about sustainability issues, but more than such personal motivation is needed since the development of a variety of competences is also required (Leal Filho et al., 2021). Similarly, even though they could be motivated to be trained in sustainability issues, educators need to know that some trainings opportunities are available for them (Aznar Minguet et al., 2011). A recent study in the German context around trainings to develop and assess ESE competences in higher education describes how educators were not motivated towards ESE, as well as highlights how the short training duration was a limitation to achieving a more transformative ESE at the

institution (Scherak & Rieckmann, 2022).

In this last regard, previous studies have focused on unraveling the interlinkages between educators' competences and individual factors, such as their motivations. For instance, Timm & Barth (2021) analyzed the links between different competences German school teachers in ESE perceived as necessary for their teaching and their individual dispositions. Individual dispositions were understood as their motivations or drivers behind engaging in ESE. These authors highlighted three main drivers or motivations as central to being involved in ESE, identified as: *"A) Building ESD-specific knowledge, B) Involvement in ecological and social challenges, and C) Intentional search for opportunities to increase school's reputation."* (Timm & Barth, 2021, p. 6).

As Figure 2 represents, *"A) Building ESE-specific knowledge"* refers to how knowledge regarding ESE motivated them to be more interested in engaging in ESE, which could have developed during their higher education by working at an educational institution already engaged in ESE. Then, *"B) Involvement in ecological and social challenges"* described the way other educators were motivated toward ESE, by, for instance, being actively participating in ecological or social activism, by solving environmental-related issues in their own school, by looking for a community spirit that motivates them to be involved in such action, and by their individual experiences. Finally, *"C) Intentional search for opportunities to increase their school's reputation"* referred to motivations that came from outside pressures, such as participating in an ESE-oriented call in which they saw a chance to improve the reputation of the school where they work.

Figure 2. Drivers behind educators' interest in ESE.



Note: Adapted from: "Drivers behind engaging in ESD at elementary-school level." by Timm & Barth, 2021, *Environmental Education Research*, *27*(1), 50-66. (https://doi.org/10.1080/13504622.2020.1813256) Copyright by Taylor & Francis Group.

Timm & Barth's (2021) results highlight the importance of these diverse motivations behind ESE educators' practice. However, there is neither research that analyses the role of these motivations in the case of educators working in non-formal ESE contexts nor studies looking at the way each of these motivations could be associated with a specific set of competences in ESE, which could be helpful when designing more transformational ESE competences' training plans. I try to fill these gaps in *Phase II* of the thesis (see Chapter 3 and Chapter 4, section 4.2, for methods and results) by exploring in depth the ways that educators' perceptions of the competences they see as relevant for their practice, their motivations and teaching challenges are interlinked across different educational settings through a case study in Barcelona.

2.4. COVID-19 implications to Educators' competences in ESE in the Network and Information Society.

The abrupt lockdown that most countries enacted due to the COVID-19 virus break resulted in increased use of digital technologies in many spheres of our society, and education was not the exception (Beasy & Ripoll Gonzalez, 2021). Nevertheless, the

research interest in digital technologies and sustainability issues in education and specifically within ESE (Wattchow & Brown, 2011) is not new in the context of a complex network and information society. For instance, Huckle (2012) discusses how if action is intrinsic to sustainability, digital technologies must be used for these purposes; in a way, these technologies need to be employed for debating and creating socially sustainable alternatives. Even though transformation initiates in people's ideas, digital technologies can create new networks to develop and foster such ideas (Gessen, 2012). Furthermore, these networks operating through digital technologies are not only local but mainly global, as Castells (2008) would argue on the global civil society as a global public sphere, which is especially relevant, considering environmental and sustainability issues are a global concern.

Indeed, if sustainability-related knowledge is socially constructed, thus learning from and towards sustainability can be mediated by digital technologies (Huckle, 2012). However, when the COVID-19 crisis occurred, not all educators and schools were prepared to adopt digital technologies in the way the lockdown measures provoked in the first months of the pandemic, implying a transition to online teaching and an adjustment of education activities (Corbera et al., 2020). According to the Teaching and Learning International Survey made by the Organization for Economic Co-operation and Development (OECD), this was true not only in terms of the digital technologies inadequacy and access to the Internet but also in terms of how competent educators felt to support their teaching using digital technologies (OECD, 2022). One of the reasons behind this was the need for more appropriate equipment or Internet connection, leading to a digital divide risk due to unequal access to digital technologies, as some reported (Rodrigues & Lowan-Trudeau, 2021).

A new field of research dedicated to examining the COVID-19 pandemic's impact on education emerged, opening further questions and debates (Karakose & Demirkol, 2022). In the ESE context, it becomes crucial to understand how the adjustment of educators' teaching methods and practices supported and challenged their efforts to face a double global crisis, the COVID-19 and the climate crisis, especially considering how pedagogies, such as outdoor learning, collective hands-on activities, and other experiential pedagogies, are highly relevant in ESE (Baldwin, J., et al., 2016; Carvalho et al., 2020; Higgins, 2009b; Sponarski et al., 2016). This situation reinforces the need for

reflection on the ups and downs of replacing face-to-face experiential learning with digital tools in ESE (Quay et al., 2020) while opening new debates regarding the capacity of educational systems and educators to effectively deal with the intensified use of digital technologies such as web-based tools, video games, videos, etc. (Ruiz-Mallén et al., 2021).

Certainly, there are numerous pre-pandemic studies on the use of digital technologies in ESE regarding its opportunities and challenges. A comprehensive literature review on digital technologies and outdoor learning proposed a framework (Hills & Thomas, 2019) that indicates that digital technologies such as digital cameras, GPS systems, tablets, and smartphones used in outdoor learning could be applied for different pedagogical purposes, such as location, attention, communication, information, and dissemination. These authors suggested that these digital technologies carry both threats and opportunities; for instance, a geolocation device could provide security and safety as an opportunity but also could threaten the sense of risk and adventure essential in outdoor learning. In general, they concluded, digital technologies *"(...) can distract from an outdoor experiential learning experience, but also provides opportunities to enhance learning too"* (Hills & Thomas, 2019).

In this sense, identified difficulties related to adopting digital technologies in formal ESE settings could involve educators' anxiety associated with their concern about whether their students perceive them as low-skilled using digital technologies (Fauville et al., 2014). Moreover, in non-formal ESE contexts, barriers to integrating digital technologies seem related to educators' perception of digital technologies as deterring students from engaging with nature, as a survey-based study among environmental educators worldwide revealed (Peffer et al., 2013). Other case studies enabled in-depth explorations of the reasons behind educators' skills and (de)motivations for integrating digital technologies into their practice. For instance, a qualitative research on an ESE course in a UK primary school showed how Augmented Reality helped teachers make content more accurate and accessible to their students; also, these teachers complained about the lack of flexibility of this digital technologies regarding the inclusion of their explanations and felt overwhelmed with additional tasks required by its proper implementation (Kerawalla et al., 2006).

As mentioned above, during the first months of the pandemic, the lockdown

situation required that educators in ESE adjusted their teaching methods and practices to the new learning and teaching situation. In this sense, different experiences have been reported regarding using digital technologies in ESE during the pandemic. Within the Latin-American context, ESE educators in Ecuador worked more collaboratively with their colleagues and adapted their lessons via WhatsApp or Zoom by creating educative materials for both their students and their families, to help the families to be more engaged in the children's education towards reflectiveness on the environmental hazards and possible solutions within their community (Román et al., 2021).

Within the European context, a study focused on children's environmental citizenship during the pandemic in Portugal; among their findings, they describe how after the lockdown, there was an emotional ambivalence regarding being outdoors and nature since fear of the virus was still present, yet the excitement for returning into nature appeared when measures were lighter (Rios et al., 2021). In Cyprus, Karagozlu (2021) analyzed primary school teachers' perceptions of using Augmented Reality in sustainability-related courses during the pandemic. Teachers found this digital tool highly useful for introducing new topics to the students and improving communication among them, while most of their experienced difficulties were related to technical aspects of the digital tool that needed to be solved.

Another study based in the Netherlands (Hesen et al., 2022) found that higher education students develop a sense of community and actively participate in an ESE online course with hybrid mix activities during the lockdown that explored topics such as competences in sustainability and the use of art. Within their conclusions, they explained that the positive effect this course caused among students in terms of community building was due to the need for belonging people felt during lockdown but also for the interactivity promoted where the educator created a learning environment that fostered this sense of community, too (Hesen et al., 2022).

These challenges and opportunities could be related to the competences ESE educators need to have (Mulà et al., 2017; Rieckmann & Barth, 2022; UNECE, 2012; Vare et al., 2019) included the digital competence, defined by the European Digital Competence Framework for Educators as*: "the confident, critical and creative use of ICT to achieve goals related to work employability, learning, leisure, inclusion and/or participation in society."* (Redecker, 2017, p. 90). Even though this competence

references elements of some competences in ESE that could be transversally intertwined, such as creativity or critical thinking, these interlinkages are still underexplored (Colás-Bravo et al., 2021). I try to fill this gap in *Phase III* of this study (see Chapters 3 and 4, section 4.3, for methods and results, respectively).

CHAPTER 3. Methods

"It's not the photographer
who makes the picture,
but the person being photographed."
Sebastiao Salgado

3.1 Methodological Approach

As mentioned in the introduction (see Chapter 1), this thesis was developed through three methodological phases that are structured around the three specific objectives of the thesis:

Phase I. A systematic review of frameworks on educators' competences in ESE. This phase addresses specific objective #1, aiming to unravel how the different competences proposed in the frameworks and models for ESE educators found in the scientific literature can promote transformational education. To do so, I systematically searched in the academic literature and identified existing frameworks of competences in ESE addressed to teachers and other educators and critically examined its relation to transformational perspectives in education through a content analysis. In doing so, I also identify a guiding framework to analyze data gathered in *Phases II* and *III.*

Phase II. Interlinkages between educators' competences, their motivations, and challenges across both formal and non-formal contexts. It focuses on specific objective #2, seeking to explore the interlinkages between ESE educators' perceptions of their competences, motivations, and challenges across different educational settings in Barcelona. To achieve this, I interviewed ESE educators in the Barcelona Metropolitan Area and identified those competences that the educators in a particular ESE context recognized as essential for effectively conducting their role in ESE while examining their motivations and challenges in ESE. Finally, I found quantitative and qualitative patterns to unravel the interlinkages between their motivations, challenges, and competences.

Phase III. Connections between educators' competences in ESE and the opportunities and challenges experienced when using digital technologies during the first months of the COVID-19 pandemic. This last phase corresponds to specific objective #3, which explores how educators' competences in ESE were associated with the pedagogic

opportunities and challenges they experienced by the forced use of digital technologies during the lockdown period in different educational settings in Barcelona. To do so, based on the interviews done in *Phase II*, I did a new analysis by focusing on another section of the interview guide to qualitatively identify the opportunities and difficulties that these ESE educators perceived when adopting or adapting the use of digital technologies in the first months of the pandemic, as well as how these relate with educators' competences in ESE.

3.2. Onto-epistemological and theoretical ground of methods used for data collection.

As a starting point of the PhD thesis, in Phase I, I conducted a systematic review to investigate the main approaches underlying the existing frameworks of educators' competences in ESE, the competences defined and the pedagogical strategies used to promote these competences. A systematic review is defined as *"a scientific process governed by a set of explicit and demanding rules oriented towards demonstrating comprehensiveness, immunity from bias, transparency and accountability of technique and execution"* (Dixon-Woods, 2022, p. 332). Consequently, it is a useful method for working with large amount of information and data to provide concrete responses to questions about what it is included and not in a framework or model. By using a systematic review, I could identify research gaps in the study and development of frameworks of educators' competences in ESE, on which I relied to conduct further research in the context of my thesis (Petticrew & Roberts, 2006).

In Phase II and III, I performed semi-structured interviews. (Galleta, 2013; Krippendorff, 2004). Semi-structured interviews are conversations that: *"enable researchers to maintain some consistency over the concepts that are covered in each interview […] some topics are chosen before beginning the research based on the literature or practice. However, when and how the topics are presented is not structured"* (Corbin & Strauss, 2015, p. 39).

I decided to use this method to address key different topics that needed to be discussed, such as the educators' motivations to engage in ESE or the use of digital technologies during the first months of the COVID-19 pandemic. An unstructured interview did not represent an option because these interviews are open conversations on a main topic and do not typically use predefined topics. At the same time, a highly structured interview was not useful for the purposes of this analysis since many of the topics to be discussed could come up at different times of the interview. Thus, some

flexibility during the interview contributed to gathering data on the different purposes of these two phases. In sum, semi-structured interviews were used to deeply explore the ESE educators' views of the competences they perceived as needed in their teaching contexts, their motivational drivers to engage in ESE, the challenges they face in their teaching practice, and the opportunities and difficulties experienced adopting digital technologies during COVID-19 lockdown. Regarding interview questions addressing perceived competences needed in ESE, I acknowledge that I did not directly ask the participants for having or not having a particular competence since responses could be biased due to the different understandings of the competence definition. Instead, I explored their perceptions and discourses to identify those more dominant in their interventions, which is one of the many benefits of using qualitative inquiry in general (Corbin & Strauss, 2015), and semi-structured interviews in particular (Galleta, 2022).

Overall, my PhD thesis followed a mixed methodology based on a mixed hierarchy (Azorín & Cameron, 2010). Within this hierarchy, qualitative methods used were more central to provide in-depth information on the educators' views, perspectives and motivations (Newing, 2011) while quantitative methods were used in a supportive role to understand the background information about the development of educators' competence frameworks in ESE (Morse, 1991). By following this mixed methodology, mainly relying on qualitative research, this thesis offers more profound insights into the analyzed topics and also a better understanding of the contextual and causal elements regarding educators' competences in ESE (Anderson, 2016). Specifically, in the Environmental and Sustainability Education field, the interpretative approach exists since the 1980s onward (Greenall, 1981). Furthermore, specifically these approach has also focused on teacher thinking, having its origins within the critical theory research approach, that is also grounded in emancipatory or critical pedagogy research, seeking to "empower pupils" (Huckle, 1991, p. 54). Consequently, the role of teacher becomes central in the very research methods (Gough, 2013).

3.3. Methodological Steps

In the following lines, I will present the methodological details in each of these dissertation' phases.

3.3.1. Phase I: Systematic Review

As stated, I conducted a systematic literature review (Haddaway et al., 2015) on the frameworks of educators' competences in ESE. I searched academic literature in the

SCOPUS database. I chose this database mainly due to the broad search engine that this platform offers by including specialized educational databases (e.g., ERIC). A first search was conducted in November 2019 with the following keywords: (TITLE-ABS-KEY (‘sustainab*’) AND TITLE-ABS-KEY (‘education’) AND TITLE-ABS-KEY ('framework') AND TITLE-ABS-KEY (‘competenc*' OR 'skill') AND TITLE-ABS-KEY ('educator' OR 'teacher'). I got an initial sample of a total of 169 academic publications (after removing replicates). To refine the selection, the abstract of each paper was screened according to the following inclusion criteria:

-The article focuses on education for sustainable development and/or Environmental and Sustainability Education,

-The framework is addressed to educators, and

-A framework is used and/or assessed through a training course or another intervention that is analyzed.

Through this first screening, 131 papers were discarded. The remaining 38 articles of the sample were then totally and carefully reviewed to ensure that they fully met the inclusion criteria. As a result, eight articles fulfilled the inclusion criteria, whereas 30 were discarded. In some cases, for instance, papers were excluded because no framework of sustainability competences was conceived, presented, applied, or discussed, such as in the case of Shallcross & Robinson’s article (2007) on teacher education towards sustainability that did not discuss a framework of competences. In other cases, the articles focused on curriculum changes towards ESE but without addressing the topic of educators' competences, as in the case of Husanu et al. (2017) article on the HEI’S green curriculum, but where the educators’ topic is not relevantly discussed.

When reviewing the eight selected papers, I realized that some key literature I had previously reviewed for framing the theoretical and conceptual approach of the thesis needed to be present in the sample. Therefore, I decided to broaden the search terms and include another keyword (i.e., model) in a second search in SCOPUS. I conducted this second search in May 2020 by using the following keywords: (TITLE-ABS-KEY ('sustainab*’) AND TITLE-ABS-KEY (‘education’) AND TITLE-ABS-KEY (‘model’) AND TITLE-ABS-KEY (‘competenc*’ OR ‘skill’) AND TITLE-ABS-KEY ('educator'

OR 'teacher'). I followed the same steps as those from the first search and ended up with six new articles in the sample (see Figure 3 for a complete picture of the two searches and Appendix A for discarded papers). Table 1 shows the 14 articles included in the systematic review final sample.

The two searches were in English because it is the primary language used in academia worldwide. However, I acknowledge that potentially relevant literature on the topic from non-English sources could have been excluded, which is a methodological limitation since it is possible that the systematic review does not capture the variety of frameworks published in other languages. Using the above-mentioned descriptors might have left behind different perspectives working with EE and ESD to develop sustainability-related competences in educators.

Figure 3. Summary of Data Collection.

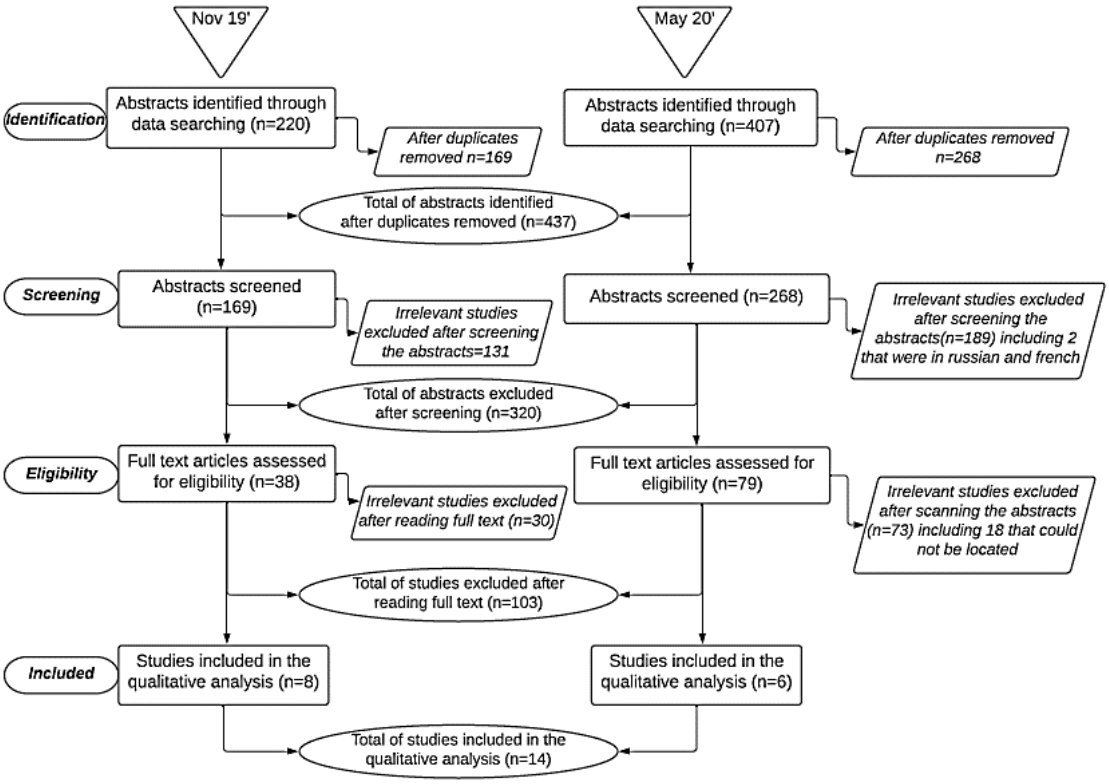


Table 1. Analyzed academic articles (*) in the systematic review.

Num.	Year	Authors, Title.
Doc.		

D1	2019	Vare P., Arro G., de Hamer A., Gobbo G.D., de Vries G., Farioli F., Kadji-Beltran C., Kangur M., Mayer M., Millican R., Nijdam C., Réti M., Zachariou A. *''Devising a competence-based training program for educators of sustainable development: Lessons learned"* (Vare et al., 2019)
D2	2017	Garcia M.R., Junyent M., Fonolleda M. "*How to assess professional competencies in Education for Sustainability?: An approach from a perspective of complexity"* (Garcia et al., 2017)
D3	2017	Meyer J., Mader M., Zimmermann F., Çabiri K. *"Training sessions fostering transdisciplinary collaboration for sustainable development: Albania and Kosovo case studies"* (Meyer et al., 2017)
D4	2016	Winter J., Cotton D., Warwick P., *The University as a Site of Socialization for Sustainability Education* (Winter et al., 2016).
D5	2019	Albareda-Tiana S., García-González E., Jiménez-Fontana R., Solís-Espallargas C., *"Implementing pedagogical approaches for ESD in initial teacher training at Spanish universities"* (Albareda-Tiana et al., 2019).
D6	2018	Sánchez-Carracedo F.S., Segalàs J., Vidal E., Martin C., Climent J., López D., Cabré J. *"Improving engineering educators' sustainability competencies by using competency maps. The EDINSOST project"* (Sánchez-Carracedo et al., 2018).
D7	2017	De Kraker J., Dlouhá J., Machackova Henderson L., Kapitulcinová D. *"The European virtual seminar on sustainable development as an opportunity for staff ESD competence development within university curricula"* (De Kraker, 2017).
D8	2015	Cebrián G., Junyent M. *"Competencies in education for sustainable development: Exploring the student teachers' views"* (Cebrián & Junyent, 2015).
D9	2013	Rauch F., Steiner R. *"Competences for Education for Sustainable Development in Teacher Education"* (Rauch & Steiner, 2013).
D10	2018	Albareda-Tiana S., Vidal-Raméntol S., Pujol-Valls M., Fernández-Morilla M. *"Holistic approaches to develop sustainability and research competencies in pre-service teacher training"* (Albareda-Tiana et al., 2018).
D11	2019	Álvarez-García O., García-Escudero L.Á., Salvà-Mut F., Calvo-Sastre A. *"Variables influencing pre-service teacher training in education for sustainable development: A case study of two Spanish universities"* (Álvarez-García et al., 2019).
D12	2014	Pipere A., Mičule I.

