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ELCRA Environmental Literacy

Learning outcomes and competencies framework to foster environmental literacy and prevent radicalized environmental activism

RESPONSIBLE PARTNER

University of Coimbra

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Learning outcomes and competencies framework to foster environmental literacy and prevent radicalized environmental activism

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WP 3 - Development of a community of practice on issues of environmental literacy and prevention of radicalised environmental activism

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1. Introduction

The MOOC titled "Environmental Literacy and Empowerment for Climate Justice" was created within the ELCRA Project and intends to equip higher education students with the knowledge, skills, and competencies needed to understand and actively address environmental challenges. The course adopts an integrated approach to environmental literacy, highlighting critical awareness of ecological systems, sustainable lifestyles, and active involvement in tackling the climate crisis.

This methodological brief, inspired by Guraziu & Latorre (2024), describes the development of a framework of learning outcomes and competencies to promote environmental literacy and pro-environmental behaviors, with a systemic vision of climate justice, for university students across Europe, along with a Massive Open Online Course (MOOC).

The MOOC focuses on three key areas of development: knowledge (Thinking), by deepening understanding of environmental processes and sustainability principles; skills (Personal and Social), through the application of systems thinking, problem-solving, and communication for sustainability; attitudes (Acting), fostering responsibility, empathy, and ethical engagement with the planet; and activism (Acting), encouraging civic participation and transformative action at local and global levels. These areas enable students not only to navigate environmental issues but also to become agents of change who can engage in climate activism safely, responsibly, and non-violently.

Based on the posthumanism approach that argues that traditional frameworks fail to address contemporary challenges like globalization, technological advances, and ecological crises (Braidotti, 2013b), and drawing on a constructivist theoretical perspective that maintains learners are not passive recipients but actively construct knowledge and meaning through experience, reflection, and social interaction (Vygotsky, 1978), this learning outcomes and competencies framework aligns with Bloom et al.'s (1956) taxonomy of

educational objectives, GreenComp: The European Sustainability Competence Framework (Bianchi et al., 2022), and LifeComp: The European Framework for Personal, Social, and Learning to Learn Key Competence (Sala et al., 2020). Together, these frameworks support the MOOC's pedagogical approach and are tailored for university students, ensuring that environmental literacy includes not only knowledge and awareness but also the competencies needed to lead transformative, sustainable change in this era of constant, unpredictable challenges.

In this matter, we adopted the Council of the European Union (2017) definitions of learning outcomes and competencies. Learning outcomes have been defined as "statements regarding what a learner knows, understands and is able to do on completion of a learning process, which are defined in terms of knowledge, skills and responsibility and autonomy" (Council of the European Union, 2017, p. C189/20). Competence, in its turn, means "the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development" (Council of the European Union, 2017, p. C189/20).

2. Objective and Aims

The development of this framework is guided by the goal of ensuring pedagogical coherence, relevance, and alignment with European standards for education for sustainable development (ESD). ESD is a key component of the UN's Sustainable Development Goals (SDG) and it aims to provide individuals with the knowledge, skills, values and attitudes to create a more sustainable future by addressing environmental, economic, and social challenges through their daily choices and actions (UNESCO, 2025).

This framework serves as a strategic foundation for structuring course content, defining learning objectives, and fostering competencies essential to active and responsible engagement with environmental issues. This framework has the following aims:

1) Clarify the pedagogical approach, emphasizing the integration of cognitive, socio-emotional, and behavioural dimensions of learning for sustainability through a posthumanist and constructivist lens.

2) Align the expected MOOC's learning outcomes with the principles and competence areas established by the GreenComp: The European Sustainability Competence Framework (Bianchi et al., 2022) and the LifeComp: The European Framework for Personal, Social and Learning to Learn Key Competence (Sala et al., 2020).
3) Compile the learning outcomes of the MOOC, outlining the specific knowledge, skills, and competencies students are expected to acquire.
4) Present a clear progression of learning outcomes based on Bloom et al.'s (1956) taxonomy of educational objectives and its review (Anderson & Krathwohl, 2001).
5) Provide guidance for educators and stakeholders on how the MOOC contributes to developing learners' capacity to think critically, act responsibly, and participate effectively in environmental decision-making.
6) Support the evaluation and improvement of the course by establishing clear and measurable outcomes aligned with European frameworks for competence-based learning.