		"Mathematical identity for a sustainable future: An interpretative phenomenological analysis" (Pipere & Mičule, 2014).
D13	2013	Bertschy F., Künzli C., Lehmann M. *"Teachers' competencies for the implementation of educational offers in the field of education for sustainable development"* (Bertschy et al., 2013).
D14	2018	Varela-Losada M., Arias-Correa A., Vega-Marcote P., *"Training teachers committed to climate change mitigation"* (Varela-Losada et al., 2018).

(*)The order of the articles corresponds to the order in which they were found in each search: D1-D8 in Nov 2019; D9-D14 in May 2020. See the Reference section for complete references.

To analyze the collected data from the 14 selected papers, I conducted a conventional content analysis (Hsieh et al., 2005) using pre-defined categories and relying on Atlas.ti software (Table 2). A content analysis is *"a research technique for making replicable and valid inferences form texts (or other meaningful matter) to the contexts of their use"* (Krippendorff, 2019, p. 24). Following Krippendorff (2019), the use of inferences around the texts analysed are key in the process of analysis, but within the content analysis' context, these inferences are intended to be more systematic, informed and verifiable. Thus, I stand in the interpretative and constructivist approach that claims that a purely objective description of reality is not possible, but on the contrary, when describing reality the descriptions made are inseparable from the interpreter' cultural and personal background, being reality then a social construction (Sandberg, 2005).

Table 2. Codes names and description.

Code	Description
General background	Contextual or background characteristics of the reviewed studies, including country, level of education, participant's description, and research objectives.
Conceptual and pedagogical approaches to sustainability and competences.	Adopted perspectives towards the concepts of sustainability and competences within the framework or model, including if these are conceived as transformational or not.
Typology of sustainability competences	Identified types of competences included in the framework or model.

Pedagogical strategies applied to develop educators' competences in sustainability.	Pedagogical methods and activities developed when implementing and/or testing the framework or model on educators' competences in sustainability.

It is relevant to notice that the coding process of the Typology of sustainability competences was challenging because each reviewed paper used its own terminology and classification of competences in their frameworks or models. For example, while some articles identified the competences by using the terms employed by UNECE (2012) to refer to the pillars of learning (i.e., *Learning to Know*, *Learning to Be*, *Learning to Live Together*, and *Learning to Do*), other papers related these pillars to the levels of achievement of the proposed competences. For this review and to achieve a common Typology of competences, I dealt with this challenge by first identifying the competences from each framework and coding them using the terminology shown in the reviewed framework. Then, I conducted a re-coding process by merging those codes that mentioned the same idea and using the most straightforward and broadest definition, and the corresponding name of the competence for the resulting code, e.g., *Criticality* and *Critical Thinking*, were coded as *Critical Thinking*.

Further, and to enrich the analysis, I relied on the UNECE pillars of learning to establish groups of competences since even though each pillar can represent a dimension of every competence, it can also provide an idea of different learning experiences that goes from knowing to doing (UNECE, 2012). I grouped most of the coded competences into three major groups corresponding to three UNECE pillars*: 1) Learning to Know (LtK), 2) Learning to Be (LtB),* and *3) Learning to Do (LtD)* (see Table 3 for definitions). Following previous studies on educators' competence frameworks in ESE (Vare et al., 2019), the UNECE pillar of *Learning to Live Together* was considered as competence and included, as other remaining competences, into one of the following bridging groups of competences: *i) Know/Be (K/B)* and *ii) Be/Do (B/D)*. I conceived these bridging groups as those including hybrid competences that make possible the transition between two major groups or learning experiences.

Table 3. Competences groups presented as a learning experience process.

UNECE pillar group	**Definition**	**Bridging group**	**Definition**

Learning to Know (LtK)	*"A way of thinking (The educator understands…) Conceptual, factual and action-related knowledge. Need for assimilation of the interconnectivity between the individual, society and nature both locally and globally"* (Sleurs, 2008; UNECE, 2012)	**Know/Be (K/B)**	Hybrid competences represent a transition between *Learning to Know* (LtK) and *Learning to Be* (LtB)
Learning to Be (LtB)	*"A way of feeling (The educator is a person for whom…) Thinking, reflecting, weighing and taking decisions and acting are in dissociable from emotions. Emotional competency and the development of personal attributes and abilities to act independently and responsibly are indispensable for SD"* (Sleurs, 2008; UNECE, 2012)	**Be/Do (B/D)**	Hybrid competences represent a transition between *Learning to Be* (LtB) and *Learning to Do* (LtD)
Learning to Do (LtD)	*"A way of acting (The educator is capable of …) Developing practical skills and acting in relation to ESD It is the process in which all the other competencies from the other domains combine in meaningful creations, participation, and cooperation. The individual accepts freedom as responsibility, coexistence as a model for moving towards democracy and action as a vehicle for social, environmental, and economic transformation."* (Sleurs, 2008; UNECE, 2012)		

This content analysis allowed me to identify: a) the backgrounds of the analyzed frameworks, b) the conceptual and pedagogical approaches towards *sustainability* and *competences* behind them, c) the different types of educators' competences included and particularly those addressed to promote transformational perspectives, and d) the pedagogical strategies applied to develop them.

3.3.2. Phase II: Interviews and first content analysis.

I developed a study case in the Barcelona Metropolitan Area, an urban area in Catalonia, Spain, centered in Barcelona city, with a population of about four million people (Àrea Metropolitana de Barcelona, 2022). As argued in Chapter 1, Barcelona is a

proper case study to address this objective because of the diversity of ESE educators that could be found in the Barcelona Metropolitan Area, considering that in Spain, ESE educators work in a variety of settings such as public administrations, companies, NGOs, and educational systems, to name some (Soto, 2007). As mentioned above, the Barcelona case study followed a mixed methodology based on a mixed hierarchy (Azorín & Cameron, 2010), with a predominance of qualitative methodology (Morse, 1991).

To establish the sample, I followed a snowball technique (Corbin & Strauss, 2015; Newing, 2011), so I contacted educators who previously met at conferences and local ESE events by following these selection criteria: 1) experienced formal and non-formal ESE educators in the Barcelona Metropolitan Area, and 2) working with young people from 13 to 29 years old (secondary to higher education ages). After interviewing them, I asked them to provide contacts from other ESE experts. I repeated this process until reaching the saturation point, that is when I found similar elements in answers and decided to stop collecting data (Corbin & Strauss, 2015; Newing, 2011). A total of 18 key educators working in ESE were interviewed, 7 male and 11 female (see Table 4 for their socio-demographic characteristics).

Table 4. Interviewees' socio-demographic information.

Category	Subcategory	Formal setting	Non-formal setting
Gender	Female	5	6
	Male	5	2
Institution	Secondary Education	3	0
	Higher education	7	0
	NGO/Private organization	0	4
	Public organization	0	4
Experience	Professor/Educator	10	8
	Voluntary in Education	2	2
	Administrative tasks in education	5	3
	Research	3	3
	Science Dissemination	2	3
Discipline Studied	Social and Economic Sciences	3	3

	Natural and Environmental Sciences	8	4
	Pedagogical Sciences	3	5
Discipline in teaching content	Social and Economic Sciences	10	7
	Natural and Environmental Sciences	10	8
	Engineering/Technology	3	4
	Pedagogical Sciences	2	5

I designed an interview guide for both *Phases II* and *III* and piloted it with two local experts in ESE and qualitative research. I then improved and refined the questions based on their feedback. The resultant interview guide for *Phase II* (Appendix B, section 1) consisted of three groups of questions related to the main research topics: I) the educators' perceptions of the competences they need for ESE teaching, II) the educator's motivations behind their interest in engaging with ESE III) the challenges faced by educators in ESE.

From January to March 2021, I conducted online interviews due to the COVID-19 restrictions in Spain. I used the Google Hangouts tool. Interviews lasted around 50 minutes (the shorter ones lasted half an hour, the more extended one hour and ten minutes) and were recorded (only audio) and transcribed. I obtained the participants' previous informed consent (oral and written). Interviews were transcribed and analyzed using the Atlas.ti Software to systematically identify parts of the interview that correspond to different analytic categories but also to quantitatively consider the relevance of specific codes in doing our analysis. In doing so, three groups of deductive codes were defined and employed (Corbin & Strauss, 2015) according to the research objectives. Overall, this analysis considered the learning setting (formal and non-formal) as a variable of analysis.

The primary role of the qualitative methodology in this analysis follows the rationale of focusing on the understanding of educators' field experiences, which is critical in ESE research on educators' competences since it provides evidence that allows to grasp local meanings and understand the individuals' perspective, that is, exploring under qualitative inquiry (Pipere et al., 2015) and under the interpretative and constructivist approach previously described (Sandberg, 2005).

To examine my data first, I analyzed the competences educators perceived as needed for their teaching using the *'A Rounder Sense of Purpose'* (RSP) competences framework (Millican, 2022; Vare et al., 2019). It was decided to use this framework guided by the conclusions of *Phase I* of this thesis (Corres et al., 2020). Mainly, those conclusions indicating it was the framework developed considering a wider diversity of educators' profiles and educational settings (e.g., formal, non-formal, early childhood-higher education, different EU countries). Inspired by the 39 competences of the UNECE framework (2012), the RSP framework envisions a total of 12 competences for ESE educators (see definition of each competence in Table 5). Each competence comprises verifiable learning outcomes for the students (*Learning Outcomes)* and information on what abilities the educator needs to support students in achieving the intended learning outcomes *(Underpinning Components of the Educator)* (Vare et al., 2019).

Table 5. The RSP framework of competences for ESE educators.

Competence name	Definition
Systems	The educator helps learners to develop an understanding of the world as an interconnected whole and to look for connections across our social and natural environment and consider the consequences of actions.
Attentiveness	The educator helps learners to understand fundamentally unsustainable aspects of our society and the way it is developing and increases their awareness of the urgent need for change.
Transdisciplinarity	The educator helps learners to act collaboratively both within and outside of their own discipline, role, perspectives and values.
Criticality	The educator helps learners to evaluate critically the relevance and reliability of assertions, sources, models and theories.
Futures	The educator helps learners to explore alternative possibilities for the future and to use these to consider how behaviors might need to change.
Empathy	The educator helps learners to respond to their feelings and emotions and those of others as well as developing an emotional connection to the natural world.
Creativity	The educator encourages creative thinking and flexibility within their learners.
Responsibility	The educator helps learners to reflect on their own actions, act transparently and to accept personal responsibility for their work.

Participation	The educator helps learners to contribute to changes that will support sustainable development.
Values	The educator develops an awareness among learners of how beliefs and values underpin actions and how values need to be negotiated and reconciled.
Action	The educator helps the learners to take action in a proactive and considered manner.
Decisiveness	The educator helps the learners to act in a cautious and timely manner even in situations of uncertainty.

Note: Adapted from "A Rounder Sense of Purpose: Competences for educators in search of transformation", Millican, R. In P. Vare, Lausselet, N., Rieckmann, M. (Ed.), *Competences in education for sustainable development. Sustainable development goals series.* (35-43), 2022, Springer. (https://doi.org/10.1007/978-3-030-91055-6_5) Copyright by Springer.

I did this coding by considering each RSP educators' competences and its corresponding *Learning Outcomes* and *Underpinning Components of the Educator* (See Appendix C). Some coding came from parts of the interview coming from direct questions about which kind of competences would be necessary for their teaching role**.** Other coding came from parts of the interview that corresponded to questions indirectly addressing the competences perceived as essential for their role when talking about their pedagogical practice, reflections, and other topics**.**

To find quantitative patterns that complemented the qualitative analysis regarding the perceived relevance of competences in ESE, I generated a list of codes including the number of times each competence appeared in the interviews in each educational context (formal and non-formal) (See Appendix D).

Second, to analyze the motivations behind the interest of educators in teaching ESE, I generated five codes (Table 6) inspired by Timm & Barth's (2021) previous categorization of motivations and drivers towards ESE.

Table 6. Motivations and drivers towards being interested in ESE.

Timm & Barth's driver	**Definition**	**Motivation code used in the analysis**

Existing or increasing their knowledge about environmental and sustainability issues, generated by their own studies	Individuals build their knowledge about environmental and sustainability issues during their studies (e.g., university, postgraduate studies).	*Studies*
Existing or increasing their knowledge about ESE issues, generated by working at an educational institution engaged in ESE.	Individuals build their ESE knowledge while working at an educational institution already engaged in ESE.	*Working Institution*
Involvement in ecological and social challenges within the educational institution	Individuals observe these kinds of problems and begin to act due to empathetic involvement (e.g., use of plastics in the school diner)	*Participation in working Educational Institution*
Involvement in ecological and social challenges within individual experiences	Individuals reflect on their personal experiences connected to ESE issues (e.g., experiences abroad with people living in much poorer conditions and highly dependent on local natural resources, strong personal relationships in the ESE community that make them feel comfortable).	*Participation in non-institutional experiences*
Intentional search for opportunities to increase school's reputation:	Individuals learn about calls for sustainability-oriented educational institutions and see them as an opportunity to improve their institution's image.	*Institution reputation*

Note: Adapted from: "Drivers behind engaging in ESD at elementary-school level." by Timm & Barth, 2021, *Environmental Education Research*, *27*(1), 50-66. (https://doi.org/10.1080/13504622.2020.1813256) Copyright by Taylor & Francis Group.

Then, to analyze the relationship between these motivations and drivers with the competences in ESE, I used the RSP framework (Millican, 2022; Vare et al., 2019) to also code those responses from the interviewees that corresponded to questions on their motivations but that indirectly addressed the competences they perceived as essential. For instance, within the different parts of the interviews coded under the motivation *Studies*, I look for elements in those quotations (of parts of the interview) related to each 12 RSP competences proposed in theory, such as *Systems*).

I looked for quantitative patterns that could enrich the analysis of the more relevant motivations among ESE educators and their relation to ESE competences. Using Atlas.ti and MS Excel, I generated a list of codes that included the number of times each quotation was coded under a specific type of motivation but also coded under a competence in each educational setting (see Appendix D).

Third, to code educators' answers regarding the challenges faced in ESE, I used and adapted the three action fields within the ESD educators' practice defined by the KOM-BiNE model (Rauch & Steiner, 2013; Rauch, 2008). The KOM-BiNE model (Competences for ESD in Teacher Education) was chosen since it was the only framework reviewed in *Phase I* that emphasized contextual elements regarding ESE educators' competences, which the authors named fields of action. I thus generated and defined three codes (See Table 7) that corresponded to each action field *"Instruction (i.e., classroom teaching or extramural activities), Institution (i.e., participation in the design of one's own educational institution) and Society (i.e., reaching out to society, o the institution's closer and wider environment)"* (Rauch & Steiner, 2013, p. 16).

Table 7. Fields where educators perceived challenges.

Rauch et al., 2008 ESD educators' action fields	**Definition**	**Challenge code used in the analysis**
Instruction	Challenges located in the teaching (i.e., challenging didactic situations during class, being this onsite, online, outdoors, etc.)	*Instructional challenge*
Institution	Challenges located in the educational institution that harm ESE objectives (i.e., the	*Institutional challenge*

	school lacks institutional support for ESE initiatives)	
Society/Community or the closer and broader community	Challenges located outside of the instruction and institution, to the detriment of the ESE objectives (i.e., families that are against ESE)	*Community challenges*

Note: Adapted from "Competences for education for sustainable development in teacher education", by Rauch, F., & Steiner, R., 2013, *CEPS Journal*, *3*, 9-24. (https://doi.org/10.25656/01:7663) Creative Commons License.

Subsequently, I analyzed the links between these challenges and the competences using the RSP framework (Millican, 2022; Vare et al., 2019) to code the same interview extracts (or quotations). For instance, a quote describing a difficulty coded under 'Community challenge' could also be coded under a competence such as *Transdisciplinarity*.

I used Atlas.ti and MS Excel to find quantitative patterns to guide my analysis of how these challenges relate to their competences. I, thus, generated a list that included the number of times each quotation was coded under a specific challenge type and which also was coded under a competence. I sorted this by educational setting (see Appendix F).

Finally, I quantitatively analyzed the interlinkages between educators' competences and motivations, as well as their competences and challenges. At the same time, I also relied on the qualitative data generated in previous analyses to complement these results. For instance, even though educators from both settings quantitatively emphasized more a particular competence, there were qualitative differences in the way they mentioned that competence during the interviews. The same was true for their motivations and challenges. As a result, I generated new evidence on the interlinkages between ESE educators' perceptions of their competences, motivations, and challenges across different educational settings in Barcelona.

3.3.3. Phase III: Interviews and second content analysis.

Having in mind specific objective #3, which aims to analyze the ways educators' competences in ESE were associated with their perceived pedagogic opportunities and

challenges experienced by the forced use of digital technologies during the lockdown period, I also relied on the case study in Barcelona using a mixed methodology, in particular a mixed hierarchy (Azorín & Cameron, 2010).

Even though the method used was the same as in *Phase II*, I used other questions in the semi-structured interview guide for this analysis (See Appendix B, Section 2). The sample of interviewees slightly varied from the previous analysis since I used a sample of 17 out of the 18 educators participating in *Phase II* (See Table 8 for socio-demographic data). The one I excluded from this analysis did not meet the selection criteria because s/he did not teach during the pandemic. The selection criteria were the following; 1) experienced formal and non-formal ESE educators, 2) working with young people from 13 to 29 years old (secondary to higher education ages) who did not stop their teaching during the pandemic lockdown. I followed a snowball technique until saturation point was reached, as described in *Phase II* (Corbin & Strauss, 2015; Newing, 2011).

Table 8. Interviewed ESE educators' socio-demographics traits involved in *Phase III*.

Socio-demographic category	**Subcategory**	**Formal setting[1]**	**Non-formal setting[2]**
Gender	Female	5	6
	Male	4	2
Institution	Secondary school	3	0
	University	6	0
	NGO/Private organization	0	4
	Local government educational services	0	4
Disciplines involved in teaching content	Natural and Environmental Sciences	10	8
	Social Sciences and Economics	9	7
	Engineering and Technology	3	4
	Pedagogy	2	5

[1]*Institutionalized, recognized, and regulated by the national authorities to obtain an official certificate or degree.*

[2]*It could be institutionalized but not necessarily provides an official certificate or degree; it could be seen as a complement to formal education in a person's lifelong learning.*

As mentioned above, I used the interviews conducted from January to March 2021 to gather data from different questions on how the educators used digital technologies before the pandemic, their difficulties and opportunities experienced during the pandemic, and their ESE competences potentially related to these experiences. I did not ask for specific competences directly; instead, I asked how they perceived these experiences and found, within their discourses, potential connections with their competences as ESE educators.

I employed the Atlas.ti software to identify systematically parts of the interviews that corresponded to the analytic, pre-defined categories as synthesized in Table 9 and described as follows:

-the period educators were referring to within their narratives,

-the frequency of digital technologies used before the pandemic,

-the digital tools employed during the lockdown,

-the difficulties and opportunities that educators experienced when employing digital technologies,

-the educators' competences in ESE associated with these opportunities and challenges.

Table 9. Codes used in the analysis.

Codes	Sub-codes	Definition
Period	*Pre-pandemic*	Before the pandemic
	Lockdown	During the lockdown (first three months of the pandemic)
	New normality	After the lockdown
Previous use of digital technologies	*Primary Tool*	Educators did asynchrony online teaching.
	Complimentary use of Tool	Educators used digital technologies to complement their teaching.
Digital technologies used	*Digital cartography*	Software of geolocation (e.g., Google Maps)
	Digital games	Digital games (e.g., Skribbl)
	Virtual tours	Simulation of an existing location

	Videoconferencing Platforms.	Videoconferencing software (e.g., Zoom)
	Videos	Software to create or reproduce videos (e.g., Movie Maker, YouTube)
	Digital Presentations	Presentation software (e.g., MS PowerPoint)
	Social Media	Digital social media (e.g., Instagram)
	Infographics	Software to design infographics (e.g., Canva)
	Learning management platform	Learning management platforms (e.g., Moodle, virtual campus)
	Emailing	Email software (e.g., Gmail)
	Digital Fabrication	Design and production where digital data drives manufacturing equipment *(*e.g., 3D printing)
Difficulties		Educators perceived difficulties when using digital technologies in their teaching during the pandemic.
Opportunities		Educators perceived opportunities when using digital technologies in their teaching during the pandemic.
Educators' competences in ESE		The educator, through the ESE educators' competences (Vare et al., 2019) (see Table 5), uses digital technologies in a confident, critical and creative fashion (Redecker, 2017).

For the last code, and to follow the same rationality as in the previous analysis, I relied on (Millican, 2022; Vare et al., 2019) ESE competence framework: *A Rounder Sense of Purpose* (RSP). For analytical purposes, these ESE competences were transversally intertwined with the digital competence, as understood by the European Digital Competence Framework for Educators (Redecker, 2017).

3.4. Ethical considerations

The Ethical board of the Universitat Oberta de Catalunya approved the ethical aspects of this research on April 22nd, 2019. To achieve that, I filled out an application format describing this thesis' information regarding the data gathering methodology fulfilling the integrity of participants, the data storage, and analysis procedures to guarantee anonymity, among other aspects. Following the Ethical board

recommendations, I obtained participants' informed consent (oral and written) before the interviews, anonymized their testimonies, and followed all storage and data safety guidelines. For instance, to anonymize the educator interviewees, I named each document containing an interview transcribed with the letter E, standing for Educator, and an assigned number from one to eighteen, according to the chronological order of the interview (i.e., E1, E2, etc.).