3. Theoretical foundations

Environmental Literacy inspired by Posthumanism

Recent turns to posthumanism theory in the social sciences have called for radical reconceptualization of education in response to the onset of the Anthropocene epoch (Rousell, 2016; Snaza et al., 2014), a time typified by anthropogenic climate change, catastrophic loss of biodiversity, zoonotic disease, and pervasive computational technologies (Braidotti, 2013a; Lewis & Maslin, 2015).

Posthumanism is a philosophical and theoretical framework that argues for pedagogical approaches that are flexible and responsive to the complex interactions between humans and nonhumans, and that seeks to adequately address contemporary challenges such as the climate crisis. It advocates a student-centered, relational model that values diversity, adaptability, and the integration of human and non-human elements into educational

practices. This perspective not only considers the ethical and social implications of learning in the 21st century (with all its unpredictable developments) but also actively promotes inclusion and environmental awareness, fundamentally reshaping how knowledge is created and shared.

Central to posthumanist thought is a challenge to traditional views of knowledge transmission and to the hierarchical roles often assigned to educators and learners. Instead of viewing learners as passive recipients of information, posthumanist educators see them as active co-creators within a relational educational setting. In this perspective, educators are encouraged to promote collaborative knowledge-building and to adopt non-hierarchical, flexible teaching methods (Nyika & Motalenyane, 2023; Postma, 2016).

Rousell et al. (2022) emphasize the importance of democratizing educational experiences through posthumanism lens. They argue for rethinking creative educational practices in response to social transformations, including climate change and technological advancements. This perspective aligns with broader calls for pedagogies that move beyond exclusively human-centered perspectives and incorporate others beyond the human (Cutter-Mackenzie-Knowles et al., 2020; Maistry et al., 2023).

The implications of posthumanist pedagogy extend to practical uses that promote environmental literacy and social justice. Volkmann and Fraunhofer (2023) underscore the urgency of developing teaching methods that address global crises, suggesting the combination of critical media literacy with posthumanist critiques to develop essential skills for addressing environmental issues.

In the same vein, Braidotti (2013b) explores the posthuman condition and proposes a form of posthuman subjectivity that is embodied and embedded (rejecting dualisms such as mind/body and nature/culture, and emphasizing materiality and interconnectedness); relational and affective (formed through networks and relations rather than isolated individuality); and situated and accountable (grounding ethics in responsibility and sustainability rather than abstract universal norms).

Therefore, incorporating posthumanism perspectives into environmental education opens opportunities to challenge anthropocentric assumptions and to reframe relationships between humans and the environment. Posthumanist thinking disrupts the conventional

"anthropological machine," fostering a more nuanced understanding of human–non-human interactions that is crucial for environmental education (Malone et al., 2023).

This Learning Outcomes and Competencies Framework, by integrating post-humanist principles, goes beyond simply teaching environmental facts. It seeks to raise awareness of the complex relational networks connecting humans, non-humans, and contexts. By positioning learners as active co-creators of knowledge, the MOOC encourages them to critically examine anthropocentric assumptions, explore the agency of non-human entities, and reflect on their own involvement in ecological systems.

Environmental Literacy based on Constructivism

Similar to posthumanism, constructivism is a paradigm that views learning as an active, contextual, and socially mediated process. Learners construct knowledge by engaging with real-world problems, reflecting on experiences, and interacting with others. Learning it's not about absorbing facts or being mere passive recipients, but about making meaning of our experiences**.** Constructivism emphasizes the social and cultural foundations of cognition, suggesting that learning is fundamentally a collaborative process shaped by interactions with others and mediated through language (Vygotsky, 1978).

According to Dewey (1997), the experience is central to the learning process, and education must therefore be rooted in lived reality, as people learn by doing. The author stresses the importance of reflective thinking, which consists of active, persistent, and careful consideration of any belief or supposed form of knowledge, considering its foundations and the conclusions to which it leads.

At the root of thinking lies perplexity, confusion, and doubt. These do not occur spontaneously but are triggered or prompted by something specific. Reflective thinking means not accepting conclusions based on just one piece of evidence but instead involves questioning and introducing new information that may or may not support the hypotheses raised. Since thinking is prone to errors—due to reasons like past experiences, dogmas, defense of personal interests, passions, and more—doubt should always remain central. Dewey (1997) also states that the exercise of thought is the inference that guides us toward

the unknown, and it is crucial to test any inference and distinguish it from beliefs based on evidence from those without sustainability. To achieve this, reflective action requires open-mindedness, responsibility, and sincerity.

In turn, Vygotsky (1978) argues that learning is social and introduced the concept of the Zone of Proximal Development (ZPD) to illustrate how learners can reach deeper levels of understanding when supported by more knowledgeable peers or educators. This emphasis on the social nature of learning reshapes our approach to competence development across both educational and professional contexts. In the same vein, Schön (1990) proposes a new epistemology of practice—reflective practice—stating that professionals learn through reflection-in-action. Reflective practice aims to help students acquire skills for use in situations marked by uniqueness, uncertainty, and conflict. Reflective practice involves: knowing-in-action, reflecting-in-action, and reflecting-on-reflection. The first refers to the implicit skill of performing a task without conscious thought; the second is about thinking about what is being done while we are doing it and making the necessary adjustments; and the third is the retrospective analysis of an event after it has concluded to learn from it for the future. Shön (1990) also argues that teaching should be understood in terms of its epistemology of practice and that reflective practice should be included in the curriculum. As Dewey (1997) and Shön (1990) believe, students should learn by doing, guided by more experienced teachers (coaching). The student is not instructed on what to do or not to do but is rather trained—learning by doing—in a protected environment to take as few risks as possible. Thus, he proposes three models of training (coaching), namely: 1) follow me! 2) joint experimentation, and 3) hall of mirrors. These models require different skills from the teacher and student and lead to different learning contexts. Freire (1996)also points in this direction. For him, teaching is not just transferring knowledge but creating the possibilities for its production or construction (Freire, 1996, pp. 22). The capacity for learning must be exercised critically to develop “epistemological curiosity” (Freire, 1996, pp. 25), viewing education as liberation and dialogue to foster change.

Teaching based on the tradition of technical rationality, which focuses on the acquisition of skills in writing, reading, and arithmetic, is obsolete (Cachapuz et al., 2004). What is important is the acquisition of basic knowledge (knowledge, skills, attitudes, and

strategies) oriented towards practice and context, so that it can be applied critically in situations of uncertainty and complexity (Morin, 1999), as the times we are living in with the climate crisis. They should also be cross-cutting and combine the UNESCO four pillars of education throughout life: "learning to be," and its subordinates, "learning to know," "learning to do," and "learning to live together" (Cachapuz et al., 2004, pp. 17). Learning focuses primarily on student autonomy, given that basic knowledge serves as a tool that enables the shift from directed to assisted learning, which is thus autonomous. The learner becomes the author and actor in the knowledge process, going beyond formal learning and extending to other contexts of lifelong learning. They also reinforce the importance of knowledge's transversality by linking the knowledge of various disciplines to social practices.

This theoretical framework aligns with the view that learners develop understanding through experience and reflection, and that learning is inquiry-driven rather than focused on information transfer. Knowledge is co-constructed within social and cultural contexts, and educators are seen as facilitators who guide students in fostering their curiosity and in pursuing answers. Consequently, this framework adopts the following key constructivist principles:

1) Active learning: Learners engage with multimedia content, simulations, and self-assessment tools to deepen understanding.
2) Situated learning: Content is contextualized within local and global sustainability challenges, making learning relevant and impactful.
3) Reflective practice: Learners are encouraged to examine their values, assumptions, and emotional responses to complex topics.

Environmental Literacy from the perspective of Bloom et al.´s taxonomy of educational objectives

Bloom et al. (1956) taxonomy is a foundational framework in education that classifies learning objectives into hierarchical categories. It was originally developed in 1956 by Benjamin Bloom and his colleagues, and later revised by Anderson & Krathwohl (2001) to better reflect how people learn in modern contexts.