3.5. Adjusts to research design due to the COVID-19 pandemic.

The most significant adjustment in my work plan I had to make was canceling my plan for a training intervention with ESE educators in Barcelona to explore the development of emotional competences, which was due to the unexpected situation and consequences of the pandemic. The possibility to do it online was still there, but due to the new research interest that came up in ESE and education in general regarding the forced use of digital technologies, it was decided to analyze this topic from the perspective of the ESE educators' competences using mainly a qualitative approach. Additionally, the interviews needed to take place in an online format since strict restrictions regarding in-person meetings were still in force by the time these took place.

I kindly appreciate the Universitat Oberta de Catalunya's support in extending the research contract for the length of the lockdown, which allowed further in-person meetings that were critical to the development and closure of this study.

CHAPTER 4. Results

"*There is a crack in everything,*
That's how the light gets in."
Leonard Cohen

4.1 Educators' competences frameworks and models in ESE

In this section, the reader will find a detailed description of the four main results of the systematic literature review I conducted in *Phase I* of this thesis. This includes the general background of the reviewed documents, the conceptual and pedagogic approaches behind the concepts of sustainability and competences, the Typology of sustainability competences identified from the frameworks, and the pedagogic strategies applied to develop educators' competences in ESE. These results were published in the following journal reference:

Corres, A., Rieckmann, M., Espasa, A., & Ruiz-Mallén, I. (2020). Educators Competences in Sustainability Education: A Systematic Review of Frameworks. *Sustainability*, 12(23), 9858. https://doi.org/10.3390/su12239858

4.1.1. General background of the reviewed documents

Table 10 shows the educators' competence frameworks and models in ESE reported in the reviewed articles, as well as the main characteristics of the research projects in which these were developed. In some cases, frameworks such as UNECE (2012) and CSCT (Sleurs, 2008) were used as a guide to developing their own frameworks, whereas in other cases, these main frameworks were directly applied without changes. Another guiding framework was the key competences in sustainability model by Wiek et al. (2011), which was first designed as a global model of converging a set of key competences to guide the design, teaching, and assessment of programs and courses in sustainability science. For some authors (Bianchi, 2020), the Wiek et al. (2011) framework has been the most influencing study on general sustainability competences.

Table 10. Frameworks and models used in the reviewed papers and related projects.

Frameworks or models used for guidance or direct implementation	Reviewed study, specific project name, territory, and research focus.
UNECE-ESD educators' competences framework (UNECE, 2012	**D1.** EU Project A Rounder Sense of Purpose (RSP) • Based on: UNECE-ESD educators' competences framework (UNECE, 2012) • Research focus: Framework design and training courses that assessed the competences **D2.** Spanish project Education for sustainability from the perspective of Complexity (CESC). • Based on Competencies for ESD teachers (CSCT) (Sleurs, 2008) and UNECE-ESD educators' competences framework (UNECE, 2012). • Research Focus: Framework design **D3.** Albania and Kosovo project Connecting Science-Society collaboration for sustainability Innovation (ConSus). • Based on: UNECE-ESD educators' competences framework (UNECE, 2012) and key competences in ESD by Wiek et al. (2011) model. • Research focus: Training that assessed competences by using existing frameworks **D4.** *Not a research project reported*-UK • Based on: UNECE-ESD educators' competences framework (UNECE, 2012). • Research focus: Training that assessed adapted competences from an existing framework. **D7.** *Not a research project reported*-European. • Based on: UNECE-ESD educators' competences framework (UNECE, 2012). • Training that assessed adapted competences from an existing framework **D12.** *Not a research project reported*-Latvia. • Based on: UNECE-ESD educators' competences framework (UNECE, 2012). • Research focus: Analysis of the relation between competences for educators in ESD of an existing framework and educators' identity (mathematics teaching). **D14.** *Not a research project reported* • Based on: UNECE-ESD educators' competences framework (UNECE, 2012) and key competences in ESD by Wiek et al. (2011) model. • Research focus: Training that assessed adapted competences from an existing framework
Competencies for ESD teachers (CSCT) (Sleurs, 2008)	**D2.** Spanish project Education for sustainability from the perspective of Complexity (CESC). • Based on Competencies for ESD teachers (CSCT) (Sleurs, 2008) and UNECE-ESD educators' competences framework (UNECE, 2012). • Research Focus: Framework design. **D9.** EU project Competencies for ESD teachers (CSCT) (Sleurs, 2008). • KOM-BiNE Competence model (Competences for ESD in Teacher Education) (Rauch & Steiner, 2013) • Research focus: Framework design and training that assessed the competences.

Key competences in sustainability by Wiek (2011)	**D3.** Albania and Kosovo project Connecting Science-Society collaboration for sustainability Innovation (ConSus). • Based on: UNECE-ESD educators' competences framework (UNECE, 2012) and key competences in sustainability by Wiek et al. (2011) model. • Research focus: Training that assessed competences using existing frameworks **D14.** *Not a research project reported.* • Based on: UNECE-ESD educators' competences framework (UNECE, 2012) and key competences in ESD by Wiek et al. (2011) model. • Research focus: Training that assessed adapted competences from an existing framework
EDINSOST (Winter et al., 2016)	**D5.** Spanish project Education and Social Innovation for Sustainability (EDINSOST). • Research focus: Training that assessed adapted competences from an existing framework. **D6.** Spanish project Education and Social Innovation for Sustainability (EDINSOST). • EDINSOST framework based but adapted to engineering programs. • Research focus: Framework design. **D10.** Spanish project Education and Social Innovation for Sustainability (EDINSOST). • EDINSOST framework based but adapted to all university levels. • Research focus: Training that assessed adapted competences from an existing framework
ESD-specific professional action competency of teachers in Kindergarten and Primary School (Sleurs, 2008)	**D13.** Switzerland project *Learning to help shape the future* (*ZMiLe* -Zukunft mitgestalten lernen-, *2013).* • Research focus: Analysis of two competences models (CSCT and ECE) and the design of a new framework.
Standards for the Initial Preparation of Environmental Educators (NAAEE, 2010) Guidelines for the Preparation and Professional Development of Environmental Educators (Yavetz et al., 2009) The Excellence in Environmental Education Guidelines for Learning K-12 (Wiek et al., 2011)	**D11.** *Not a research project reported* -Spain. • Model of environmental competencies for pre-service teachers, based on the considered components of environmental literacy (Álvarez-García et al., 2019). • Based on: Standards for the Initial Preparation of Environmental (Yavetz et al., 2009), Guidelines for the Preparation and Professional Development of Environmental Educators (Simmons, 2000), The Excellence in Environmental Education Guidelines for Learning K-12 (NAAEE, 2010). • Research focus: Analysis of the link between different personal and educational factors and the acquisition of environmental competences from a dimensional model.

Differently, some other studies employed frameworks explicitly created for different research purposes. It was the case of the EDINSOST framework (Albareda-

Tiana et al., 2018) designed by a Spanish project to define a sustainability competence map for different university degrees, to validate various didactic strategies, and to assess the training needs and sustainability competence levels among teachers and students. The framework named *ESD-specific professional action competency of teachers in Kindergarten and Primary School* (Bertschy et al., 2013) was also purposely developed by a research project in Switzerland to serve as a basis for the development of further education offers and coach for advanced professionalization of teachers in ESD.

Interestingly, all the studies reviewed were conducted in European countries: UK (D1, D4), Cyprus (D1), Italy (D1), Hungary (D1), The Netherlands (D1, D7), Estonia (D1), Spain (D2, D5, D6, D8, D10, D11, D14) Czech Republic (D7), Austria (D9), Latvia (D12), and Switzerland (D13). Most of them were developed within formal education contexts, including teacher training institutes (D1, D3-D6, D8-D11, D14), while the rest was conducted in non-formal educational settings such as learning camps (D1, D2, D7). Participants were educators in basic education (D1, D5, D8, D12, D13) and university level educators (D1, D3, D4, D6, D7, D9-D11, D14). One study did not report the level of education (D2).

Finally, I also found a study developing its own framework but using results and findings from previous projects on teachers' professionalization in environmental education. The model of environmental competencies for pre-service teachers, based on components of environmental literacy (Álvarez-García et al., 2019), was designed by using projects developed by the North American Association of Environmental Education (NAAEE, 2010), such as the *Standards for the Initial Preparation of Environmental* (Yavetz et al., 2009), *Guidelines for the Preparation and Professional Development of Environmental Educators* (Simmons, 2000) and *The Excellence in Environmental Education Guidelines for Learning K-12* (NAAEE, 2010).

4.1.2. Conceptual and pedagogical approaches behind the concepts of sustainability and competences

Interestingly, the definition of the term *sustainability* was not explicitly addressed by any of the reviewed papers. I found a similar situation with the concept of ESE but, in this case, the studies referred to different related terms from which one could infer their understanding. One of them referred to EE as an approach employed in its framework and used it exchangeable with ESD (D14). In contrast, other articles established direct links

between ESD and their approaches or frameworks (D1, D4, D7-D13). Thus, generally speaking, selected studies seemed to agree with the global vision of ESD, and often support this approach by relying on UNECE documents that are in line with the ESD concept and other UNESCO reports and European level conferences about education and sustainability.

The definition of ESD, although not explicitly present in all papers, was included in some of them by using different formulas. For instance, one of the studies (D2) referred to UNESCO's ESD approach that highlights its transformative potential toward changing individual and collective behaviors:

> *Education for Sustainable Development has the potential to empower learners to transform themselves and the society they live in by developing knowledge, skills, attitudes, competences and values required for addressing global citizenship and local contextual challenges of the present and the future, such as critical and systemic thinking, analytical problem-solving, creativity, working collaboratively and making decisions in the face of uncertainty, and understanding of the interconnectedness of global challenges and responsibilities emanating from such awareness* (UNESCO, 2015, p. 1)" (D2) (Garcia et al., 2017, p. 773).

In another case (D9) ESD was mainly understood as a powerful tool for encouraging participation and reflection*: "Education for sustainable development does not aim at changing people's lifestyles, but at empowering and encouraging people to participate in designing sustainable development and to critically reflect on their own action in this area (Künzli-David, 2007, p.30)*" (D9) (Rauch & Steiner, 2013, p. 14)

By contrast, other studies presented well-known debates about the different understandings of sustainability within an ESD perspective, its scope, and contradictions (D3, D4, D5, D6, D14). And, in doing this, some of them defended the use of ESD over EE when dealing with educators' competences (D3, D5, D6). In D3, for instance, it is argued that EE is reduced to the natural world while ESD deals with the interaction with the social one:

> *(…) while EE is focusing in preservation of the natural environment and the reduction of human impact, ESD teach awareness, skills, perspectives and values*

that will guide and motivate people to pursue sustainable livelihood, participate in a democratic society, and live in a sustainable manner (McKeown and Hopkins, 2003) (D3) (Meyer, 2017, p. 744).

Looking at the ways that the studies approached the term *competences*, surprisingly, it was found that almost half of the reviewed studies did not define this concept (D2, D4, D6, D10, D12 and D13). Papers reporting definitions included elements such as attitudes, knowledge, values, and skills or abilities (D1, D3, D5, D7, D8, D9, D11, and D14).

Regarding the links between sustainability and competences in definitions, just a few articles (D6-D8) integrated into their definition of *competence*, theoretical elements specifically related to *sustainability*, for seeing this relationship as a competence itself (*sustainability competence)* or as the final goal to be pursued *(competences towards SD).* Few articles explicitly referred to sustainability competences as professional competences (D2, D7, D13). For example, in D13, there was some concern expressed about the understanding of ESD competences for educators under a strict behaviorist approach. This article argued that the professionalization of teachers could not depend on promoting specific behaviors towards sustainable development. In only one paper, sustainability competences were defined as different from generic competences (D1). In this line, I identified two main understandings of the competences for educators in ESE among the reviewed papers. The first understanding addressed by D4, D6, and D11 conceptualized these competences as those related to generic competences that are not necessarily focused on the role of educators. This understanding was somehow linked to educators or future teachers in ESD, but overall addressed to foster environmental skills or values in a general way, that is, they could also be applied for students or any other societal actor. Some examples:

-D6: *"Participation in Community processes that promote sustainability"* (Sánchez-Carracedo et al., 2018, p. 6).

-D11: *"To engage in individual behavior that is respectful of the environment in everyday life, as well as participating in pro-environment collective actions"* (Álvarez-García et al., 2019, p. 14).

On the other hand, most of the papers (D1- D3, D5, D7-D10, D12-D14) conceptualized sustainability competences as those explicitly considering the role of educators**.** This understanding explicitly focused on knowledge, values, skills and attitudes needed for the educator in a ESE context. Some examples:

- D8: *"Manage emotions and concerns: promoting reflection on one's own emotions and as a means to reach a deeper understanding of problems and situations."* (Cebrián & Junyent, 2015, p. 2771).

- D12: *"Facilitate participatory and learner-centered education that develops critical thinking and active citizenship."* (Pipere & Mičule, 2014, p. 20).

In close relation to how educators can put these competences in ESE into practice, I identified that all of the reviewed papers adopted a socio-constructivist pedagogical perspective using a competence-based approach. In doing this, some referred to a transformative and socially critical pedagogy approach towards sustainability (D3-D10, D14), highlighting, for instance, the importance of linking the academic content to real-life problems to undertake action (D3). Other studies also embraced a holistic approach that related ESE with inter and transdisciplinary work, as well as complexity and research competences (D1-D3, D5-D7, and D10). Central pedagogical aspects in this regard also included reflection (D12, D14), collaboration (D1, D3, D7, D11 and D14) and participation (D12, D14).

4.1.3. Typology of sustainability competences identified from the frameworks.

I identified a total of 29 educators' competences across the reviewed frameworks and models in ESE (Table 11). As explained in the Methods section, for the analysis, I included into the same competence type those holding the same meaning and named by the studies in the same way, as well as those with slightly different names or without a specific name but promoting the same idea. According to the selected three learning moments or experiences represented by the UNECE pillars of learning (2012), I found that most of the competences were related to LtD (12), followed by LtB (8). In contrast, only a few were associated with LtK (3). The two bridging groups also showed notable differences in the number of the competences related to each group since only one competence was included in *K/B* and seven in B/D. Interestingly, frameworks defined some competences in broader terms without making an explicit reference to ESE, such as

in the case of *Intellectual Development* and *Scientific Thinking* in the LtK group,

Table 11. Competences name, group and definition, and the studies naming them(*).

Competence name	*Competence Group*	*Broader definition chosen*	*Study/ies and original competence name*
Intellectual Development	LtK	Putting emphasis on the intellectual development of students (D8) (Cebrián & Junyent, 2015, p. 2775)	**D8**-*Transversal competencies*[1]
Scientific Thinking	LtK	Explaining and interpreting phenomena scientifically and identifying appropriate explanations and predictions (D8) (Cebrián & Junyent, 2015, p. 2775)	**D4**[2] **D8-** *Science education competencies*[1] **D10**-*Research Comperency*[1]
Critical Thinking	LtK	Critical contextualization of knowledge establishing interrelationships between social, economic and environmental, local and/or global problems (D9) (Rauch & Steiner, 2013, p. 19)	**D1-** *Criticality*[1] **D2**[3] **D3**[2] **D4**[2] **D5-** *Sust1*[1] **D6-** *C1*[1] **D7**[2] **D8**[2] **D9**[2] **D10-** *Sust1*[1] **D11**-*EC5*[1] **D12**[2] **D13**[2] **D14**[2]
Connections	K/B	To know the main concepts and principles in connection with the Earth as a biophysical system and in connection with the relationships and interactions between society and the environment (D11) (Álvarez-García et al., 2019, p. 4)	**D1**-*Systems*[1] **D2**[3] **D4**[2] **D5**[2] **D8**[2] **D10**-*SC1*[1] **D11**-*EC1/EC2*[1] **D13**[2] **D14**-*Systems Thinking*[1]
Futures	LtB	It offers ways of addressing and helping to shape the future […]. It enables individuals to recognize	**D1**[3]

		relations and possible evolutions between past, present, and future and envision possible or thinkable futures alternatives and their impact (D1) (Vare et al., 2019, p. 10).	**D8**-*Future /alternative scenarios visioning*[1] **D9**[2] **D10**[2] **D14**[2]
Attentiveness	LtB	This competence relates to knowledge about sustainability issues while emphasizing the difference between information and understanding. Our pre-existing knowledge determines how we see the world and what we notice in our environment […] The goal of an educator is to help learners to process new knowledge explicitly and not to simply be exposed to information about the world (D1) (Vare et al., 2019, p. 11).	**D1**[3] **D12**[2] **D14**[2]
Holistic Dimension of Sustainability	LtB	It takes into account the historical perspective of sustainability, analyzes different dimensions, promotes creativity and innovation, reflects on new ways (D6) (Sánchez-Carracedo et al., 2018, p. 8)	**D3**-*Holistic approach*[1] **D5**[2] **D6**[3] **D10**[3]
Transdisciplinarity	LtB	Working towards sustainability calls for the ability to collaborate with a diverse group of people. Educators are challenged to promote this competence among their learners and model it by, for example, facilitating school-community collaborations […]. (D1) (Vare et al., 2019, p. 11).	**D1**[3] **D7**[2] **D8**-*Transversal competencies*[1]
Uncertainty	LtB	The educator works with others from a perspective of uncertainty as an ethical, social and political attitudes to seek social construction and with an open view of the future (D2) (Garcia et al., 2017, p. 777).	**D2**[3]
Emotions Management	LtB	To manage emotions and concerns: promoting reflection on one's own emotions as a means to reach a deeper understanding of problems and situations (D8) (Cebrián & Junyent, 2015, p. 2771).	**D1**-*Empathy*[1] **D8**-*Manage emotions and concerns*[1] **D9**[2] **D10**[2] **D13**[2] **D14**[2]

Learner centered	LtB	To provide student-centered education to promote the development of critical thinking, active citizenship and participation (D14) (Pipere & Mičule, 2014, p. 313).	**D7**[2] **D12**[2] **D14**[2]
Belong to nature	LtB	Fostering in students a sense of belonging to the environment (D8) (Cebrián & Junyent, 2015, p. 2775).	**D8-** *ESD competencies*[1]
Envisioning change	B/D	Meaning the time perspective for change toward sustainable development (…) understanding the reasons for unsustainable development, its actual development and also its future prospective. It also refers to motivation for learning out of those experiences and raising awareness for the need of developing shared visions among the different perspectives of scientific and societal stakeholders (D3) (Meyer, 2017, p. 749).	**D3**[3] **D9-***Visioning*[1] **D12**[2]
Learning to live together	B/D	A way of coexisting. The educator works with others in such a way that (…) norms, values, attitudes, beliefs and assumptions guide our perceptions, our thinking and our decisions and actions. Cooperation, interdependence, pluralism, understanding, equality, freedom, uncertainty as an ethical attitude all foster the move towards ESD (D2) (Garcia et al., 2017, p. 777).	**D2**[3] **D3**[3] **D5-***Sust 3*[1] **D7**[3] **D10-** *SC 3*[1] **D11-***EC 3*[1] **D14+**
Dialogue	B/D	That which facilitates acceptance and approaches multiple ways of understanding the world and promotes the exchange of ideas, cooperation, negotiation and understanding (D2) (Garcia et al., 2017, p. 776).	**D2**[3] **D7**[2] **D8-***Establish a dialogue between disciplines*[1] **D14**[2]
Networking	B/D	As one requisite competence, ESD teachers must be able to organize and moderate cooperation with non-formal educational institutions, in order to arrange for learning opportunities for pupils in and with extramural institutions (D9) (Rauch & Steiner, 2013, p. 21).	**D9**[2] **D10**[2]
Communicating	B/D	Ability without which all other areas are inconceivable. While communication is a *sine qua non* for planning, organizing and networking, it is	**D9**[3] **D10-***Research Comperency*[1]

		not a matter of course for the more individual areas (D9) (Rauch & Steiner, 2013, p. 20).	
Achieving Transformation	LtD	Related to transformation approaches in education, pedagogy and for educators and education systems in all the levels (Lk, Llt,Lb,Ld) (D3) (Meyer, 2017, p. 740).	**D1**-*Action*[1] **D3**[3] **D8**[2] **D12**[2] **D13**[2] **D14**[2]
Healthy Lifestyles	LtD	Developing habits and attitudes favorable to the promotion of healthy lifestyles, at the personal and community level (D8) (Cebrián & Junyent, 2015, p. 2775).	**D8**-*Transversal competencies*[1]
Economic Dimension	LtD	[The teacher] is capable of successfully carrying out the economic management (amortizations, fixed costs, variable costs, planning budgets, detect deviation, make a business plan) of a project (D6) (Sánchez-Carracedo et al., 2018, p. 10).	**D6**[3]
Creativity	LtD	That which generates imaginative processes that involve a specific result, be that an action, idea or object. Enables the creation of spaces for shared learning and promotes the visualization of sustainability scenarios (D2) (Garcia et al., 2017, p. 776).	**D2**[3] **D5**[2] **D6**[2] **D10**-*Competency Unit 1.2*[1] **D13**[2]
Innovation	LtD	Educators will need to reflect on their practice and renew their methods as they adapt to new situations while understanding that "new" is not necessarily better (D1) (Vare et al., 2019, p. 11).	**D1**[3] **D2**[3] **D4**[2] **D6**[2] **D8**-*Establish a dialogue between disciplines*[1]
Responsibility	LtD	[…] the educator of ESD will have a range of tools, through which to develop their learners' abilities to act responsibly. In this way, they will encourage long-term thinking about what kind of human beings we want to be and what kind of world we want to live in (D1) (Vare et al., 2019, p. 11).	**D1**[3] **D4**[2] **D6**[2] **D8**-*Transversal competencies*[1]
Social Dimension	LtD	[The teacher] takes into account the social impact (social justice, equity, diversity, transparency, gender perspective, needs of the most vulnerable	**D6**[3]

		groups, strategies against corruption) of his/her work (D6) (Sánchez-Carracedo et al., 2018, p. 10).	
Participation in Community	LtD	Participation in community processes that promote sustainability (D6) (Sánchez-Carracedo et al., 2018, p. 6).	**D1**-*Participation*[1] **D5**-*Sust 3*[1] **D6**- *C3*[1] **D8**-*Science education competencies*[1] **D10**-*Sust 3*[1] **D11**-*EC6*[1] **D12**[2] **D14**-*Interpersonal competence*[1]
Environmental Dimension	LtD	Takes into account the environmental impact (reuse, reduction, recycling, minimization of the natural resources and residues, the concept of ecological footprint) of his/her work (D6) (Sánchez-Carracedo et al., 2018, p. 10).	**D6**[3]
Applying Sustainability Values	LtD	To apply ethical principles related to sustainability values in personal and professional behavior (D10) (Albareda-Tiana et al., 2018, p. 2).	**D6**-*C4*[1] **D9**[2] **D10**-*Sust 4*[1] **D11**-*EC3 and EC5*[1] **D13**-*ESD competence aspect motivation and volition*[1] **D14**-*Normative competence*[1]
Sustainable Use of Resources	LtD	Sustainable use of resources and prevention of negative impacts on the natural and social environment (D6) (Sánchez-Carracedo et al., 2018, p. 6).	**D6**-*C2*[1] **D10**-*Sust 2*[1]
Design Educational Activities	LtD	Ability to choose possible teaching topics and to evaluate their aptitudes for ESD regarding their economic, ecological, social and cultural design as well as their relevance for sustainability (pedagogical content knowledge) (D13) (Bertschy et al., 2013, p. 5076).	**D10**[2] **D13**-*ESD competence aspect knowledge and ability*[1]

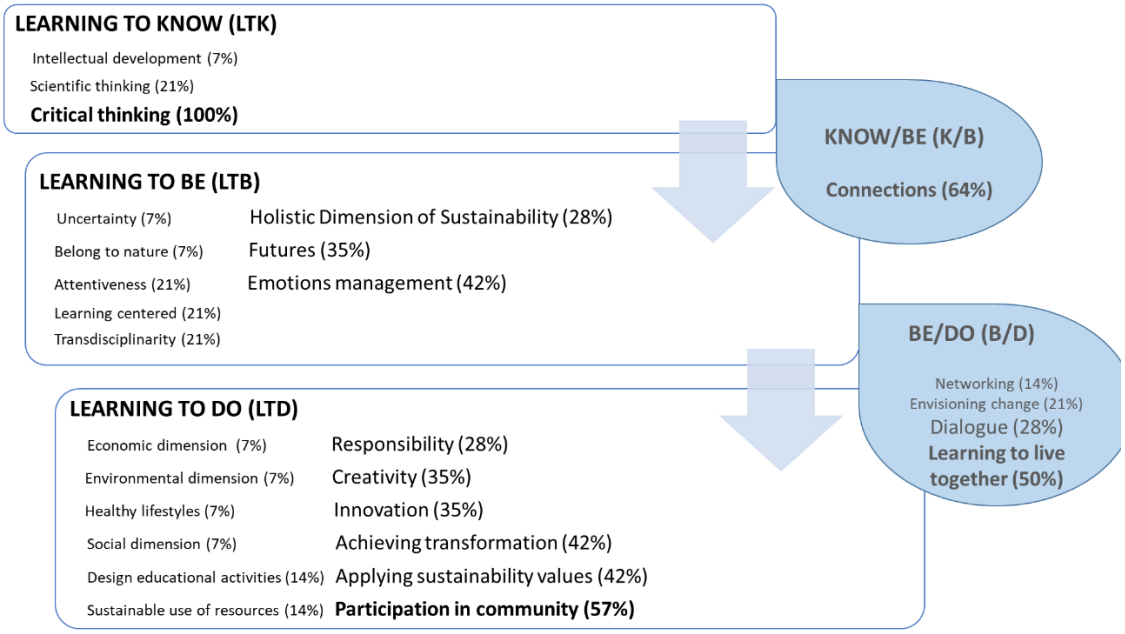
(*) Meaning of the superscript numbers next to the studies:

[1] The competence was named in a slightly different way, but the main idea agrees with the broader definition of the competence, there is an explicit indication of the original name.

[2]*The competence was not named under any particular name, but the main idea agrees with the broader definition of the competence.*
[3]*The competence was exactly named as the Typology offered.*

The most commonly mentioned competence in the reviewed frameworks and models was *Critical Thinking*, which belonged to the LtK group and was found in the 14 studies (100%). *Connections*, which was classified as a bridging competence in the K/B group, was found in nine frameworks (64%), followed by *Participation in Community*, from the LtD group, mentioned by eight frameworks (57%) and the bridging competence of *Learning to Live Together* by seven papers (50%). Also, *Emotions Management* (42%) and *Futures* (35%) from the LtB group and *Achieving Transformation* (42%) belonging to the group of LtD relatively stand out. By contrast, I found several competences in different groups that were only mentioned by one study (7%), most of them referring to specific aspects of the UNECE pillar of LtD (Mulà et al., 2017) and included in the framework of D6, such as *Economic Dimension, Social Dimension* and *Environmental Dimension.* Figure 4 offers a visual representation of the identified competences across the learning process and their quantitative presence in the reviewed studies. As mentioned above, four competences were included in most of the frameworks reviewed (between 50%-100% of the 14 studies reviewed). Nine competences were cited by 4 to 6 articles (between 30%-49% of the documents), while 16 competences were less represented since they were only found in one, two or three studies (between 7% and 29% of the total).

Figure 4. Typology of competences and percentage of their presence in the reviewed frameworks, by groups of competences.



When looking at the different types of competences included in the reviewed frameworks and models, it was often found that replicability was a topic of concern and discussion. Some studies highlighted that the framework presented, and consequently, the competences included, had been used by different institutions or in other scenarios beyond the original ones (D1 and D2). Also, they raised the concern that the additional impact of these frameworks will depend on the institutional (research-teaching) and governmental willingness to adopt and implement them (D1, D3, D5, D7). This concern relates to the challenge of how each competence will be understood, and consequently implemented, by each institution and teacher (D1). Additionally, in the case of those frameworks resulting from a crossed analysis between competences in ESE and other topics such as competences for mathematics educators (D12), complexity (D2), or research (D10), such integrative approaches were seen as a positive innovation but also required further research to be fully implemented in the field of ESE.

4.1.4. Pedagogical strategies applied to develop educators' competences in ESE.

More than half of the studies (64%) included and reflected about the pedagogical methods and activities that could be employed to promote the educators' competences in ESE addressed in their frameworks (D1, D3-D5, D7-D10, D14). These pedagogical strategies were not explicitly linked to the promotion of any particular competence, but they could be associated with the three main UNECE pillars of learning representing learning experiences (Mulà et al., 2017). Some relevant examples are presented in what follows:

-**Learning to Know**: A variety of pedagogical activities mainly addressed *Critical Thinking* and *Scientific Thinking* competences, ranging from peer discussions to planning a research project. For instance, peer discussions were implemented primarily to let educators know and reflect on the history of the field of ESE while exploring its different paradigms from a critical perspective (D4). Holding periodic peer discussions together with group analysis procedures and the planning and design of a research process through a series of guiding tasks and questions were also highlighted as useful to foster these competences among educators (D5, D10).

-**Learning to Be**: *Transdisciplinarity* and *Dialogue*, for instance, were promoted

through developing briefs for teaching sustainability by working in interdisciplinary teams of educators (D4). An artistic, pedagogical proposal was applied in the case of the competence *Apply sustainability values* for which role plays were used because of the potential of this approach to work with values, and particularly sustainability values (D14). By contrast, finding pedagogical activities to address the competence of *Holistic Dimension of Sustainability effectively* was challenging (D1, D6-D8). Exceptionally, it was highlighted that working in small groups to solve real problems was crucial for developing this competence (D10). But another study suggested that the implemented pedagogical activities to promote a holistic view of the system were not successful because teachers conferred more importance to *Learn to know* related competences than to those competences working on attitudes, values and emotions from the LtB group (D8).

-Learning to Do: Pedagogical strategies promoting competences related to *Participation in Community* and *Decisiveness* included, for instance, the provision of an authentic and real-world task in the classroom (D1), excursions with municipal bodies and other local stakeholders outside school (D3), and research projects on real sustainability problems which findings were further presented in congresses through posters. Additionally, within these projects, other actions were implemented to improve these competences among educators such as their involvement in the development of blogs, lapbooks, models of ecological information for schools, or compilations of activities in parks. In some cases, these pedagogical actions and strategies were done in international teams of educators facilitated by the use of digital technologies (D7). These active-learning strategies were found as useful in addressing real-world problems. Still, it was argued that further research should consider socio-demographic aspects when designing the pedagogical activities focused on LtD competences to contextualize them and increase their effectiveness in terms of transformation (D5).

It is worthy to notice that, in some cases, these pedagogical interventions approached the educator as a student in the hope that through experiencing and doing the activities they could replicate them in their role as educators (D3, D4, D8, D9, D10). However, these interventions did not include spaces for reflection on how the educators could relate the competences they were acquiring as students with their role as educators. Training participants could even have had problems to differentiate and recognize that the competences to be developed were for them as educators and not for their students

(D1). Only in several cases, training participants had the opportunity to reflect on their role as educators when improving their competences through the activities (D1, D5, D7, D14).

Finally, in some cases, the analyzed pedagogical interventions led educators to reflect on their role in influencing pupils' behavior and how to improve their practice towards more action-based and transformational education perspectives (D5, D7, D9, D12, D14). See, for instance, the following observations and testimonies from two studies:

> -*it is not about training children to adopt a behavior which has been recognized as correct, but about supporting them in taking decisions based on their own judgment.* (D9) (Rauch & Steiner, 2013, p. 19).

> -*(…) future teachers highlighted the importance of using motivational methodologies based on globalized approaches which favor interaction and participation, and where students go from being spectators to becoming actors (D14)* (Varela-Losada et al., 2018, p. 316).

4.2. Interlinkages between ESE educators' competences, and their pedagogic challenges and motivations.

In this section, I present my findings resulting from the analysis of the interlinkages between educators' competences in ESE and their teaching challenges and motivations. First, I show the results of the quantitative and qualitative analysis on the competences that educators perceive as needed for their teaching in ESE, and then I present the results on their motivations and challenges. Finally, results on the interlinkages between the three components are described.

These results were presented in an oral presentation format in the *11th World Environmental Education Congress: Building Bridges in Times of Climate Urgency*, which took place in Prague (Czech Republic), from March 14th to 18th, 2022.

4.2.1. Competences in ESE perceived by educators as needed in their teaching in both formal and non-formal settings.

Transdisciplinarity stood out as one of the most relevant competences for educators across both educational contexts, formal (F) and non-formal (NF), since it was the most mentioned competence in the interviews (20-F/21-NF)[1]. But the most widely mentioned competence among educators in the formal context was *Systems* (25-F/15-NF). Educators in the non-formal context also emphasized the relevance of *Participation* (15-F/20-NF). Other competences were similarly emphasized across both educational contexts: *Values* (16-F/16-NF), *Action* (16-F/16-NF), *Empathy* (16-F/14-NF), *Creativity* (13-F/14-NF), *Criticality* (11-F/8-NF), *and Decisiveness* (6-F/7-NF). By contrast, the importance given to *Responsibility* was slightly higher in formal contexts than in non-formal (11-F/6-NF) as it happens in the case of *Attentiveness* (12-F-2NF) that was much less emphasized in the non-formal setting. Finally, the competence *Futures* (3-F/0-NF) was perceived in both contexts with less relevance (Appendix D).

Qualitative data helps to understand these quantitative results. *Transdisciplinarity* was especially highlighted in both educational contexts by interviewees who referred to the need to use pedagogies to promote cooperation. Interestingly, the understanding of who should be involved in such cooperation differed between those educators in formal and non-formal contexts. At the same time, the first ones understood such collaboration only among teachers and other colleagues from the school or university, the second ones referred to seeking collaborations with other institutions. As explained by the interviewees:

"Talk with my colleagues, with the director of the program, etc., to find out a bit what they are doing in the other subjects to avoid overlaps because maybe your ideas are already being addressed in others and there will be redundancies" (*Transdisciplinarity / Formal:* E12[2]).

"(...) we work with collective organizations, we have a bag of the city needs, that we, later on, pass to the educational centers" (*Transdisciplinarity/Non-Formal:* E2).

In both contexts, educators also emphasized how to explain and deal with

[1] The total (N) is the number of times that interviewees referred to the competence in their responses. It is not based on the total number of participants.
[2] See Chapter 3, section *3.4 Ethical considerations* around the letter E use standing for Educator and an assigned number according to the chronological order the interviews took place.

complexity in their teaching, which is a key element of *Systems* competence. On the one hand, formal educators described that it is necessary for their teaching to be capable of providing more information and context when dealing with complex topics, because some ESE topics are particularly intricate and can generate more profound debates than expected. An example in an educator's words**:** *"If a student asks me more information, I need to be there, to give the student a deeper vision and to those that want to go deeper"* (*Systems/ Formal:* E11). On the other hand, educators highlighting the *Systems* competence in the non-formal context referred to the skills they need to master to provide space to understand complex information or *"digest it"* instead of focusing on giving students new information.

Moreover, and as shown by the quantitative results, the *Participation* competence was also relevantly perceived, since educators reflected on techniques and pedagogies that foster learners' engagement when being interviewed. This can be seen across both contexts when educators mentioned using project-based pedagogies to deal with sustainability-related changes in and outside the classroom and the institution. Additionally, other pedagogies related to *Participation* that turn the student into the protagonist were emphasized, as revealed by some educators that encouraged their students to share and debate their learnings at school with their families. Nonetheless, in non-formal settings more than in the formal ones, educators emphasized components of this competence when, for instance, they explained how they relied on outdoor learning strategies that involved not only being surrounded by nature but collaborating with other ESE-related organizations. To illustrate this in the interviewee's words: *"they* [students] *plant, harvest, prepare and eat those ailments within the school garden and with local farmers. They do so working service-learning activities and we accompany them for a long time"* (*Participation /Non-Formal:* E2). However, in the formal context, only one educator described using project-based pedagogies integrated in his/her teaching as an extensive practice because s/he was working in a school where ESE is transversally implemented, while the rest of formal context educators reported the use of participatory strategies occasionally in specific pedagogies developed.

Qualitative data also helps to understand why some competences received less attention during the interviews. For instance, *Futures* competence was barely referred to in the formal setting and not mentioned in the non-formal context. Only a few educators in formal ESE described using future studies techniques, such as futures simulation or

multiple scenarios with retrospective analysis through time, to help their students envision potential futures and evaluate their impacts. As stated by a participant when implementing retrospective scenarios to imagine possible futures: *"my exams always have two images with 70 or 60 years of difference. I want them to explain to me the changes in the landscape at the social, ecological and climate change levels"* (*Futures/ Formal:* E17). In the case of *Attentiveness* competence, it was referred by some educators, particularly in the formal context. They explained how they applied appealing pedagogical methods that raised students' interest and awareness of the need of urgently changing unsustainable aspects of our society, doing so promoting discussions with multiple perspectives. In a participant's words: *"you have to help them to anchor the concepts into the real world, the science we explain to them translated to their reality, to me that is indispensable*" (*Attentiveness/Formal:* E17). Thus, using teaching techniques to promote reflection about the future and to learn how changing urgently unsustainable aspects of the human-nature relationship, were not particularly emphasized by interviewed non-formal educators.

4.2.2. Motivations and drivers towards engaging in ESE

As shown in Appendix E, within formal education settings, educators' motivations were notably linked with experiences they had while studying under the Studies code back in their childhood experiences or as university students (12 quotations-Formal). As one of the interviewed teachers explained: *"I had some practices with a teacher who was able to transmit this interest to me, and from that point to now, I keep exploring this. He (the teacher) was my great master; this needs to be acknowledged"* (*Studies/Formal:* E7). Few were mentioned to be motivated concerning their involvement in activism or social movements outside an educational institution under the Participation in non-institutional experiences code (7-F*).* Meanwhile, only one formal educator reported being motivated towards ESE because the educational institution pushed him to engage in ESE (coded as Institution reputation). That is, his/her university decided to look for sustainability innovations to increase its reputation.

On the other hand, educators in non-formal educational settings were mainly motivated by engaging in previous environmental and social advocacy (Participation in non-institutional experiences code:16-Non-Formal*)*. As one educator mentioned:

"Then there was a point where we said: Let's do things for this! But we realized that we Europeans go and do things in other parts of the world, and we have a lot of work here, too. Sometimes you need to go to realize this." (*Participation in non-institutional experiences-Non-Formal:* E18).

Some others also mentioned they become motivated from previous educational experiences. For instance, several remembered a high school teacher who inspired them to become interested in biology and the environment (Studies code: 5-NF); or how having worked in an educational institution that was already ESE oriented fostered their interest in ESE (Working institution code: 2-NF*)*. An educator mentioned h/she felt motivated by trying to work towards sustainable challenges from his/her own' ESE institution, such as the lack of curriculum coverage of ESE topics, among others (Participation in working in Educational Institution experiences code: 1/NF*)*.

4.2.3. Challenges experienced by ESE educators in their practice.

By looking at the quantitative data, there was more emphasis towards Instructional (29) and Institutional (21) challenges within participants' ESE practice than Community (6) challenges (See Appendix F).

Within Instructional challenges, educators referred to their self-perceived lack of expertise to implement creative and diverse pedagogies, as well as their lack of knowledge around specific sustainability topics, such as teaching about marine species in the Mediterranean or biodiversity in the closer mountain in Barcelona (i.e., Collserola), to name some of the examples provided by educators. Some formal educators also referred to the difficulty in planning and teaching within heterogeneous backgrounds since, in occasions, their students (especially at the higher education level) came from diverse disciplines and motivations. In this sense, it was also challenging for educators in this context, to integrate into their teaching some relevant topics theoretically associated with ESE issues, such as gender topics. These teachers explained that such topics were far away from their disciplinary background, even though they were interested in knowing more about them to also be able to teach them. Descriptions from the non-formal context described environmental dilemmas experienced. For instance, an educator explained how when deciding to use plastic elements into his/her teaching, he/she considered these could

facilitate a participatory-oriented project, but also a concern was raised among he/she and their colleagues in terms of the possibility to send a contradictory message to their students.

Other Instructional challenges referred to how to deal with the lack of interest among their students in ESE-related topics. As an educator in a formal context explained: *"more and more we see that our students are disenchanted, they are not worried about anything. They are not aware of where they live, they have no will to change and transform the world" (Instructional/Formal: E6).* Educators from formal contexts described struggling with the lack of motivation among their students and complained about not being able to help them grasp ESE-related values and truly motivate them. In the case of university teachers, they also felt students suffered from a lack of basic literacy around ESE topics that prevented them from to becoming interested, as explained during the interviews:

> "*They [the students] don't have any background information about the topic, so it's difficult for them to have an opinion and propose things since they do not know them. And consequently, they don't know how to be critical or become interested" (Instructional/Formal: E5).*

In the non-formal context, some educators found it challenging to deal with students' emotions when, for instance, explaining about the future without being catastrophic or leaving them with a feeling of hopelessness. In an interviewee's words: "*to awake interest and motivation within my students, especially generate in them the will to act and do things without frustrate them, since sometimes there's almost panic when words like climatic emergency emerge" (Instructional/Non-formal: E18).*

In terms of the Institutional challenges, these were described in both contexts as related to limitations and barriers to promoting collaboration with other colleagues at their own schools or from other organizations involved in ESE. For instance, in the formal context, an educator described difficulties to carry on a whole-institution sustainability project and concluded it was because: *"my colleagues have no knowledge about sustainability" (Institutional/Formal: E16).* Other challenges mentioned at the formal settings were related to the rigidity of the curriculum and the pedagogies promoted by their institutions; as an educator explained, "*According to the curriculum, we have to*

make students memorize, for instance, the five nature kingdoms. That's a lot of memory!" (Institutional/Formal: E4). In contrast, among non-formal settings educators, these challenges were more associated with their precarious work conditions, which meant overwork and lack of time to do their pedagogic interventions properly, generating insufficient time to bond with students.

Finally, Community challenges mainly were associated with a need for more cooperation with other organizations and members of the closest community. This was explained differently across both contexts. For example, an educator from the formal context explained they should get more opportunities to collaborate with institutions, which could allow non-formal educators to teach their students complementary to the mandatory curriculum (i.e., outside school ESE educators' visitors proposing extracurricular pedagogies such as school gardening) and improve students' motivation toward environmental and sustainability issues. Also, in the formal context educators explained that some families demotivate students towards ESE by not supporting their child's environmental actions (e.g., discouraging them from using recyclable objects). Similarly, educators from non-formal settings explained how some action-based projects developed by their students did not achieve involvement from the large and closest school' community, which was necessary for the project's success and to keep students motivated. In the case of the non-formal context, this lack of cooperation was also perceived as happening among different ESE-oriented NGOs in the Barcelona Metropolitan Area since, according to them, there is a competition to win governmental budgets, causing an uncooperative spirit between them.

4.2.4. Connections between competences, motivations, and challenges.

Figures 5 and 6 show two graphical syntheses of the analyzed codes interlinked in both formal and non-formal contexts, respectively. In the center of both figures are rectangles corresponding to the twelve ESE educators' competences proposed in the *RSP* framework of educator competences in ESE (Millican, 2022; Vare et al., 2019). The thicker the rectangle is, the more quotations received that competence, that is, more perceived emphasis quantitatively. At the top of both figures are circles corresponding to the five codes for educators' motivations or drivers towards ESE (Timm & Barth, 2021). At the bottom of both figures, are triangles corresponding to the three codes of the action fields where educators perceived challenges in their practice (Rauch & Steiner, 2013).

The arrows thickness pointing to the competences from both their motivations and their challenges, represents the quantitative interlinkages between their motivations and competences (on the top) and among their challenges and competences (on the bottom). The thicker the arrow is, the more emphasis was found in the quotations number.

Figure 5. Formal context analysis.