Bloom et al.'s taxonomy classifies learning into three domains: cognitive, affective and psychomotor. The cognitive domain is the most emphasized in Bloom et al. (1956). It focuses on intellectual skills, thinking, and knowledge acquisition. Behaviors are organized into six hierarchical levels, progressing from simple to complex: knowledge, comprehension, application, analysis, synthesis, and evaluation. According to Bloom et al. (1956), each level builds on the previous, encouraging progression from memorization to critical thinking and creativity. The affective domain concerns attitudes, values, and emotional responses. The psychomotor domain involves physical skills and motor coordination.

In 2001, Anderson and Krathwohl revised Bloom et al.'s taxonomy, restructuring the original framework to better reflect contemporary educational practices and cognitive science. The revised taxonomy organizes cognitive skills into six hierarchical levels, from basic to advanced, and changes the designation (nouns) to action verbs: remember, understand, apply, analyze, evaluate, and create (table 1).

Table 1. Comparison of Bloom et al.'s (1956) taxonomy and the revised taxonomy by Anderson and Krathwohl (2001)

Level		Description	Verbs
Bloom et al. (1956)	Anderson & Krathwohl, 2001		
Knowledge	Remember	Recall facts and basic concepts	define, list, identify, memorize
Comprehension	Understand	Explain ideas or concepts	describe, explain, summarize, interpret
Application	Apply	Use information in new situations	implement, solve, demonstrate, use
Analysis	Analyze	Break down information and see relationships	compare, contrast, differentiate, examine
Synthesis	Evaluate	Justify a decision or course of action	assess, critique, argue, support
Evaluation	Create	Produce original work or new patterns	design, construct, formulate, invent

Contemporary educators criticize this taxonomy, arguing that Bloom et al. (1956) sent the wrong message by placing knowledge at the bottom of the pyramid, often seen as "low-level" learning, while evaluation is at the top. Because knowledge is dynamic and used through questioning—and critical thinking involves more than mere judgment, including understanding context and creating new knowledge—the pyramid should be inverted, with knowledge at the top, not the bottom. New knowledge comes from new questions, making inquiry the true driver of learning. In this view, knowledge is both the foundation and the ultimate goal of critical thinking (Wineburg & Schneider, 2010). The Reverse Bloom Learning Framework (RBLF) reverses the hierarchy by starting with co-creation and collaboration to develop new knowledge.

The Bloom et al.'s taxonomy is also limited because it focuses on cognitive aspects, sidelining the psychomotor (skills) and affective (social/emotional) domains, which creates an imbalance in education. The RBLF redefines learning as a social, iterative, and co-creative process in which knowledge is developed through collaboration rather than just transferred. It strives to balance knowing, doing, and being in education to address a volatile, uncertain, complex, and ambiguous world (Shelley, 2021). The increasing use of AI has also reinforced this view. Instead of starting with remembering and understanding, students now begin with creation using AI tools, then move toward analysis, evaluation, and comprehension, reversing traditional Bloom's hierarchy (Pesovski et al., 2024).

In this Learning Outcomes and Competencies Framework, Bloom's Taxonomy is combined with Reverse Bloom's Taxonomy to form a hybrid approach that blends foundational knowledge with higher-order thinking. Since reverse Bloom's can be applied to specific learning situations, such as those enabled by online environments, this hybrid model offers greater flexibility by recognizing the value of both traditional and reverse methods in promoting critical thinking. Some lessons begin with creation (reverse) to engage learners and then include activities involving analysis and evaluation, as in the traditional model, and also allow for adjustments to accommodate different learner paces, enabling learners to control their own progress throughout the MOOC.

Contribution of Environmental Literacy to the GreenComp: The European Sustainability Competence Framework

The GreenComp (Bianchi et al., 2022) is a guidance tool developed by the European Commission to support learning for environmental sustainability across all sectors of education and lifelong learning across Europe. It was developed as part of the European Green Deal to help individuals and communities build the knowledge, skills, and attitudes needed to live and act sustainably. This initiative aims to promote sustainability as a core competence across education systems and to encourage responsible and empathetic action for the planet and public health. It offers a structured yet flexible framework that aligns with the MOOC goals of empowering learners to think critically, act responsibly, and envision sustainable futures.