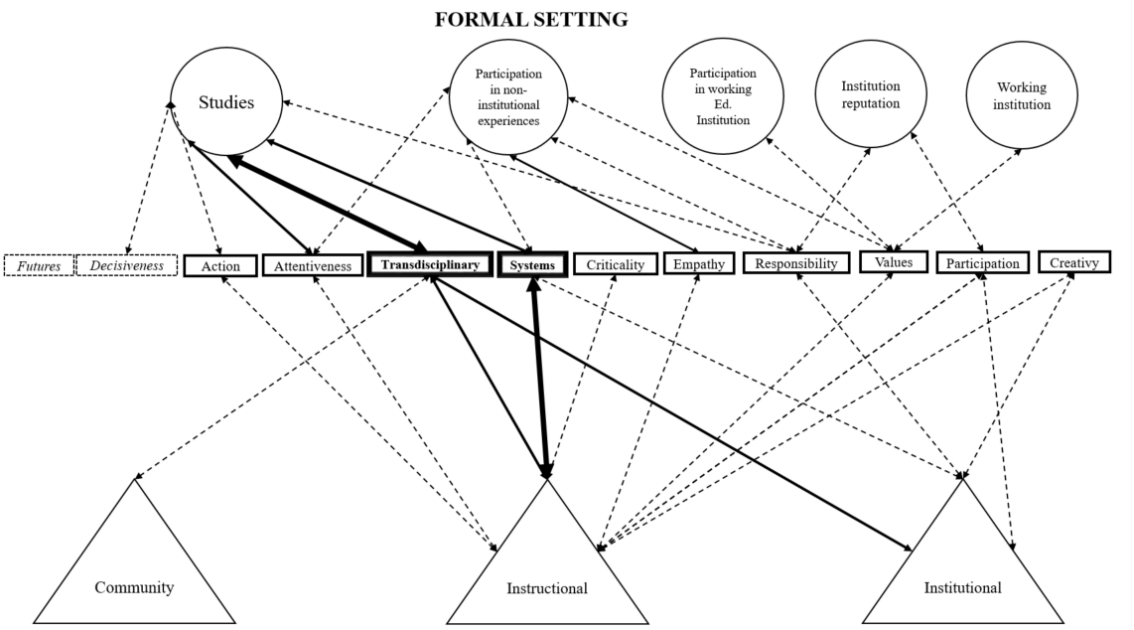
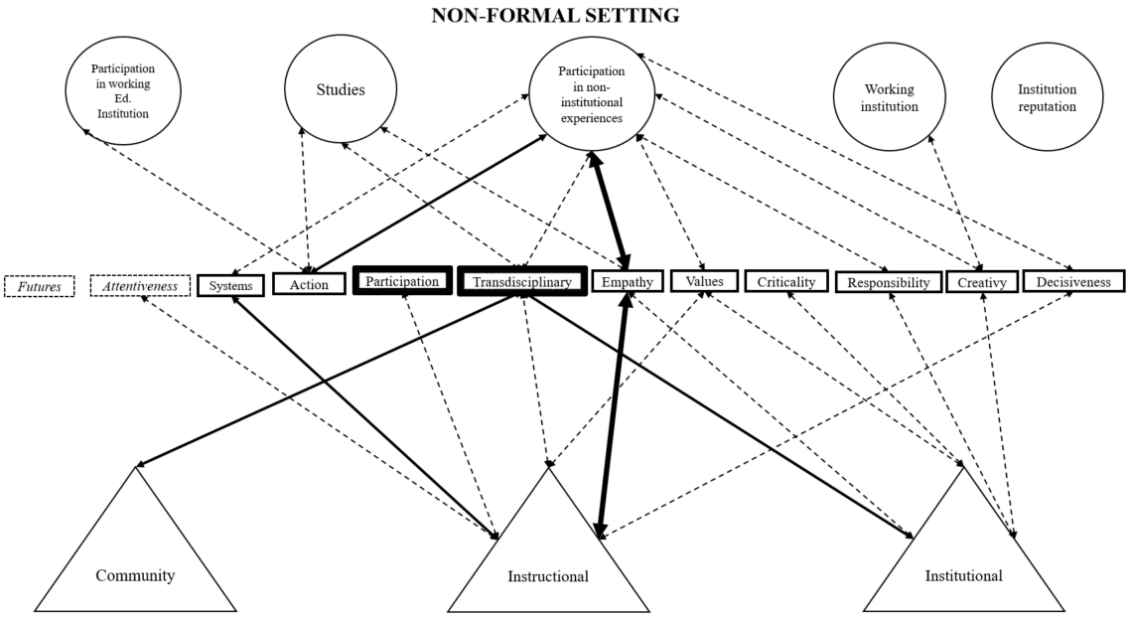


Figure 6. Non-formal context analysis



First, for the formal context (Figure 5), results show that *Transdisciplinarity* and *Systems* competences were especially emphasized as relevant by these educators (rectangles thickness). Nevertheless, these competences also strongly associated with motivations (arrows thickness link to circles) and challenges (arrows thickness link to triangles). Notably, no challenges were associated with *Futures* and *Decisiveness* competences. Neither *Futures, Creativity* nor *Criticality* were associated with their motivations.

Within formal educators' discourses around their motivations, elements of *Transdisciplinarity* competence were identified when educators referred to how they chose to study a university degree with an interdisciplinary curriculum because they thought it would be a proper space to learn about different disciplines. As seen in their narrations: *"I liked Environmental sciences the most since it was very multidisciplinary, and I like to learn in this way, a little bit of physics, math, biology, ecology, economics" (Studies/Transdisciplinarity/Formal: E17).* However, some of them also reported having trouble working with more disciplines in their teaching (Instructional), which is an essential *Transdisciplinarity* underpinning component. As explained by an educator: *"it was difficult to try to incorporate different disciplines such as art, music…" (Instructional/Transdisciplinarity/Formal: E7).* Educators also referred to Institutional barriers to working across disciplines, such as the rigidity of the curriculum) or the lack of knowledge and interest in sustainability issues among some of their colleagues. Furthermore, as the *Transdisciplinarity* competence also considers the broader collaboration with other community members, the challenges described by some educators regarding the students' families, whose lack of involvement in students' ESE projects were also linked to this competence. In sum, this competence was highly interlinked to all fields of action where educators can find challenges in this context.

Formal educators also justified their motivation for ESE because they started to become interested in understanding complex environmental problems (i.e., pollution) when studying at the university, which is in line with elements of the *Systems* competence. Even though this competence was associated to their motivations, at the same time educators referred to difficulties when teaching complexity (Instructional), an underpinning component of *Systems* competence. To illustrate this, an educator explained:

"I think the main problem is that what the students know is poor. They have no background yet and have a lot of trouble formulating an opinion and proposing anything because they don't know. As they don't know, they don't know how to be critical or have any interest. I remember once we were working around the telecommunication topic, talking about the mobiles and the problem associated with how to do these more sustainable, and I just had to drop it because it was too big for them, they did not understand what I was asking them to investigate" (Instructional/Systems/Formal: E5).

Although interviewed formal educators did not perceive *Empathy* competence as the most relevant, they did describe vital experiences outside school that motivated them in ESE. For instance, they mentioned childhood experiences near natural environments that foster their sense of belonging to the natural place and taking care for plants and animals, to name some. Yet, some educators reported having trouble to found pedagogies and strategies to grow in their students a sense of empathy and identification with nature, which are also *Empathy* competence' underpinning components.

My results regarding the non-formal context (Figure 6) also show that *Transdisciplinarity* and *Participation* competences were perceived as relevant for the educators (rectangles thickness). However, differently from the formal context, only *Transdisciplinarity* was strongly associated with their motivations (arrows thickness link to circles) and to their challenges (arrows thickness link to triangles). The competences of *Attentiveness, Criticality, Futures,* and *Participation* were not associated with their motivations reported. Notably, *Action* and *Futures* competences were not associated with challenges in the non-formal context.

Non-formal educators found their motivations to become interested in ESE in their experiences outside of school, which came from their previous hands-on experiences and contact with nature during traveling to other parts of the world or when watching a documentary that beautifully showed the Amazon jungle. These experiences are related to the underpinning components of *Empathy* competence, such as recognizing the needs of other beings beyond humankind. In this line, an educator exposed: *"when I was three years old, someone told me: why do you step on a little ant? Would you like a giant come and crush you? From that moment, I think it started my ecological awareness, I don't know" (Participation in non-formal experiences/Empathy/Non-formal: E2).* Non-formal

educators also reported several challenges interlinked with *Empathy* components, such as how to develop coping mechanisms and resilience resources to face overwhelming ESE topics. As an interviewee described:

> *"for me, the biggest challenge right now is to teach activities related to the topic in which the result is not pessimistic. Trying they come out of the class without the sensation that we are in a bad place where there is nothing we can do, but they can be hopeful; you can't just drop the bomb and leave, we have to help them see it is possible to do things, but this is difficult for me" (Empathy/Instructional/Non-Formal: E18).*

Interestingly, there were also Institutional barriers associated with developing this competence since some educators in the non-formal settings reported that lack of time, associated to their precarious work conditions, generating insufficient bonding with students, which is associated to *Empathy* competence elements.

Also, in their motivating experiences outside their formal education, educators narrated how the engagement in democratic processes in the context of sustainability triggered their interest in ESE, which is associated with elements of *Action* competence. As declared by an interviewee*: "I started to be involved in social movements, in the ecologist local movement, and that was where I learned since I was 15 years old*" *(Participation in non-formal experiences/Action/Non-Formal: E2).* Notably, they did not report challenges associated with this competence, except in the case of an educator who complained about the difficulties to truly and actively engage students in an action-oriented project.

Finally, it is interesting to notice that *Transdisciplinarity* competence was strongly linked to the challenges that non-formal educators perceived in their practice. However, differently than formal educators, these difficulties were primarily due to Institutional barriers that prevented them from work in collaboration with others. As explained by an educator:

> *"to truly fulfil the potential of our project we need someone specifically working as a communication manager that could facilitate the communication among entities, we have eleven buildings but only twenty-eight people […] the city is full*

of possibilities, I speak with someone in the urban ecology department and PUM! the light ball lights on thinking: Why don't we do this or that? The same when I speak with someone from the design and arts school, or with people from high schools, and think of many different ideas [to collaborate]" (Transdisciplinarity/Institutional/Non-Formal: E3).

4.3. Opportunities and challenges of using digital technologies during COVID-19 pandemic from a competence perspective.

The results described in this section provide evidence of the educators' pre-pandemic use of digital technologies, followed by the opportunities and difficulties they experienced when using digital technologies during the lockdown, and how these opportunities and difficulties are connected to their competences in ESE. These results will be published in:

Corres, A., & Ruiz-Mallén, I. (accepted). Digital technologies and the COVID-19 pandemic: opportunities and challenges for environmental educators in Barcelona. *Journal of Environmental Education*

4.3.1. Setting the context: Pre-pandemic use of digital technologies.

Most interviewed educators (14 out of 17) reported using digital technologies in a complementary way before the pandemic. Those within the formal context (7) described using learning management platforms only for uploading texts to be read by students before face-to-face encounters. These educators also employed digital presentations with images and videos during their lessons. One of them also encouraged students to use social media and blogs to share their thoughts on the topics learned in class. Non-formal educators (7) reported using similar digital tools during face-to-face sessions. A couple also relied on digital cartography tools (e.g., Google Maps) when visiting a natural park or implementing citizen science projects to collect and share data on plant species and air pollution smells, respectively. Another educator employed digital fabrication tools (i.e., 3D printing) to create sustainable and responsible solutions that respond to community needs in service-learning projects.

The other three environmental educators, two in formal settings and one non-formal educator, employed digital technologies as primary tools for their teaching before the pandemic. All three mainly relied on asynchronous online teaching through learning

management platforms, such as virtual campuses, which involved creating and implementing other digital tools such as virtual tours, sharing videos, and digital presentations.

4.3.2. Opportunities and difficulties faced by environmental educators when using digital technologies during the COVID-19 pandemic.

Overall, interviewees perceived digital tools as a pragmatic solution to continue teaching during the lockdown. Interestingly, those who already used digital technologies as primary teaching tools identified an increased demand for their online educational offer during the lockdown, as mentioned by a higher education professor in an online university: *"It is clear that for the university, in the short term this has meant more people enrolling, new students coming in, since within the pandemic context our institution is well valued*" (E11, F). Others, employed social media to strengthen networking and knowledge sharing within the ESE field. In the words of an NGO educator who used to organize online sessions before the pandemic: "*We decided to stop doing more online workshops [during the lockdown] and decided to give publicity to what others were doing due to the boom in online environmental education"* (E13.NF.).

Interviewed non-formal educators who used digital technologies in a complementary way before the pandemic also explained they increased videoconferencing tools and social media use as an opportunity to reach international audiences, in some cases for the first time. In the words of an educator organizing agroecology talks around service-learning projects in a public organization:

> *"this interaction through the screen [by using videoconferencing] allowed that new people from outside joined the [students'] groups. Specifically, I have seen people from Chile and Brazil that have been with them because we were able to say: Hey, why don't you join [the course]? And they joined even if it was 5 am for them. And this has been interesting, and maybe if this goes on, new groups could emerge"* (E1:NF).

Participants also adopted specific digital tools they hardly used before the pandemic and became opportunities for enhancing their teaching practice during confinement. For instance, formal and non-formal educators highlighted the pedagogical

value of videoconferencing to promote collective reflection and debates when accompanied by videos and readings, to help students to become more confident and open to participate in discussions, and to create a closeness feeling despite the physical lockdown. Some mentioned the integration of videoconferencing in their classes allowed them to continue working on participatory projects with other educational centers, despite physical interaction missing, as narrated by a formal context educator:

> "*next week our students will share a training to other students in Girona through videoconferencing. Before the pandemic, we used to go there, but now we have searched some way to do the same, maybe not with the same result, but we figure it out"* (E4: F).

Non-formal educators also referred to other digital technologies, divergent from the formal context educators, as highly useful for their teaching, such as online games, infographics, and videos, often created by them. They used these digital technologies to make content more accessible for students, motivate them to continue learning about their immediate environment, and foster collaborative learning processes with students. Consequently, many of them perceived that their digital competences improved, as the educator working with 3D printing for ESE service-learning projects and participated in creating online courses that were further used after lockdown. In his words:

> *"Even going back to normal, what we did is good for us; we created a Moodle course that gathers all the original texts [on 3D printing for local service-learning projects], (...) they [students] will have all the information they need; we are still improving it."* (E2. NF).

Another non-formal educator created a virtual tour throughout a protected area to help people connect with nature during the lockdown.

However, interviewees also detailed difficulties in their teaching practice using digital technologies during the pandemic due to socio-emotional issues. Educators who used digital technologies as a primary tool experienced challenges mainly related to their lack of skills to manage students' emotional and affective-based attitudes through videoconferencing, that resulted from the new lockdown situation. These educators explained that students were less focused because they were concerned about their

family's health, and some suffered from psychological and health problems. Interviewed educators felt they were required to be more empathetic with their students and rethink online and offline pedagogies into more appealing ways, which was quite challenging because they were not used to it. Interviewed teachers from an online university recognized they were exhausted because of such new and increasing demands.

Similar motivational challenges were reported among those environmental educators who combined digital technologies with face-to-face activities before the pandemic. For instance, some secondary and higher education teachers explained it was difficult to catch students' attention during videoconferencing with digital presentations, adding it was not possible to know whether students were paying attention to their explanations or not because many turned their cameras off.

Non-formal educators, whether they used digital technologies as primary or complementary tools before the pandemic, perceived the main difficulty was replacing face-to-face methods for digital technologies while sustaining the impact on environmental learning. A couple of them noticed videos they created to replace outdoor learning experiences did not have the same effect on students' learning as when visiting the place *in situ*. Another non-formal educator described videoconferencing platforms' limitations in replicating hands-on activities s/he used to do with students:

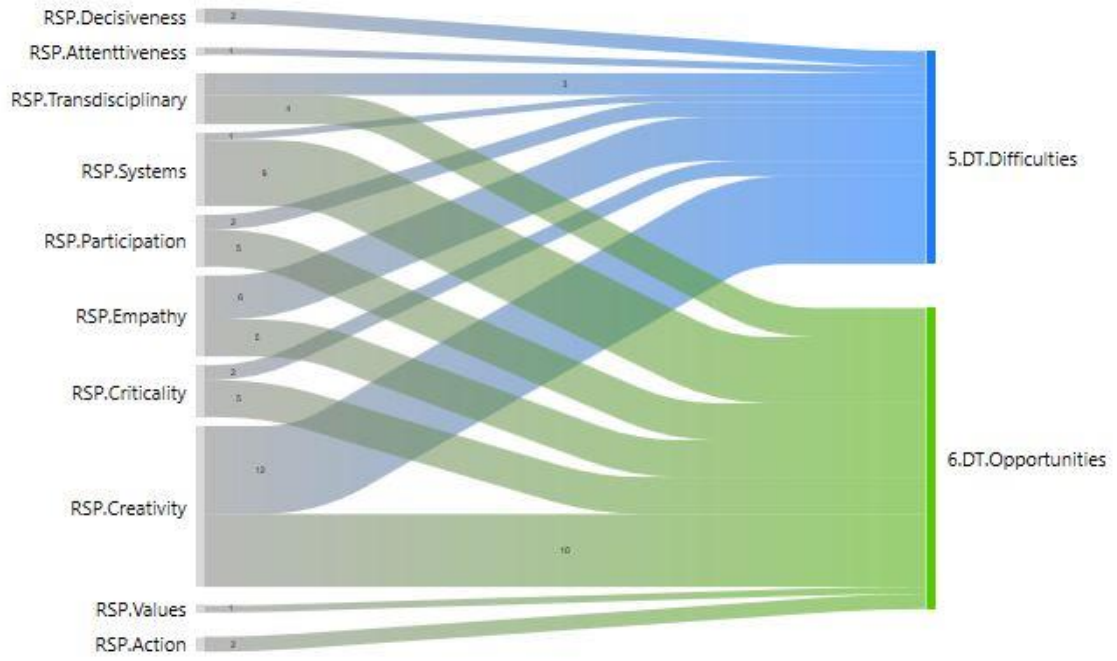
> "*the main difficulty was to adapt all of these activities that required walking in the neighborhood, to touch plants, etc., to ask them to look into their window and perceive certain elements, it loses all the sense, I don't know"* (E9.NF).

Additionally, unequal and limited access to digital technologies was also reported as a limitation by educators in public universities who highlighted some students did not have access to high-speed Internet at home or had to share equipment with other family members in the same situation, which negatively impacted on their environmental learning. Finally, a public university teacher explained the pressure to meet the curricula objectives impeded her from exploring a more diverse and engaging set of digital technologies; instead, s/he predominantly used videoconferencing and digital presentations. S/He explained: *"Not everything is a game, they have to learn what is in the syllabus, and I already had trouble learning how to use a zoom"* (E7: F).

4.3.3. How are these opportunities and difficulties interlinked with educators' ESE competences?

Ten of the 12 educators' ESE competences included in the RSP framework (Vare et al., 2019) were identified in the interviewees' discourses about the opportunities and difficulties they faced when using digital technologies for teaching during the lockdown. In this sense, the Figure 7 created with the Atlas.ti' analysis tool, shows codes' density when the ones related to their difficulties and opportunities were interlinked with the competence's codes.

Figure 7. Relation between environmental educators' perceived difficulties and opportunities when using digital technologies during the pandemic and educators' competences in ESE as identified in interviewees' discourse.



Participants' answers did not refer to two competences highly linked to the pandemic situation in terms of dealing with uncertainty and accepting new duties: *Futures* associated with educators' capability to explore alternative scenarios, and *Responsibility,* which emphasizes reflection on the impact of one's actions on the environment.

By contrast, *Creativity* was predominantly found in the educators' narratives

about the difficulties and opportunities encountered when using digital technologies during the lockdown. Particularly, non-formal educators explained they could employ digital technologies in new and creative ways when teaching sustainability-related topics while encouraging their students to do the same. They did so by utilizing various digital tools such as creating videos and infographics, using social media, and learning management platforms, and playing and creating digital games. However, some of them also recognized that replacing face-to-face activities with these tools was challenging in terms of promoting students' creativity to respond to sustainability-related issues, as an NGO educator narrated when referring to the creation of videos on biodiversity conservation that adapted storytelling methods originally used when visiting protected areas, in the educators' words:

> *"We adapted an activity that used to consist in going to the Black Tower, which is a place associated to the ecological activism history here in Sant Cugat [a municipality within the Barcelona Metropolitan Area], to do different activities. But since we couldn't go out there, we created a couple of videos that explained the story of a boy who goes there with his family to visit and discover a series of elements"* (E1: NF).

Furthermore, secondary and university teachers interviewed mainly perceived digital technologies' forced use as a barrier to implementing innovative teaching strategies to foster students' creativity in ESE. These teachers used to rely on videoconferencing and digital presentations placing students in a passive role, which they experienced as demotivating. As an educator in a secondary school described:

> *"I needed more patience, creativity, and flexibility (…) It was already difficult to catch students' attention or re-invent ourselves. But what frustrated me the most was wondering: How can I do an activity that truly touches them? Some days I achieved it through games, but most I didn't"* (E15: F)

Empathy competence was similarly found in the interviewees' discourses about perceived opportunities and difficulties when using digital technologies, which mainly was emphasized using videoconferencing. Some non-formal educators described how they employed videoconferencing to tell stories that reinforce students' connection with nature when in situ visits to natural areas were not allowed, in the educator's voice: *"We*

did story-telling activities related with the environment through videos and videoconferencing that now we keep using, it has helped us to facilitate some processes that we already had" (E8: NF). Meanwhile, school teachers were able to create bonds with their students and families through videoconferencing, as explained by a teacher: *"It was nice to create a personal bonding, since the contact with them and their families was beautiful, imagine every day I was in contact with their parents, this made me think that what I was doing was fruitful"* (E15: F). However, many also expressed barriers to using videoconferencing linked to *Empathy*. For instance, it was challenging for both formal and non-formal environmental educators to engage students actively and motivate them in learning or even keep a dialogue if they could not see their faces because students turned their cameras off or had connectivity issues.

Similarly, interviewed educators referred to the ups and downs of videoconferencing in relation to *Transdisciplinarity* competence. This tool helped school teachers encourage students to collaborate and maintain contact with previous partners. Still, environmental educators in non-formal settings explained digital technologies could not replace face-to-face interaction in fostering cooperation with other organizations as they used to before the pandemic. Nonetheless, one educator from a non-formal organization described opportunities regarding the use of videoconferencing to create new collaborations with other colleagues around the world that before the pandemic were just unthinkable, as stated by the educator:

> *"These interactions through the screen are allowing that people from the outside [of the classroom] enter. So, I specifically have seen people from Chile, from Brazil, that we have told them: 'Hey, why don't you join?'. And they join, even though its 5 am for them, they are there, present. So that has been interesting, I also think that if this thing goes on, we can generate new groups"* (E1: NF).

Competences focused on system and critical thinking (*Systems* and *Criticality*), and *Participation* were more related to the identified opportunities resulting from using digital technologies than to the perceived difficulties. As in the case of *Systems*, formal educators explained they helped students reflect and understand complex sustainability issues by preparing digital presentations with content and asking them direct questions during videoconferencing. Non-formal educators prepared infographics and digital videos to support students' understanding of the connections between social and natural

systems. In both settings, elements of *Criticality* competence were identified when educators reflected on their capability to promote critical reflection on the pandemic's environmental impacts by leading discussions through a variety of digital technologies such as videoconferencing, learning management platforms, and emailing. Linkages between opportunities using digital technologies and *Participation* competence were analyzed among non-formal environmental educators. They explained they created videos that engaged students in actively sharing experiences and ideas among potential contributions to sustainable change in their immediate environment, which were perceived as partly replacing the role of field trips. Similarly, some school teachers working with service-learning projects continue supporting students' participation by organizing videoconferencing meetings.

Notably, two ESE competences, i.e., *Action* and *Values*, were poorly addressed when environmental educators referred to the perceived opportunities in using digital technologies. Only a couple of interviewees from non-formal settings mentioned they adapted face-to-face action-oriented pedagogies into videos shared on social media to foster students' agency on sustainability topics, which resonates with *Action* competence. In the case of *Values* competence, a non-formal environmental educator described employing digital technologies to build teamwork and positive relations among educational partners.

Finally, although identified by a few interviewees, two ESE competences were only associated with difficulties found when using digital technologies during the pandemic: *Decisiveness* and *Attentiveness*. Both were linked to the difficulty of finding the appropriate digital technologies that encourages students to make prudent and conscious decisions towards a more sustainable society in a moment of urgency and uncertainty such as the pandemic.

CHAPTER 5. Discussion

"I knew it was going to be difficult,
but I also knew we were going to triumph,
because the river told me so"
Berta Cáceres

5.1 Summary of the main discussion points

This thesis aims to answer the general research question of: How can educators' competences in ESE be strengthened to navigate towards transformational education in times of global crisis? To find responses, I have analyzed both theoretical models and practical elements (e.g., individual factors and contextual aspects, including the expanded use of digital technologies because of the COVID-19 pandemic lockdown), the last through a case study in Barcelona. Among my findings presented in the previous chapter, I identify three highly relevant for discussion to enable progress toward transformational education.

First, from both the scientific literature reviewed and the interviews with ESE educators in the case study, findings reveal there are specific competences related to the three learning dimensions that are critical to achieving transformational education in ESE: *Empathy, Creativity* and *Transdisciplinarity* (socio-emotional)*; Systems* and *Criticality* (cognitive); and to *Participation* and *Action* competences (behavioral). Each of these are discussed according to the corresponding educational setting (i.e., formal and non-formal), the association to their motivations and challenges as well as the use of digital technologies during the first months of the pandemic.

Second, in my review of the competence frameworks and models in ESE for educators, I found the *sustainability* and *competences* conceptualizations used in the analyzed frameworks, on the one hand, overcomes the sustainability debates in terms of its relation to development and growth and, on the other hand, relies on limited theoretical foundation to define the competence concept. I discuss how the different ways of understanding and operationalizing sustainability and competences behind these frameworks can shape educators' transformational capacities in ESE.

Third, in my analysis of ESE educators' use of digital technologies during the first months of the COVID-19 pandemic, results show the use of digital technologies was differentiated across formal and non-formal educational settings since educators from formal settings mainly relied on videoconferencing supported by digital presentations.

Meanwhile, those from the non-formal context implemented a wider diversity of digital technologies, such as infographics, videos, and virtual tours. These differences are discussed in terms of the competences developed in each educational setting and by considering transformational education implications.

Finally, at the end of this chapter, I discuss methodological limitations of my thesis.

5.2. Relevant educators' competences in ESE for transformational education across this study.

In this section, I discuss my findings on those educators' competences in ESE that found to be the most relevant for making progress toward transformational education. This is the most extensive section of the discussion because I pay attention to discussing the importance of each identified competence in both formal and non-formal educational context and concerning the educator's motivations and challenges faced in their practice, including the use of digital technologies during the pandemic lockdown. I present such discussion in three parts corresponding to the three dimensions of learning: behavioral, socio-emotional, and cognitive (European Commission (2022). These dimensions of learning are related to the key competences (which are also key elements of any competence) from Jacques Delors (1996), were used in the guiding framework of UNECE (2012) and adapted in the resulting Typology of Competences (see Chapter 4, section 4.1.3). Thus, the Learning to Do (LtD) group of competences is described in the behavioral dimension; the Learning to Be (LtB) group, in the socio-emotional dimension; and the Learning to Know (LtK) group, in the cognitive dimension. In what follows, across these three dimensions of learning, I will mainly use the terminology of the RSP framework (Millican, 2022; Vare et al., 2019) because I mainly used it in both my analyses of *Phase II* and *Phase III* (see Chapter 3).

5.2.1. Behavioral dimension of learning

My results from the review of competence frameworks in ESE show that those competences such as *Participation in Community*, that were more present across frameworks, particularly address knowledge, skills, values and attitudes that have been identified as those that educators need to face current sustainability challenges, from a critical and transformational education perspective (Barbeito et al., 2018; Bürgener, 2018;

Wals & Jickling, 2002). However, the fact that the most frequently addressed competences in the frameworks, as well as the most varied pedagogical strategies put into practice to implement the reviewed competence frameworks, are also the ones related to the LtD group of competences (associated to behavioral learning dimensions), might be a sign of applying the competence-based approach with an excess of pragmatism and reductionism (Díaz-Barriga, 2019). Some authors have discussed such caveats in terms of focusing on instrumentalist competences, instead of enforcing those that are more emancipatory and connected with transformational education (Rieckmann, 2020).

This theoretical emphasis on the behavioral dimension, matches with the interviewed educators' discourses from the non-formal context. Results in this regard show how the *Participation* and *Action* competences were perceived as especially relevant for their role as educators.

Overall, competences from the behavioral dimension that are seen as critical to achieve transformational education (UNESCO, 2022), were more associated with educators' experienced challenges in the formal setting. Such results may suggest that barriers related to these competences, previously reported in the literature (Varela-Losada, 2018), could have been closer to getting solved in the case of non-formal educators. It could also be indicating that the emphasis ESE, and more specifically non-formal ESE, has been doing on participative and action-oriented pedagogies in the last decades (Cebrian et al., 2021), might be having a positive impact on the development of these competences. Particularly, regarding the *Participation* competence' relevance among the interviewed non-formal educators in Barcelona, even during the pandemic restrictions. In this sense, non-formal educators perceived more opportunities when using digital technologies during the first months of the pandemic associated with this competence than challenges. For instance, some of them reported they could adapt their projects during lockdown using a diverse set of digital technologies without negatively impacting learners' participation. Regarding competences from the behavioral dimension of learning, this result can also suggest that the rigidity of formal settings (Jickling, 2017) could have prevented formal educators from finding more opportunities when using digital technologies and overcoming pedagogic challenges related to *Action* and *Participation.*

5.2.2. Socio-emotional dimension

Indeed, it has been argued that educators aiming to make ESE more transformational, need to engage in an action-oriented pedagogy while embracing self-directed learning, orientation to the problem, inter and transdisciplinarity, participation, and collaboration (UNESCO, 2017). Thus, other sets of competences, different than those discussed in the previous section that relates to the behavioral dimensions, are also needed to foster transformational education (Pol & Castrechini, 2013). These competences are referred here as those associated with the socioemotional dimension, such as the ones in the LtB group in the Typology of competences (*e.g., Emotional management, Connections, Uncertainty, Empathy,* among others). In this sense, handling with controversial topics in ESE involves knowing how to embrace and deal with related values and attitudes, which requires the mastery of these competences. The challenge here is to explore effective pedagogical approaches to improve educators' competences related to emotional aspects so they can create the space for environmental values to evolve (Weston, 1992).

Interestingly, my results show that the reviewed frameworks on educators' competences in ESE put little attention on these competences, compared to the LtD group of competences, previously discussed. This result, matches with previews case-studies on climate change education, showing that trainings for future ESE educators focused on cognitive dimensions leaving behind emotional aspects related to generating hope, dealing with despair, and complex emotions (Hung, 2014; Pihkala, 2017). Likewise, these findings are in line with the need for emphasizing the social-emotional dimension of learning that should foster trust, mutual respect, and a sense of community, as found by De Kraker (2017). Other authors have too discussed the little emphasis on the emotional aspects in learning in terms of the need to promote pedagogies of care, collaboration and empathy in ESE, which are at the core of transformational education, and are as well, especially relevant in social realities where violence is a cross-cutting issue (Hordatt Gentles, 2022).

Furthermore, my results from the case study in Barcelona also show that the socio-emotional dimension of learning played a key role during the pandemic lockdown. Perceived benefits and barriers of the increased use of digital technologies by educators in ESE during that period, were poorly connected to their previous experience in implementing digital technologies in teaching; while closely linked to specific ESE

competences as *Empathy* and *Creativity*. In turn, this shaped how they employed digital technologies in their corresponding learning and teaching settings. The *Empathy* competence underpins educators' capacity to help learners deal with their emotions and feelings related to the natural world and sustainability issues (Millican, 2022; Vare et al., 2019). Thus, it involves emotional aspects and corresponding values and attitudes that are still underexplored in ESE (Pihkala, 2020a), as it also happens in the connected field of science education (Ruiz-Mallén et al., 2021). Pandemic ESE research examining the emotional and psychological effects of the lockdown has mainly targeted students (European-Commission, 2021; Rios et al., 2021); thus, the impacts on educators and their relation to emotional competences is still an open question to be addressed. In this regard, my results show how some educator interviewees perceived using digital technologies as a barrier to connect with students and catching their attention, while others saw digital tools as improving their ability to create or reinforce an emotional bond with them. The latter finding matches with the evaluation results in a previous study (Hesen et al., 2022), which showed how university students were emotionally engaged in learning through a sustainability-related online course. The lessons were implemented by a teacher during the pandemic by promoting openness to share opinions, worldviews, personal experiences, and emotions using artistic methods through videoconferencing. However, as this thesis' findings show, ESE educators still need to improve their ability to deal with emotions when implementing digital technologies. Before the pandemic, environmental educators already felt they lacked the skills to encourage *"progressive and positive hopes and visions among the students"* (Sjøberg et al., 2019). Interestingly, there are recent efforts to address this deficit by employing digital technologies, such as an online training on how to teach climate change by relying on social and emotional learning (UNESCO-MGIEP & Ojalá, 2022).

This thesis' results also show that, especially when using videoconferencing and learning management platforms, ESE educators can seek more space for connection with students, promote bidirectional dialogue instead of unidirectional, and share with them daily experiences linked to their immediate environment. In doing this, educators also need to be more attentive to students' conflicting emotions resulting from life experiences during the pandemic and support them by being flexible with professional commitments, particularly in formal learning settings (Corbera et al., 2020).

Nonetheless, and regardless of the use of digital technologies, *Empathy* is also associated with challenges in the case of ESE educators from the non-formal setting. My results show that they perceive that lack of time to implement their educational activities (e.g., when they are external educators in formal education institutions), deters them from better bonding with students. This may suggest the need for disruptive pedagogical spaces, as proposed by the wild pedagogies (Jickling, 2018), even in non-formal settings. Accordingly, these pedagogies implied that instead of adapting to the rigidity of educational institutions, ESE should promote the reverse by renegotiating the very idea of education, by redefying norms, achieving critical reflection, building connections, and growing creativity, where nature could be, actually, a co-teacher (Jickling, 2018).

The rigidity of the education system was more evident in the discourses of formal setting educators than those from non-formal ones, when reflecting on the limitations of using digital technologies during the pandemic lockdown, especially concerning *Creativity* competence. By contrast, their colleagues in non-formal settings reported many opportunities related to this competence, for instance, when having the chance to adopt a more comprehensive range of digital technologies than in formal settings. This resonates with the idea that more transformational pedagogies can often happen by offering more time, instructional options and flexibility, which contrast with the predetermined learning outcomes that dominate in formal settings (Jickling, 2018).

Despite this, other studies still found it challenging to use digital technologies to achieve similar learning outcomes than when using face-to-face methods, particularly when trying to replace art-based methods that are typically implemented in outdoor and experiential learning (Baldwin, Persing J., et al., 2016; Higgins, 2009a; Sponarski et al., 2016). Indeed, it has been suggested that promoting students' active role in learning through the use of digital technologies in outdoor learning is quite a challenge for ESE educators in non-formal settings (Hills & Thomas, 2019), which the confinement situation could have exacerbated. But certainly, the lockdown could have helped those non-formal educators in ESE, who did not feel the school curricula deadlines pressure, to invest more time in rethinking and adjusting their teaching to the new situation of increased digital technologies use (Corbera et al., 2020). In others words, they described more *Creativity* competence elements, when reported they effectively adapted their face-to-face pedagogies to digital formats that aimed to foster students' creativity (e.g., storytelling through videoconferencing and virtual tours to protected areas).

In other words, when developing competences highly related to the socioemotional dimension of learning in ESE, such as *Creativity* or *Empathy*, the educators and institutions should rethink the very educational spaces, whether these are virtual or not. Additionally, to achieve more transformational, empathetic, and in a way, meaningful ESE, educators should also be critical of the curriculum rigidity and traditional educational means. In the same line, the fact that in the non-formal context the *Empathy* competence was more highly related to their motivations to become interested in ESE, could suggest a guideline to work this competence through their own drivers to overcome these challenges. Consequently, a good practice towards transformational education might be to encourage educators to bring up their own experiences that help them build a meaningful connection with the more than human world, at times outside of the curriculum, such as contemplating animals and watching nature documentaries, to name some that the interviewees in this study brought up. As argued in terms of the wild pedagogies approach, *"(...) despite curriculum control and testing pressures, many committed teachers find ways to resist, to create, and wiggle into spaces for what they consider real teaching. For the immeasurable"* (Jickling, 2018, p. 65).

Transdisciplinarity is another key competence considered for discussion purposes as part of the socio-emotional dimension. This, since educators' descriptions of challenges in the Institutional and Community fields of action, lead to the idea that even though they consider *Transdisciplinarity* as highly relevant, they do not have the conditions to truly develop this competence and its inherent pedagogies. This perception about the challenges to develop *Transdisciplinarity* competence, is in line with recent international studies on ESE educators, showing that their institutions do not support inter- and transdisciplinary assessment nor feel trained to do so (UNESCO, 2021c). To deal with these challenges, some studies have discussed the need to promote mutual learning across educators coming from various academic disciplines, doing so at the institutional level (Lozano et al., 2021). Meanwhile, another study emphasized that, besides the importance to train educators in ESE competences, there should also be an institutional commitment to properly integrate sustainability within the institutions (Busquets et al., 2021).

Transdisciplinarity was also linked to the way digital technologies can be implemented across both formal and non-formal settings. Even though this tool helped

school teachers encourage students to collaborate and maintain contact with previous partners during the first months of the pandemic, for some ESE educators in non-formal settings, digital technologies could not replace face-to-face interaction in fostering cooperation with other organizations as they used to before the pandemic. Beyond confinement conditions, digital technologies can thus help ESE educators to create networks of collaboration, which is a *Transdisciplinarity* key element. In our complex network and information society, it has been argued that digital technologies should be used to create democratic debates and social alternatives, which is fundamental to create more sustainable futures (Gessen, 2012; Huckle, 2012). In this sense, some other non-formal educators did report opportunities regarding using digital technologies to create collaborative networks that impacted their classroom objectives during the pandemic (i.e., videoconferencing with other ESE educators from Brazil to motivate their students). This last example is in line with Castells (2008) argument on the relevance of networks operating through digital technologies being not only local but global.

5.2.3. Cognitive dimension of learning related competences

When looking at other competences in ESE that are related with the cognitive dimension of learning, my results suggest that in both frameworks and interviews analyzed, a more relevant emphasis and importance was given to specific elements of *Systems* and *Criticality /Critical Thinking* competences. My findings highlight that elements related to these competences around making complexity accessible to the students, were commonly found at both conceptual and practical levels. That is, within the reviewed competence frameworks in ESE for educators, and also within the interviewed teachers' discourses around the competences they need, and the experienced opportunities using digital technologies during the pandemic. These findings also agree with previous international research (UNESCO, 2021c) that described how ESE educators feel more confident in teaching cognitive skills, such as *Systems* components, than emotionally related competences, close to specific elements of *Empathy* or *Creativity* that I have discussed above. Within this UNESCO study, it is discussed that such disparities are partly due to the dominance of prioritization of cognitive competences in public policies (UNESCO, 2021c).

In a way, these results show how relevant these cognitive-oriented competences may be to finding transformational paths to ESE, especially in formal settings where more relevance is given to this competence while it is still found challenging.

5.3 Lack of conceptual definition of Sustainability and Competences in the reviewed competence frameworks and models in ESE for educators.

The results from the systematic review presented in Chapter 4, section 4.1, suggest that the initial debates about the different understandings of the *sustainability* concept between EE and ESD, claiming that ESD relies on the idea that economic growth is possible, while EE would claim for the transformation in the core of economic structures according to the physical limits of our planet (Sauvé & Orellana, 2002), is not addressed by the reviewed competence frameworks. Looking at my thesis findings in terms of the included types of competences for educators in ESE across the fourteen documents reviewed, stands out that only one study explicitly includes in its framework a competence focused on economic growth and development (Sánchez-Carracedo et al., 2018). It seemed then, that most of the authors from the reviewed competence frameworks, conceived sustainability as it is in the post-sustainability debates. That is, as an empty signifier that opens new spaces for critical discussion and transformation, as well as a process that permanently is in-becoming, rather than a close concept mainly related to growth (Le Grange, 2017). Accordingly, the reviewed frameworks have relied on the ESD approach by understanding sustainability as *"(...) both an explorative process and a broad direction"* (Sterling, 2010, p. 512).

Beyond the understanding of the term sustainability, the transformational potential of the reviewed frameworks is also related to how they conceive and theoretically address the concept of competences in ESE. These results suggest that there might be limited theoretical foundation in this last regard since only half of the reviewed define this concept when applied to educators. This apparent lack of theoretical foundation could also be associated with the fact that some of them used Wiek's et al. (2011) framework of competences as a reference, which was initially conceived for sustainability science students in higher education. The fact that educators' competences frameworks in ESE rely on a concept of competences initially conceived to be applied for students might lead to some bias since the way that competences in ESE are conceived

for students can differ in the case of educators. Such clarification is relevant to avoid confusion. For instance, when defining the *Participation* competence, one the frameworks does not specifically refer to educators': *"Participation in Community processes that promote sustainability"* (Sánchez-Carracedo et al., 2018, p. 6). On the other hand, another does clarify their role as follows: *"Facilitate participatory and learner-centered education that develops critical thinking and active citizenship."* (Pipere & Mičule, 2014, p. 20). As the first seems to be the case, in more recent efforts that propose a framework for Green Competences to be used as a guide for teachers to develop these competences among their students, without making emphasis in the educators' role when defining those competences (Bianchi et al., 2022).

Moreover, some frameworks consider theoretical and pedagogical approaches as competences, such as *Learner Centered*, or include competences not explicitly related to ESE, such as *Scientific Thinking*, which might lead to conceptual confusion and misguide educators' practice. Therefore, I wonder whether it is theoretically and practically suitable to include these types of competences in a framework addressed to educators in ESE. Different answers will evolve from the two main conceptualizations of sustainability competences shown in the review results: one that specifically addresses the role of educators and another that relates these competences to generic ones that could also apply to students or other actors. Previous research (Bertschy et al., 2013) has suggested that frameworks should emphasize those competences linked to the professionalization of educators, which follows the first conceptualization. This approach is of special consideration for curriculum developers in pre-service training institutions who pursue to training future teachers by using the existing frameworks and models found in this review. It is not the same preparing educators to enhancing their competences in sustainability issues (i.e., teaching future teachers to recycle), than training them to improving competences related to educate in ESE (i.e., teaching future teachers to know how to handle contradictions within sustainable dilemmas exposed in a class). In this sense, further research can comparatively analyze the transformational impact of each approach in terms of educators' development of competences in ESE.

5.4. Differences between formal and non-formal educators in ESE in the use of digital technologies during the first months of the COVID-19 pandemic

I now discuss the last finding, which, as highlighted in my results presented in Chapter 4, section 4.3, goes around the differences in adopting and using digital technologies during lockdown between educators interviewed from formal and non-formal learning settings. I show how educators in secondary and higher education mainly relied on videoconferencing (i.e., Zoom) supported by digital presentations (i.e., PowerPoint), while non-formal environmental educators reported implementing a broader digital technologies' variety, including infographics, videos, and virtual tours. Such a qualitative difference in the adoption of digital technologies between formal and non-formal environmental educators could be interpreted in terms of holding or not holding the skills to deal with digital technologies before the pandemic in a creative fashion. The latter has been reported by educators from all disciplines and backgrounds worldwide (OECD, 2020). However, it does not seem to be the case in this study because educator interviewees did not report that they lacked digital skills or that digital devices and tools were complicated to implement.