According to Bianchi et al. (2022, p.12), "sustainability means prioritizing the needs of all life forms and of the planet by ensuring that human activity does not exceed planetary boundaries". In this context, GreenComp describes sustainability competence as the capacity to empower learners to internalize sustainability values and navigate complex systems, enabling them to initiate or advocate for actions that protect ecosystem health, promote justice, and inspire visions of sustainable futures.

GreenComp is built around four equally important and interrelated competence areas, each containing three specific competences, designed to foster values, systems thinking, future-oriented visioning, and action (figure 1). The four areas are the following:

1. Embodying sustainability values - Fosters care, responsibility, and respect for nature and human well-being;
2. Embracing complexity in sustainability - Encourages systemic and critical thinking and understanding interconnectedness;
3. Envisioning sustainable futures - Inspires creativity and optimism in imagining better futures;
4. Acting for sustainability - Focuses on taking initiative and collaborative action for change.

Figure 1. GreenComp. Source: GreenComp - The European sustainability competence framework, p. 3

The GreenComp inspired the structure of the MOOC´s modules. Each module was designed to consider the four areas of competence, and the 12 competencies helped define learning outcomes, knowledge assessment, and skills progression. The GreenComp competences were embedded into MOOC objectives and lessons, as they are defined as interdisciplinary, lifelong, and transformative, being aligned with environmental literacy and climate justice education goals.

Environmental Literacy & LifeComp: The European Framework for Personal, Social and Learning to Learn Key Competence

LifeComp is a conceptual, non-prescriptive framework developed by the European Commission's Joint Research Centre in 2020. It defines a set of personal, social, and learning-to-learn competences essential for thriving in the 21st century, across education, work, and civic life.

It was created in response to the 2018 Council Recommendation on Key Competences for Lifelong Learning, and is intended to support curriculum design, teacher training, and learner development in formal, informal, and non-formal settings. LifeComp

includes 9 competences, grouped into 3 domains, each with 3 descriptors that reflect the interdependence of emotional intelligence, interpersonal skills, and metacognitive strategies:

1. ***Personal***

- *Self-regulation:* Managing emotions, stress, and motivation
- *Flexibility:* Adapting to change and uncertainty
- *Wellbeing:* Promoting physical and mental health