The testimonies of participant educators in my study might contrast with pre-pandemic studies showing educators in ESE could even stop using digital technologies because they felt anxiety related to their perceived lack of digital skills (Fauville et al., 2014). Instead, the formal education system's rigidity could explain the difference in adopting digital tools. As argued by Jickling (2018), formal education is based on predetermined learning outcomes, curriculum control, and testing pressures, while non-formal settings are characterized by offering more time and flexibility; thus, more transformational pedagogies can often happen. It is highly possible that, during the lockdown, school and university educators did not have time to rethink their face-to-face classes into more dynamic pedagogies, instead videoconferencing or digital presentations were dominant due to the urgent need to follow up with the curricula. By contrast, the lockdown could have helped those non-formal environmental educators who did not feel the pressure of school curricula deadlines to invest more time in rethinking and adjusting their teaching to the new situation of increased digital technologies use (Corbera et al., 2020).

My findings on the differences in using digital technologies between educators in formal and non-formal learning contexts during the first months of the pandemic are

relevant regarding transformational education; primarily because the lack of flexibility that has been reported in the formal setting, may be deterring teachers from using more transformational pedagogies, such as those dealing with the socio-emotional dimension. In a way, even if they are competent enough in emancipatory competences, structural barriers still need to be addressed. Some authors discussed the potential of the whole-institution approach toward sustainability as one pathway towards overcoming these barriers at formal educational institutions towards more holistic and transdisciplinary ways to collaborate (Ruiz-Mallén & Heras, 2020).

5.5. Methodological limitations.

This thesis has three main methodological limitations that I recognize and consider when reporting my results.

First, regarding the systematic review methodology, the studies included in my sample review came from the European arena, and most of them were developed in formal education, particularly in higher education backgrounds. This might suggest that the specific research approach toward competences that is exploring how models and frameworks are conceptualized and implemented, could have been mainly developed by academics working in European institutions. Still, some reviewed studies relied on North-American models, such as the one from Wiek et al. (2011) and the guidelines produced by NAAEE (2010), which also highlight the relevance of the research produced in this world region. These results are consistent with the general Western dominance in this research area within the field of Environmental and Sustainability Education that has been already found by previous studies (Barth & Rieckmann, 2015). However, the observed geographical trend could also be due to limitations in the research design of the systematic review. As mentioned earlier, this search was guided by a set of pre-established keywords, so some other studies may have been included in the sample if I had added other synonyms to this search, such as "guideline". Besides, since the search was conducted in English and within SCOPUS, the academic literature published in other languages was, thus, excluded as well as other databases different from this review (e.g., Latin-American or French-speaking African countries).

Second, the results from the mixed-methods analysis, specifically a mixed hierarchy in which I choose qualitative as the predominant (Morse, 1991), should be

interpreted cautiously, considering these were achieved in a particular geographical area through a case study in Barcelona, to understand the underlying relations within this context deeply. I also acknowledge limitations in the mixed methodology implemented, as some authors claim phenomenological incompatibility exists between qualitative and quantitative approaches (Azorín & Cameron, 2010). Nonetheless, from this research perspective, the chosen methodology could bring up deeper and newer insights into a topic underdeveloped and explored that could be relevant to other contexts (Anderson, 2016).

Finally, as the pandemic prevented us from conducting face-to-face interviews, it could have positively impacted the participants' trust to discuss their perceptions more confidently. Nonetheless, all of the participants seemed comfortable enough, and their trust grew despite the circumstances as the interviews took place.

CHAPTER 6. Conclusions

"Out of the mountain of despair,
A stone of hope."
Martin Luther King, Jr.

6.1. Main findings

The present doctoral research dissertation has shown how competences in ESE of those educators working in diverse educational settings need to be developing toward a more transformational education. I do this considering the theoretical and empirical evidence analyzed here, as well as how these competences are shaped by and connected to individual elements and contextual factors, including global circumstances, through a study case in Barcelona.

In general terms, my results suggest that there are persisting competences relevant to achieve a more transformational education in ESE that are being emphasized in the literature reviewed, as well as in the testimonies of teachers and non-formal educators from the case study. *Critical Thinking* is the only competence present in all the competence frameworks analyzed, which denotes its importance. Such conceptual understanding is also reflected in practice. When referring to the first months of the pandemic, educators from both formal and non-formal contexts in Barcelona highlight the opportunities of using digital technologies regarding *Criticality* and *Systems* competences. Additionally, among formal educators, *Systems* competence was seen as highly relevant for their teaching role and, at the same time, highly associated with their Instructional challenges.

Differently, those competences associated with the behavioral dimension of learning, such as *Action* and *Participation*, receive more attention conceptually than in practice. *Participation* was only emphasized in the non-formal educators' descriptions concerning its relevance for their teaching practice and their motivations towards sustainability activism. Nevertheless, *Participation* competence is more connected with the opportunities educators perceived when using digital technologies during the

pandemic than with the experienced difficulties.

Findings from the systematic review stand out that competences linked to the socio-emotional dimension of learning (European Commission, 2022), such as *Emotional Management* and *Transdisciplinarity*, received low attention in the reviewed conceptual frameworks on ESE competences. Likewise, educators across both formal and non-formal settings in Barcelona do not perceive *Empathy* as a particularly relevant competence. Still, it is considerably interlinked with the motivations of these educators towards ESE as well as their teaching challenges, predominantly in the case of non-formal educators and during the pandemic when they had to expand their use of digital technologies.

By contrast, *Transdisciplinarity* is persistently mentioned in the discourses of educators across both educational settings. Also, it is highly associated with their motivations and challenges, which are described differently in each educational setting. Non-formal educators reported inter-institutional barriers to achieving more collaborative and transdisciplinary projects, while formal educators described barriers inside their institutions to implement the whole-institution approach. The relevance of the *Transdisciplinarity* competence in educators teaching in ESE is also highlighted by the interviewed educators in the pandemic situation. Still, with different views: for some, the use of digital technologies allowed for cooperation and collaboration, while others find that digital technologies could not replace the face-to-face interaction that promote collaborative networks.

Another critical finding discussed was a result from the systematic review of frameworks of competences in ESE. Most of the reviewed frameworks and models need to provide a proper definition of the concepts of *sustainability* and *competences* that should guide their theoretical and conceptual development. Likewise, this lack of clarity is linked to the distinct conceptualizations of sustainability competences in the reviewed frameworks, from those that explicitly address the educators' role when defining the competences, to those that relate these competences with the generic ones. Such misunderstanding may negatively impact the transformational potential of ESE because the definition of the competences proposed should adequately address the complex and relevant role of educators in ESE, so that they can develop these competences accordingly.

Finally, although it was partially discussed in this thesis, another main finding refers to how educators see the adoption of digital technologies in the first months of the pandemic as necessary and valuable to continue with their teaching activities during the lockdown, while allowing them to follow-up with existing collaborations, reaching new audiences, and promoting collective learning based on reflection and debate. Overall, educators in non-formal settings could employ a wider variety of digital technologies than their peers in formal settings, which might be due to the lower flexibility to do that in formal education systems.

6.2. Practical implications

As the educators' frameworks and models of competences in ESE are being used as practical tools to develop and assess competences in educators (Mulà et al., 2017), these should be employed cautiously. Especially considering that, as my results have shown, some of these frameworks are theoretically grounded in a conceptualization of competences that mainly considers students, while others do not consider sustainability in a transversal way and many of them do not give to the socio-emotional dimensional of learning the same relevance than the emphasis given to other dimensions. In addition, the digital competence is often poorly integrated, which is crucial in the current network society (Redecker, 2017). These caveats and limitations need to be considered in future trainings and development plans of educators in ESE to foster the full transformational potential of developing competences in ESE.

In this regard, future efforts should develop diagnostic tools that consider educators' challenges before implementing competence development trainings, keeping in mind the particularities present in each educational context. In other words, future trainings should focus on those competences more related to the challenges that educators face in their own educational settings. For instance, in the studied case of Barcelona, *Participation* and *Action* competences were not as associated to challenges described among non-formal educators as other competences, consequently, these should not be a priority when planning trainings to develop crucial competences among these particular educators. Moreover, a co-learning process between formal and non-formal educators, through developing trainings mixing these ESE educators, could bring up new and fresh strategies to achieve this goal, considering how the weaknesses within a particular context

could be a strength in the other context.

To achieve more transformational, empathetic, and meaningful ESE, several obstacles regarding the potential of key competences should be considered. In light of these thesis results, to overcome barriers regarding *Transdisciplinarity* competence, it is pertinent to notice how it needs to be developed not only in the Instructional field, but in the Institutional and Community fields of action as well. This could be done by incorporating educators from other disciplines, teachers, and institutional staff into sustainability-related projects. Furthermore, how to foster or improve institutional support for a transformational education should be planned differently according to the educational setting. From the results of my case study in Barcelona, I suggest different strategies to develop competences in ESE in the formal and non-formal contexts. In schools and universities, a particular emphasis should be made on supporting project-based approaches that promote cooperation among educators with diverse disciplines background, as well as to enforce institutional willingness to continue offering suitable trainings to develop these competences. A recent study in Catalonia that explores these issues from the perspective of school principals has also find that project-based pedagogies, together with service and community learning, could overcome the challenge of engaging all school actors (Cebrián et al., 2022). This is also especially relevant considering that previous studies showed that trainings need to be developed over a more extended period of time to better achieve their purposes (Scherak & Rieckmann, 2022). Nonetheless, overcrowded curricula can inhibit educators' ability to teach additional ESE content (Cebrián et al., 2022; UNESCO, 2021c), which justifies why sustainability topics should be embedded within the existing curricula.

On the other hand, good practices to face these challenges in the context of non-formal educators in ESE are related to the promotion of inter-institutional collaborations working towards shared purposes regarding ESE objectives. For instance, the creation of network encounters that promote synchronic objectives, such as those promoted by the Catalan Environmental Education Society ([SCEA], 2022) that organizes conferences, workshops, and other networking activities, are especially pertinent to develop *Transdisciplinarity* competence. My findings also suggest digital technologies can be highly useful in this regard since ESE non-formal educators were able to create networks of collaboration during the pandemic lockdown. Indeed, not only during confinement

these technologies are relevant, but in our complex network and information society, technologies should be used to create democratic debates and social alternatives around ESE issues, in creative, local and global ways, which is fundamental to move forward more sustainable futures in a global crisis context (Gessen, 2012; Huckle, 2012).

Reflecting on improving trainings for educators in ESE is also essential concerning other competences, such as *Empathy,* since the rigidity of curriculums and traditional educational means also represents an obstacle to the full development of this competence. In this sense, it is pertinent to consider how some *Empathy*-related challenges are especially relevant in the Instructional field. Therefore, when designing trainings for educators in ESE, it is particularly encouraged to address *Empathy* by addressing educators' difficulty of handling pedagogies that help the student to be hopeful and not pessimistic, and in doing so being able to make a confident use of digital technologies when dealing with emotions. Besides, and since *Empathy* competence' elements can be also associated to educators' motivations to be engaged in ESE, another good practice to develop this competence could be to encourage educators to bring up their own experiences that help them build a meaningful connection with the more than human world, at times outside of the curricula. This endeavor requires training educators to promote spaces for sharing experiences, emotional openness, and meaningful understanding (Jickling, 2017); in sum, putting emphasis, following the "wild pedagogies" approach, to emotions and the fluctuant reality (Blenkinsop, 2018).

Results regarding the links between cognitive-oriented competences, specifically the relevance put in *Systems* competence, and the challenges educators faced in the formal context also need to be considered when planning trainings in this educational setting. Thus, further trainings could explore engaging and motivating strategies to develop this competence.

Altogether, the recommendations here presented regarding more and suitable training opportunities to ESE educators, should also acknowledge that asking educators for more responsibilities and competences, also imply providing them with better working conditions since an overcrowded curricula and poor work conditions can inhibit educators' ability to teach ESE (UNESCO, 2021c).

6.3. Further research

Research around frameworks and models of ESE educators' competences should

continue analyzing the transformational potential of future frameworks and models of competences, approaches, and pedagogies. Likewise, frameworks development studies should consider the specific role of the educator when formulating competences addressed to them, but also the educational context and individual factors such as motivations and challenges perceived by the educators when defining the competences and their underpinning components. Additionally, research around frameworks needs to deal with its applicability across different educational contexts and include the use of digital technologies. This could be done by analyzing the particular pedagogical challenges and motivations of educators in ESE, and how these are associated to a specific educational context.

Notably relevant is the further exploration of innovative ways to approach the understanding and development of competences related to the socio-emotional dimensions of learning in the practical arena. In this sense, further research can explore new engaging and motivating strategies to develop these competences in different case studies; as well as develop trainings for ESE educators in both formal and non-formal contexts where they could learn from their strenghts, motivations and already acquired competences. Such research can contribute to the design of trainings that emphasize in socio-emotional competences to improve and develop educators' emancipatory qualities with transformational potential (Wals & Jickling, 2002).

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APPENDIX A: Systematic Review' discarded papers.

It is not addressed to teachers/educators	It is not about sustainability or sd	This is not a framework of comp	Sustainability or SD or Environmental education not the focus	Authors, Title, Year, Link (as provided by SCOPUS)
Search 1				
1				Jamieson M.V., Shaw J.M.,"Teaching engineering for a changing landscape",2019,"https://www.scopus.com/inward/record.uri?eid=2-s2.0-85073443887&doi=10.1002%2fcjce.23626&partnerID=40&md5=867cbe12d554219763392f1c13cc94ef"
1				"Evans T.L.,""Competencies and pedagogies for sustainability education: A roadmap for sustainability studies program development in colleges and universities"",2019,""https://www.scopus.com/inward/record.uri?eid=2-s2.0-85073616203&doi=10.3390%2fsu11195526&partnerID=40&md5=56349519fd43c6d2ea4f55c4104962d9"""
1	1			"Suhairom N., Musta'amal A.H., Mohd Amin N.F., Kamin Y., Abdul Wahid N.H.,""Quality culinary workforce competencies for sustainable career development among culinary professionals"",2019,""https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065919752&doi=10.1016%2fj.ijhm.2019.04.010&partnerID=40&md5=b34a954fad15e720fc93913aad71724b"""
1	1	1		Haselberger D., Motschnig R.,"Computer science students' experience of reflecting on team leadership - A case study of a student-centered course on communication",2019,"https://www.scopus.com/inward/record.uri?eid=2-s2.0-85063442481&doi=10.1109%2fFIE.2018.8658542&partnerID=40&md5=d337d9c1c4986edb2c7f8889cb2f7689"
			1	Srisaeng P., Upvall M.J.,"Looking toward 2030: Strengthening midwifery education through regional partnerships",2019,"https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065199623&doi=10.1111%2fjan.14015&partnerID=40&md5=bb91c2fef12f2da71a5cd8decf51f180"
	1			"Nyoni C.N., Botma Y.,""Implementing a competency-based midwifery programme in Lesotho: A gap analysis"",2019,""https://www.scopus.com/inward/record.uri?eid=2-s2.0-85057176859&doi=10.1016%2fj.nepr.2018.11.005&partnerID=40&md5=41fcd2d08ab94888111c839ca7774f70"""
	1		1	Ismail A., Hassan R., Abubakar A., Hussin H., Mat Hanafiah M.A., Asary L.H.,"The development of tvet educator competencies for quality Educator",2018,"https://www.scopus.com/inward/record.uri?eid=2-s2.0-85061864652&partnerID=40&md5=8f3956a695bd155e2585f208ed103431"
1	1			Schofield R., Chircop A., Baker C., Dietrich Leurer M., Duncan S., Wotton D.,"Entry-to-practice public health nursing competencies: A Delphi method and knowledge translation strategy",2018,"https://www.scopus.com/inward/record.uri?eid=2-s2.0-85043514261&doi=10.1016%2fj.nedt.2018.03.001&partnerID=40&md5=ee3d59f04f49e41951e95e321a4ba3c7"
		1		"Phillips J.M., Riner M.E.,""Global health engagement: At home and abroad"",2018,""https://www.scopus.com/inward/record.uri?eid=2-s2.0-85042943889&doi=10.3928%2f00220124-20180219-04&partnerID=40&md5=84b84c0882dc35843fda8ee93cad8972"""

	1			Bedford D., Garcia-Perez A., Georgieff M., Brown-Grant J.,"Knowledge management education standards: Developing practical guidance",2018,"https://www.scopus.com/inward/record.uri?eid=2-s2.0-85055503560&partnerID=40&md5=b786749609d38e2c1ee7adb85da94d1c"
	1	1		Mercer S., MacIntyre P., Gregersen T., Talbot K.,"Positive language education: Combining positive education and language education",2018,"https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062288426&partnerID=40&md5=6968370070225c7d048888a7e572b59b"
1				Gilmanshina S.I., Gayfullina A.Z., Fedotova N.R., Gilmanshin I.R.,"Building the environmental literacy through school natural science education",2018,"https://www.scopus.com/inward/record.uri?eid=2-s2.0-85050918104&partnerID=40&md5=e38a1f345299ef64f9f1a89201707eb7"
1				"Lozano R., Merrill M.Y., Sammalisto K., Ceulemans K., Lozano F.J.,""Connecting competences and pedagogical approaches for sustainable development in higher education: A literature review and framework proposal"",2017,""https://www.scopus.com/inward/record.uri?eid=2-s2.0-85032854131&doi=10.3390%2fsu9101889&partnerID=40&md5=a58a00baa75c20d4d2bee5edbbe3f415"""
	1			Cheng A., Grant V., Huffman J., Burgess G., Szyld D., Robinson T., Eppich W.,"Coaching the Debriefer",2017,"https://www.scopus.com/inward/record.uri?eid=2-s2.0-85019637588&doi=10.1097%2fSIH.0000000000000232&partnerID=40&md5=6ecad8d2a4898ac0893d548163aea417"
	1			Baldwin C.D., Chandran L., Gusic M.E.,"Building sustainable professional development programs: Applying strategies from implementation science to translate evidence into practice",2017,"https://www.scopus.com/inward/record.uri?eid=2-s2.0-85021055581&doi=10.1097%2fCEH.0000000000000151&partnerID=40&md5=2467e420c891a198c3b46ef0aa504f5d"
				"Mulà I., Tilbury D., Ryan A., Mader M., Dlouhá J., Mader C., Benayas J., Dlouhý J., Alba D.,""Catalysing Change in Higher Education for Sustainable Development: A review of professional development initiatives for university educators"",2017,""https://www.scopus.com/inward/record.uri?eid=2-s2.0-85023615284&doi=10.1108%2fIJSHE-03-2017-0043&partnerID=40&md5=39b4433c7af7a21c6bc36ead917eb528"""
			1	"Di Giulio A., Defila R.,""Enabling university educators to equip students with inter- and transdisciplinary competencies"",2017,""https://www.scopus.com/inward/record.uri?eid=2-s2.0-85023646025&doi=10.1108%2fIJSHE-02-2016-0030&partnerID=40&md5=d0b5f64b4778dad8a7751d899f2b14f7"""
	1			Bedford D.A.D., Georgieff M., Brown-Grant J.,"Lifewide, lifelong comprehensive approach to knowledge management education – emerging standards",2017,"https://www.scopus.com/inward/record.uri?eid=2-s2.0-85034567730&doi=10.1108%2fVJIKMS-12-2016-0068&partnerID=40&md5=a057fd6e6ff57a19b99a734726e216e5"
1	1			Bratitsis T., Meireles G., Neto C.,"WeAreEurope: An online game for European citizenship education for primary school",2017,"https://www.scopus.com/inward/record.uri?eid=2-s2.0-85036469263&partnerID=40&md5=bfe50fb2bf4bbc77514b3fdf62fecd6e"
1				"Johan K., Turan F.M.,""The development of Sustainability Graduate Community (SGC) as a learning pathway for sustainability education - A framework for engineering programmes in Malaysia Technical Universities Network (MTUN)"",2016,""https://www.scopus.com/inward/record.uri?eid=2-s2.0-85012288933&doi=10.1088%2f1757-899X%2f160%2f1%2f012074&partnerID=40&md5=78cc4c2a6e1c096bf044fb8bc0f3ecd4"""