2. ***Social***

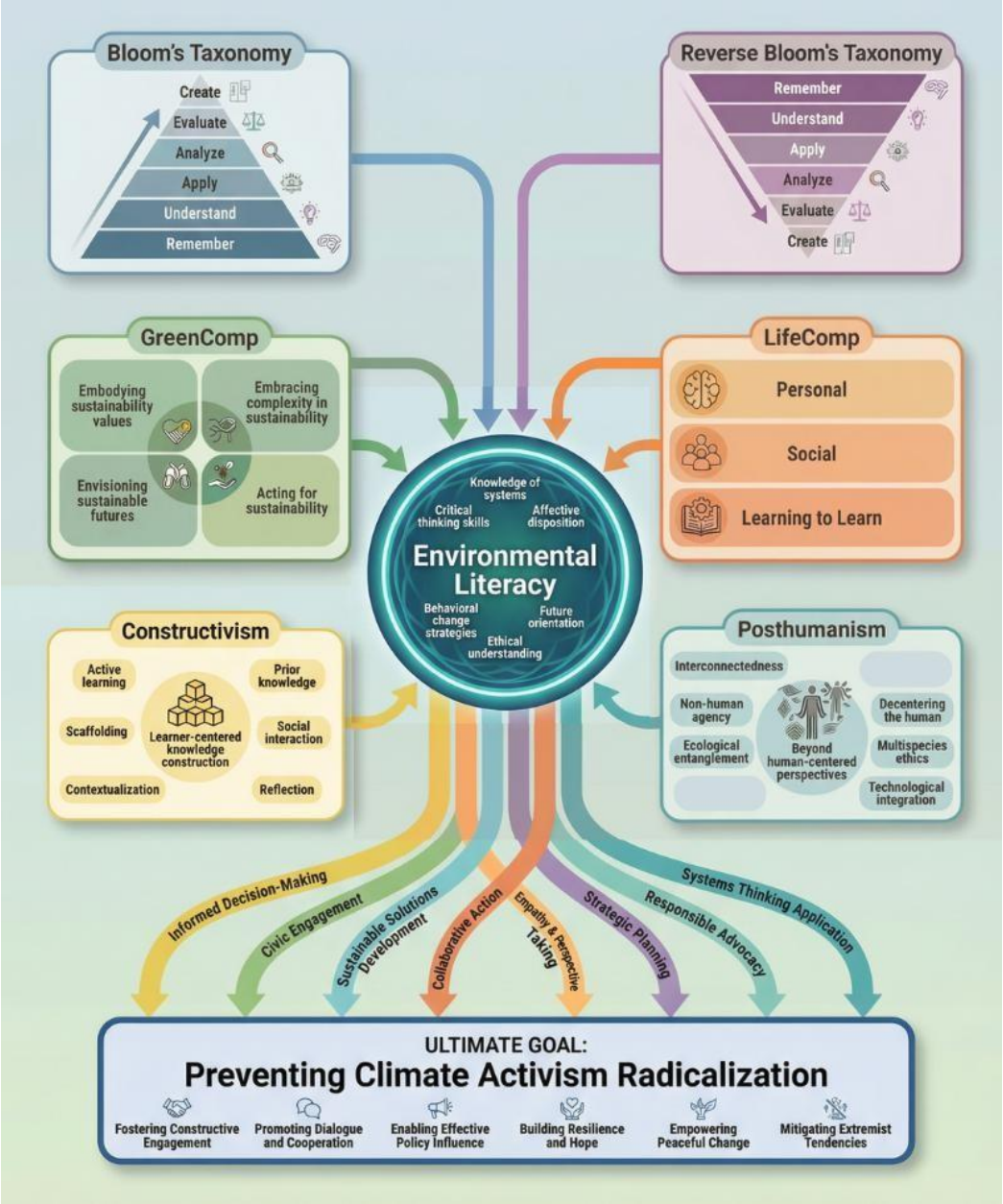
- *Empathy:* Understanding others' emotions and perspectives
- *Communication:* Expressing oneself clearly and respectfully
- *Collaboration:* Working effectively with others

3. ***Learning to Learn***

- *Growth mindset:* Believing in the ability to improve through effort
- *Critical thinking:* Evaluating information and arguments
- *Managing learning:* Planning, monitoring, and reflecting on learning

In designing this MOOC, the LifeComp was applied to incorporate a socio-emotional dimension related to climate justice education, fostering resilience and adaptability among students navigating eco-anxiety. It also supports self-directed learning in MOOCs through a growth mindset and aims to design inclusive online learning environments that value empathy, communication, and well-being.

Figure 2. Integrative framework for preventing climate activism radicalization[1]

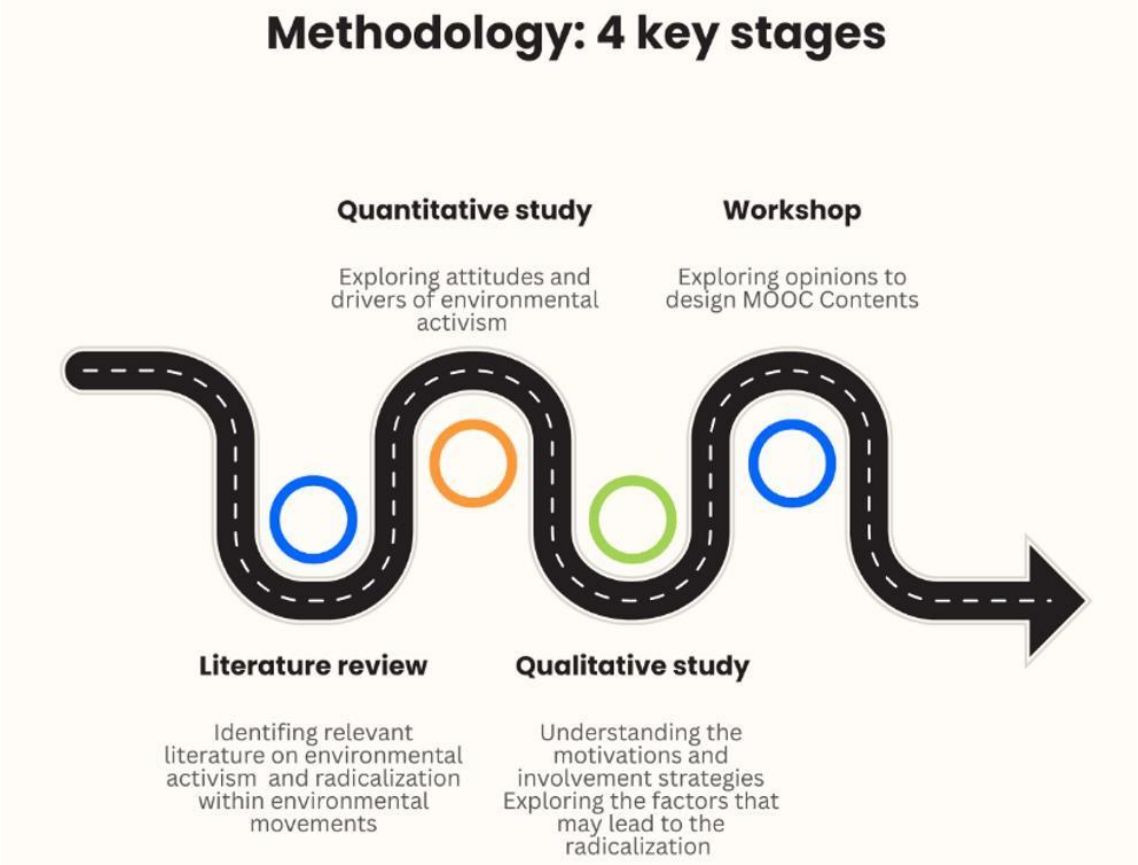


[1] This image was generated by the free version of Skywork.ai with the following prompt: *"Produce an integrative visual diagram showing the relationships among Bloom's Taxonomy, Reverse Bloom's Taxonomy, GreenComp, LifeComp, Constructivism, Posthumanism, and how they collectively connect to Environmental Literacy as a pathway for Preventing Climate Activism Radicalization."* Other prompts were used to refine the image.

4. Methodology

This framework, along with the MOOC, outlines the systematic process for developing a comprehensive understanding of environmental activism and its potential pathways toward radicalization. The approach was designed to integrate multidisciplinary perspectives and empirical insights gathered through both quantitative and qualitative research. It combines theoretical analysis, data-driven investigation, and participatory engagement to ensure a robust and contextually grounded outcome. This framework has been developed through 4 key stages (Fig. 3): literature review, quantitative study, qualitative study, and hands-on workshop.

Figure 3. Methodology: 4 key stages



1st stage: literature review

A **literature review** was conducted to identify existing research on environmental activism and to examine key cases of radicalization within environmental movements. This review was conducted by all consortium partners, each contributing their expertise in areas such as Social Psychology, Pedagogy, Law, and Communication Science to provide insightful and current perspectives in their respective fields (Molinario et al., 2024). In this first stage, we also include the careful reading, analysis, and synthesis of GreenComp: The European Sustainability Competence Framework (Bianchi et al., 2022); LifeComp: The European Framework for Personal, Social, and Learning to Learn Key Competence (Sala et al., 2020), and Bloom et al.'s taxonomy of educational objectives (Bloom et al., 1956). These readings enabled us to define the competences to be taught and to structure the MOOC into several modules/lessons. These steps resulted in the definition of competencies and learning outcomes, presented for each module, which comprises several lessons.

2nd stage: quantitative study

A **quantitative study** on attitudes and drivers of environmental activism was conducted, using a cross-cultural survey with 792 higher education students from countries within the consortium and the US (Telesca et al., 2025). It aimed to gain an in-depth understanding of university students' attitudes and opinions on sustainability issues and the fight against climate change, providing us with information on the content to be developed in the course.