1		1		"Lönngren J., Svanström M., Ingerman Å., Holmberg J.,""Dealing with the multidimensionality of sustainability through the use of multiple perspectives – a theoretical framework"",2016,""https://www.scopus.com/inward/record.uri?eid=2-s2.0-84941342866&doi=10.1080%2f03043797.2015.1079811&partnerID=40&md5=e5518d5eb89ba314e337107c5d8b1eaa"""
1				"Besong F., Holland C.,""The Dispositions, Abilities and Behaviours (Dab) Framework for Profiling Learners' Sustainability Competencies in Higher Education"",2015,""https://www.scopus.com/inward/record.uri?eid=2-s2.0-84943808176&doi=10.1515%2fjtes-2015-0001&partnerID=40&md5=88453b5d6a8d2e087e4021174c87cb2a"""
1				"O'Rafferty S., Curtis H., O'Connor F.,""Mainstreaming sustainability in design education - a capacity building framework"",2014,""https://www.scopus.com/inward/record.uri?eid=2-s2.0-84896283706&doi=10.1108%2fIJSHE-05-2012-0044&partnerID=40&md5=38e32e5c032cc4cc0c8b9cd0e517d7fe"""
1	1	1		Enoka I.S., Petrini M.A., Turale S.,"Samoan Philosophy of Nursing: A basis for culturally proficient care and policy",2014,"https://www.scopus.com/inward/record.uri?eid=2-s2.0-84906238393&doi=10.1111%2finr.12115&partnerID=40&md5=b7e83f26a391154872193d3cc2c0a3f1"
1				Ramirez B., West D.J., Costell M.M.,"Development of a culture of sustainability in health care organizations",2013,"https://www.scopus.com/inward/record.uri?eid=2-s2.0-84884216516&doi=10.1108%2fJHOM-11-2012-0226&partnerID=40&md5=2dac5a7fec398f796eb011a94f83027f"
1	1			Witt C.M., Withers S.R.,"Research training in integrative medicine: How can we make teaching and learning in research methods more sustainable and engaging?",2013,"https://www.scopus.com/inward/record.uri?eid=2-s2.0-84883759140&doi=10.1016%2fj.explore.2013.06.004&partnerID=40&md5=8a554f7c69d044899225d396302d40df"
1				Galt R.E., Parr D., Jagannath J.,"Facilitating competency development in sustainable agriculture and food systems education: A self-assessment approach",2013,"https://www.scopus.com/inward/record.uri?eid=2-s2.0-84872425095&doi=10.1080%2f14735903.2012.683569&partnerID=40&md5=0384e08bfa930b209d4e030e0301dd30"
1				Mattick C.S., Allenby B.R.,"Teaching old disciplines new tricks: Sustainable engineering education",2013,"https://www.scopus.com/inward/record.uri?eid=2-s2.0-85026222534&doi=10.1007%2f978-1-4020-8939-8_114&partnerID=40&md5=d3d2ff4053eab0fc8a07582d3b960148"
1		1		Andenoro A.C., Bletscher C.G.,"Transforming the international learning experience for students: Moving beyond the principle of accompaniment",2012,"https://www.scopus.com/inward/record.uri?eid=2-s2.0-84861700026&doi=10.1002%2fjls.21228&partnerID=40&md5=41b46781c3236c09649c28183a2d3525"
1		1		Hasna A.M.,"Embedding sustainability in capstone engineering design projects",2010,"https://www.scopus.com/inward/record.uri?eid=2-s2.0-77954993459&doi=10.1109%2fEDUCON.2010.5493062&partnerID=40&md5=2312cfa39c4c222582984831944315ac"
1		1		"Allan M., Chisholm C.U.,""The development of competencies for engineers within a global context"",2008,""https://www.scopus.com/inward/record.uri?eid=2-s2.0-84872100870&partnerID=40&md5=5d991a837341675fcf690ff58a040f89"""
1	1	1		Peterson R., Herrington J., Konza D., Tzvetkova-Arsova M., Stefanov K.,"Assisting Bulgarian special educators with competency development online",2008,"https://www.scopus.com/inward/record.uri?eid=2-s2.0-51349096944&doi=10.1108%2f10650740810900649&partnerID=40&md5=aa380cdf36148c9289ee816c5277d73e"

1				"Allan M., Chisholm C.U.,""Achieving Engineering Competencies in the Global Information Society through the Integration of On-Campus and Workplace Environments"",2008,""https://www.scopus.com/inward/record.uri?eid=2-s2.0-84983281470&doi=10.5367%2f000000008784867237&partnerID=40&md5=15c1c27bffb94313afc63473fa664b4e"""
		1		"Shallcross T., Robinson J.,""Is a decade of teacher education for sustainable development essential for survival?"",2007,""https://www.scopus.com/inward/record.uri?eid=2-s2.0-34247630614&doi=10.1080%2f02607470701259382&partnerID=40&md5=d7bbefba40b327c95c3f0267331c9a66"""
SEARCH 2				
1	1	0	0	Jamieson M.V., Shaw J.M.,"Teaching engineering for a changing landscape",2019,"https://www.scopus.com/inward/record.uri?eid=2-s2.0-85073443887&doi=10.1002%2fcjce.23626&partnerID=40&md5=867cbe12d554219763392f1c13cc94ef"
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APPENDIX B: Interview Guide.

SECTION 1

INTERVIEW GUIDE USED IN PHASE II

No.	Interview question	Expected answers
0	(Explain again the general objective of the interview) Please tell me your: -Name -Studies -Current work position	*Elements of the profile*
1	Where have you developed your role as educator around ESE topics? [*Decide here with the educator in which role he/she wants to talk about in the interview, suggesting the more predominant and/or related with the research focus*]	*Elements of the profile* *-Work experiences* *-Educative Levels.* *-Educative context (Formal-Non-Formal).* *-Characteristics of the most dominant role as educator.*
2	To get to know more about the activities you perform as educator, I would like you to share with me: -What topics do you usually address in your classes? -What disciplines are closer to your role as educator? -What kind of didactics or pedagogical activities do you usually implement?	*Elements of the profiles and competences:* *-Concrete pedagogies* *-Topics address related to ESE* *-Didactics they work (competences implicit)*
3	Since in occasions there is no specific subject called "Environmental Education" or "Sustainable Development II", If you had to explain to someone who are you as educator in ESE, how would you define yourself?	*Elements of the profile* *-Self-definition as educators in relation to a discipline, pedagogical orientation, etc.*
4	Particularly, as *_____* *(name the self-definition they just said))* How would you say is your relation to your students? What would you say you want to promote in them?	*Elements of their competences* *-Define relation with students describing their pedagogical visions of educator, student and the aims of ESE*
5	What motivated you or lead you to be interested in the environment and/or sustainability issues and later on to become an educator?	*Elements of the profile* *-Drivers behind their interest in ESE*
6	What didactic challenges have you faced in your experience as *____*? *(For instance, maybe when you wanted to approach a certain topics the way you wanted to approach it did not work, etc.)*	*Elements of the Didactic Challenges*

7	How from your role as *_____* you have been able to promote transformations beyond your classroom, for instance maybe at the institutional level, community, etc.? *[If negative response, ask:* Why would you think this has not been the case?]	*-Elements of their competences and Didactic Challenges.* *-Description of the transformational possibilities of their role as educators.*
8	Now, we will discuss the educator competences in ESE subject. Having in mind that competences are "interaction between knowledge, capabilities, skills, reasons and affective and individual willingness" but this time with the focus in those that an educator that works in ESE needs to have. In this sense, I would like to know, from you role as *_____* What competences would you say are necessary to be *_____*?	*Elements of their competences*
9	Having in mind the didactic challenges that you mentioned earlier such as:_____. What other competences would you think might be necessary to overcome these challenges?	*Elements of their competences*
x	That's all from my part, thank you so much for participate in the interview. Do you have any other comments or doubts you want to express?	*Comments and/or doubts*

SECTION 2

INTERVIEW GUIDE USED IN PHASE III

No.	Interview question	Expected answers
0	In general, before the pandemics, how was the role of digital technologies in your teaching as ESE?	*Description of the role digital technologies had before pandemics*
1	What obstacles or difficulties have you find during the pandemic as an ESE educator?	*Described difficulties experienced during the pandemic.*
2	What competences do you think have been more important in your role as an ESE educator to overcome these difficulties?	*Competences descriptions*
3	Have you experienced new opportunities in this pandemic situation in relation to your role as ESE educator?	*Described opportunities experienced during the pandemic*
4	To finish and in general terms, what is the importance digital technologies have had in your teaching during the pandemic?	*Description of digital technologies used and how have been used.*
x	That's all from my part, thank you so much for participate in the interview. Do you have any other comments or doubts you want to express?	*Comments and/or doubts*

APPENDIX C: Example of Learning Outcomes and Underpinning Components used in the codification process of Phase II.

RSP' Competences	**Emphasized RSP competences' *Learning Outcome* (L.O) or *Underpinning Component* (U.C.)**	**Interview extract coded as an example from Formal Context**	**Interview extract coded as an example from Non-Formal Context**
Systems: UC1	UC1: *"Identify the level of complexity and abstraction to be tackled with students and use techniques such as concept mapping, systems analysis, games, or structured research-based activities to make complexity accessible to them".*	"Please do a table that syntheses these concepts in your community" (**Formal:** E12), "and if a student asks me more information, I need to be there, to give the student a deeper vision and to those that wants to go deeper" (**Formal:** E11).	

	L.C.1.3 *"Apply different viewpoints and frames when looking at systems, e.g. different scales, boundaries perspectives and connections".*	"to be very competent in a discipline, it might be atmosphere, physics, or maybe geology, or biology, but being very competent in a discipline" (**Formal:** E8), "to add value in our contents, in the class curriculum, so that sustainability is very well reflected, it is well explained in all its dimensions" (**Formal:** E11). -.-.-.-.-.-. "to know the dynamics that exists in nature to be able to transmit this active listening to the students, then as much knowledge of the environment we have, it could be the urban context, the better. This knowledge about the dynamics of the environment, the typical too, right? 'Hey you guys! have you heard the sound of the bird? So, when that happens in means that this will happen'. So, it's like wow! An information that not many people have, and if you as educator can have it, it's better that you have more than you lack of it and you won't be a little lost in the dynamics of nature" (**Non-Formal:** E9), "more knowledge purely ecological, let's say. In way, I would say, to have strong basis in the environmental topic, for instance, if it's about pollution and the odors, try to link the	"to know the dynamics that exists in nature to be able to transmit this active listening to the students, then as much knowledge of the environment we have, it could be the urban context, the better. This knowledge about the dynamics of the environment, the typical too, right? 'Hey you guys! have you heard the sound of the bird? So, when that happens in means that this will happen'. So, it's like wow! An information that not many people have, and if you as educator can have it, it's better that you have more than you lack of it and you won't be a little lost in the dynamics of nature" (**Non-Formal:** E9), "more knowledge purely ecological, let's say. In way, I would say, to have strong basis in the environmental

		environmental pollution and the air quality. But well, this is the engine to achieve a debate, you know? It could also be, which plants are in a river that might be bio-indicators of environmental problems, and from this point then, provoke a debate that awakens: 'Wow! Then what is going on? Why is this problem emerging?' In sum, the ecology it's important to generate this debate." (**Non-Formal:** E10), "to have minimal knowledge of environmental education" (**Non-Formal:** E14).	topic, for instance, if it's about pollution and the odors, try to link the environmental pollution and the air quality. But well, this is the engine to achieve a debate, you know? It could also be, which plants are in a river that might be bio-indicators of environmental problems, and from this point then, provoke a debate that awakens: 'Wow! Then what is going on? Why is this problem emerging?' In sum, the ecology it's important to generate this debate." (**Non-Formal:** E10), "to have minimal knowledge of environmental education" (**Non-Formal:** E14).
Transdisciplinarity: U.C.3.2a	U.C.3.2a *"Manage the co-creation of collaborative processes: problem framing, value recognition, consensus building and the integration of different*	"we cooperate with other schools to work around noise pollution in the city and together we were for ¼ of an hour in absolute silence, those kind of things" (**Formal:**E5), " I work in a collective way, a	"we work with collective organizations, we have a bag of the city needs, that we later on pass to the educational centers

	discipline and other stakeholders' knowledge".	team of educators of the course, so I have to be able to organize a small group, even if it's only 2-3 people" (**Formal:** E11) "in the class curriculum we don't talk explicitly about sustainability but here is space called tutorship and in there we have a small program that works different things like sustainability" (**Formal:** E15), "even though I studied environmental sciences, it would be good that more people from other schools could come, people that can come and motivate the students(…) we have created a micro-network here in Barcelona of people who work the eco-agricultural topic and together with other teacher we have created a sustainability commission to be in touch with them" (**Formal:** E16). -.-.-.-.-.-.-.-.-. "we work with collective organizations, we have a bag of the city needs, that we later on pass to the educational centers (…) it is a competence to go outside and search in your environment, saying: "ok here there's people related with this farmers that will suite for "x" thing (…) it's not necessary to do great things, but we need to be able to find those things that are already done" (**Non-Formal:** E2) "I coordinate the	(…) it is a competence to go outside and search in your environment, saying: "ok here there's people related with this farmers that will suite for "x" thing (…) it's not necessary to do great things, but we need to be able to find those things that are already done" (**Non-Formal:** E2) "I coordinate the work between the technicians that stimulate and accompany with the educational agents. To net a network of contact to learn digital competences through working sustainability and inclusive projects, to trigger these relationships within the city to maximize these possibilities" (**Non-Formal:** E3).

		work between the technicians that stimulate and accompany with the educational agents. To net a network of contact to learn digital competences through working sustainability and inclusive projects, to trigger these relationships within the city to maximize this possibilities" (**Non-Formal:** E3).	
	U.C.3.1: *"Recognise the importance of involving people from different disciplines and other stakeholders to tackle sustainability related issues".*	"Work conjoint projects together with the chemistry teachers, for naming a subject, to relate this with learning how to treat the olives that they grow" (**Non-Formal:** E3).	"Work conjoint projects together with the chemistry teachers, for naming a subject, to relate this with learning how to treat the olives that they grow" (**Non-Formal:** E3).
Participation U.C.9.3 and U.C.9	U.C.9.3 *Identify strengths and weaknesses in top down and bottom up approaches and note the advantages of participative solutions.*	"They are the messengers of this information within their families, in their social networks, with their friends, I make them protagonist" (**Formal:** E4); "they have won visibility, they share they experiences with the exterior. Now the school do not understand the projects without their participation, the very students when they see something they alone say: let's do this or that!" (**Formal:**E5).	

	U.C.9 "U.C.9 *Use techniques and pedagogies fostering participation of learners within and outside the class, such as project-based pedagogy, leadership games and consensus-building activities".*	"It is something we work in parallel with the class objective, sometimes within classes, doing a project that looks at environmental components of social justice, other times related with food waste in the school diner and later on we comment this in class" (**Formal:**E5). "they plant, harvest, prepare and eat those aliments in the school garden and with the farmer, work service-learning activities in the school diner, since teachers have the obligation to work this, and we accompany them for a long time" (**Non-Formal:** E2); "That could be a longer project, such as service-learning one, this is really when our interventions really make the student to participate, act and collaborate with other social organizations that are working the class topics, such as food poverty" (**Non-Formal:** E18).	"they plant, harvest, prepare and eat those aliments in the school garden and with the farmer, work service-learning activities in the school diner, since teachers have the obligation to work this, and we accompany them for a long time" (**Non-Formal:** E2); "That could be a longer project, such as service-learning one, this is really when our interventions really make the student to participate, act and collaborate with other social organizations that are working the class topics, such as food poverty" (**Non-Formal:** E18).
	"U.C.9.2 *Understand the central importance of enabling participants to be heard and the implications of not doing so".*	"What really interest us is that the students to be protagonist; since we have seen for a long time now, that is useless to go to a place, talk, talk and that the only thing they do is listen. When they are the protagonists and they have to do things, is	"What really interest us is that the students to be protagonist; since we have seen for a long time now, that is useless to go to a place, talk, talk and

		much easier to acquire a certain knowledge" (**Non-Formal:** E6). "Now, with citizen science, they are generating scientific content that is trustable, so that also empowers the students, they can see that a scientific committee validates what they do" (**Non-Formal:** E10).	that the only thing they do is listen. When they are the protagonists and they have to do things, is much easier to acquire a certain knowledge" (**Non-Formal:** E6). "Now, with citizen science, they are generating scientific content that is trustable, so that also empowers the students, they can see that a scientific committee validates what they do" (**Non-Formal:** E10).
Futures	*U.C.5 Utilize future studies techniques such as simulation games, future newspaper, scenario analysis and back casting.*	"my exams always have two images with 70 or 60 years of difference, I want them to explain to me the changes in the landscape at the social, ecological and climate change levels*"* (**Formal:** E17).	
Decisiveness	*L.O.12.2 Take decisions even in a context of sustainability related dilemmas, uncertainties, contradictions and wicked problems in accordance with their values, being aware that postponing decisions and not acting is also a decision.*	"We tried to look at it in a different way, we did an environmental commission integrated basically by the students where they were in charge of doing the school diagnostic and to propose activities to carry on, things to improve and to reduce the consumption" (**Formal:** E5) "I asked them: Would you motivate yourself to do different good actions? Or	"I asked them: Would you motivate yourself to do different good actions? Or maybe they come up with new ideas and I motive the group to be autonomous since at a certain point we no longer are with them, in some cases the

		maybe they come up with new ideas and I motive the group to be autonomous since at a certain point we no longer are with them, in some cases the garbage topic could end up in an action of awareness to pick up trash in the Collserola mountain, etc." (**Non-Formal:** E9)	garbage topic could end up in an action of awareness to pick up trash in the Collserola mountain, etc." (**Non-Formal:** E9)
Attentiveness	U.C.2.1 "*Access and analyze current research and reports on a range of sustainability-related issues".*	"to search information, analyze it, the reading, and generate useful information for the students" (**Formal:** E11).	
Criticality	U.C.4 **"***Utilize techniques to challenge assumptions such as problem-based learning, debates or dilemma analysis".*	"even though some activities are evidently about reaching very specific knowledge, they have to be self-reflective of their own practice, that try also to de-construct something, I'm not saying what they know is not important, but problematize this" (**Formal:** E12)	
Empathy	U.C.6 "*Employ techniques to help learners develop their empathy within a context of sustainability, e.g. use of images, drama, paired simulation, debate and role-play".*	"They had to represent with a video an interview so they make up as represented a TV presenter, other was a contester and the rest friends that explain a certain type of life. So we propose to do a video and they have to search what was threatening each living being, for instance, in the case of the shark the way some fisherman are cutting parts of their body, or the case of the pesticides that affects the bees, etc. So it	

		was really interesting and it was a way for them to feel what the animal was experiencing, transmitting love for the nature, we are not above the rest of the living beings, to be empathetic" (**Formal:** E4).	
	U.C.6.1b *"Listen actively and authentically to others and build on each other's views".*	"Working for a long time with a school, generates more bonding between us and the students and their teachers" (**Non-Formal:** E18)	"Working for a long time with a school, generates more bonding between us and the students and their teachers" (**Non-Formal:** E18)
Creativity	U.C.7: "*Apply creative and innovative teaching techniques in relation to sustainability issues, positioning the teaching processes in a real-world or simulated context".*	"We go to the olive trees plantations to discover what is a forest, and what is an agricultural area, or we go to eco and non-eco farms" (**Non-formal:** E2).	"We go to the olive trees plantations to discover what is a forest, and what is an agricultural area, or we go to eco and non-eco farms" (**Non-formal:** E2).
Responsibility	L.O.8.3 "*Reflect critically on their own decisions and actions and those of others, looking for opportunities for improvement and development".*	"But through the students I do provoke changes in families. There's a lot of parents that when you have students that love your class the, family come asking who I am so that they understand why their child don't want to buy mangoes from x places" (**Formal:** E4). "That they can see that everything is not working correctly, that is something that we all are doing" (**Non-Formal:** E9).	"That they can see that everything is not working correctly, that is something that we all are doing" (**Non-Formal:** E9).

Values	U.C.10.2b "*Operate in an open way that engenders trust and empowers others".*	"I don't like that image of the professor being the only one that teaches, I like that I can get to reach them in deeper and different levels, make them think about their values, not only about the environment but also about our society." (**Formal:** E15).	
	UC 10.1 "*Facilitate and participate in the learning process with colleagues as well as learners".*	"Provide tools to the professors so they can develop their own projects and later on to be autonomous" (**Non-Formal:** E3)	"Provide tools to the professors so they can develop their own projects and later on to be autonomous" (**Non-Formal:** E3)
Action	U.C.11.3 "*Be able to see meaningful educational opportunities in 'real life' and encourage learners to do the same".*	"through the research the students do in their master and PhD students linked to, for instance the Barcelona City Hall, so there's impact and transformation" (**Formal:** E7).	
	UC11.1b "*Make use of the reflective learning cycle (planning, acting, reflecting, adjusting or the Anticipation-Action-Reflection cycle)".*	"in the part of action, we try that this could be like tea, to discuss, to take some strength and say: ok, we have arrived to this conclusion, but, can we do more things to change? Can we change the way things are working?" (**Non-Formal:** E9).	"in the part of action, we try that this could be like tea, to discuss, to take some strength and say: ok, we have arrived to this conclusion, but, can we do more things to change? Can we change the way things are working?" (**Non-Formal:** E9).

APPENDIX D: Competences emphasized sorted by educational context in *Phase II*.

Formal			***Non-Formal***		
Systems	25	Higher	**Transdisciplinarity**	Higher	21
Transdisciplinarity	20		**Participation**		20
Values	16	Middle	*Values*	Middle	16
Action	16		*Action*		16
Empathy	16		*Systems*		15
Participation	15		*Empathy*		14
Creativity	13		*Creativity*		14
Attentiveness	12		*Criticality*		8
Criticality	11		*Decisiveness*		7
Responsibility	11		*Responsibility*		6
Decisiveness	6	Lower	Attentiveness	Lower	2
Futures	3		Futures		0

APPENDIX E: Motivations related to RSP competences sorted by context in *Phase II.*

	Studies		*Working Institution*		*Participation in working Educational Institution*		*Participation in non-institutional experiences*		*Institution reputation*	
RSP' Competences	**F.**	**N.F.**	**F.**	**N.F.**	**F.**	**N.F.**	**F.**	**N.F.**	**F.**	**N.F.**
Systems	3						1	1		
Attentiveness										
Transdisciplinarity	5	2						1		
Criticality										
Futures										
Empathy		1					3	6		
Creativity				2				1		
Responsibility	2						2	1	1	
Participation					1				1	
Values			1		1		1	2		
Action	2	2				1		3		
Decisiveness								1		
TOTAL BY MOTIVATION AND SETTING	12	5	1	2	2	1	7	16	2	0
TOTAL BY MOTIVATION	17		3		3		23		2	

APPENDIX F: Challenges related to RSP competences sorted by educational context in *Phase II*.

	Instructional		***Institutional***		***Community/Society***	
RSP' Competences	**F.**	**N.F.**	**F.**	**N.F.**	**F.**	**N.F.**
Systems	6	3	1	0	0	0
Attentiveness	1	2	0	0	0	0
Transdisciplinarity	3	1	3	4	2	3
Criticality	0	1	0	1	0	0
Futures	0	0	0	0	0	0
Empathy	2	1	1	2	0	0
Creativity	0	0	1	2	0	0
Responsibility	0	0	1	1	0	0
Participation	1	2	1	0	1	0
Values	1	2	0	2	0	0
Action	2	0	0	0	0	0
Decisiveness	0	1	1	0	0	0
TOTAL BY CHALLENGE AND SETTING	16	13	9	12	3	3
TOTAL BY CHALLENGE	29		21		6	