3rd stage: qualitative study

A **qualitative study** was conducted to understand the motivations and involvement strategies of students and activists regarding environmental issues, as well as to explore the factors that may lead to the radicalization of certain individuals and groups. The research was based on semi-structured interviews and focus groups conducted in five countries within the consortium (Italy, Lithuania, Poland, Portugal, and Spain). It involved 49 participants (24 students and 25 activists) for the semi-structured interviews and 52 participants (14 activists, 19 students, and 19 academics) for the focus groups (Melacarne et al., 2025). This study, like the quantitative study, contributed to the definition of the MOOC's content.

4th stage: workshop

A **workshop on Climate Justice Activism** was held in Coimbra on 11 December 2024, as part of the conference "Climate Justice Activism: is it possible to change the world without breaking the rules?". This workshop aimed to explore students' and activists' opinions on the learning content that should be included in the MOOC (Table 2). A dynamic was developed in which participants were invited to select and rank the topics as very important, important, or irrelevant, listed on cards prepared by each consortium member according to their area of expertise. Participants were also invited to add other topics they considered relevant that were not mentioned on the cards.

Table 2 shows the various areas of expertise of the consortium members (law, education, communication, and psychology), with the respective topics, taking into account their importance, with the most important ones written in green and the important ones in blue, corresponding to the topics that were voted on by three or more countries. The topics that participants added are in black. These results also informed the design of the MOOC.

Table 2. Development of learning contents

Area	Themes
Law	Environmental agreements Rule of law Right to access to information Deliberative mechanisms Fundamental rights and human rights (means of protection)
Criminal Law	Environmental crimes Criminal offence Legal interest Main penalties Omission of aid Disruption of the functioning of a constitutional body
Added concepts	Climate negotiations (COP and others). Processes and substance.

	Corporate responsibility (Require practical transformations in consumption chains (for example). how you organize the activity of the manifestation how can I react to destroying nature around me? legal DIY Right to protest. How it looks like and what it allows. Discussion of various pro-ecological legal solutions from different countries (e.g. granting legal personality to non-human beings) Freedom of expression Ecocide European Citizens' Initiative Whistleblower protection
Education Added concepts	Environmental Education Education for Sustainable Development Critical Thinking Social Justice Education Participatory Learning Community-Based Learning Transformative Learning Art and environment Effective modes of action Eco-culture Tactics for change Sociological aspect Strategies to encourage collective resolution in environmental activism Global North-South inequalities
Communication	Social Media Management for Environmental Activism Disinformation and Climate Change Green Social Marketing vs. Greenwashing Environmental Risk Communication Visual Communication of Climate Change Influence of Eco-Influencers Mastering Strategic Communication Digital Environmental Education Ethical Use of Environmental Data Cultural Narratives about Nature Deepening Communication Being More Creative

Added concepts	Artificial Intelligence, Ecosystems, and Climate Change Artificial intelligence in environmental warfare. Understand the usefulness of artificial intelligence to counter or minimize the impact of climate change. "how to talk about climate change with grandma/friends" - the basics of communicating about climate in everyday situations Publicising and disseminating the work of environmental organisations
Psychology	Pro-environmental Behaviors, Environmental and climate change activism Knowledge on current problems Social movements, extremism, and radicalization How does radicalization occur and what are its consequences
Added concepts	Story of his practice of activism. mechanisms responsible for lack of engagement don't limit the environmental narrative to activism/less emphasis on activism Coping with difficult emotions regarding climate change Building self-efficacy Global / national identity and engagement for the climate role of values and motivations in climate actions Climate anxiety

5. MOOC competencies and learning outcomes framework

Combining the Posthumanism and constructivist theoretical approaches with Bloom et al.'s taxonomy and its reverse, LifeComp and GreenComp allow us to develop a MOOC's competencies (Table 3), a learning outcomes framework (Table 4), and progression levels (Table 5). This helps us understand that students are active participants in their own learning process, capable of thinking, feeling, and acting, as they reflect on themselves, others, and the world. It also enables us to address both inner development and external sustainability

efforts, supporting the creation of competence-based curricula that are emotionally intelligent and ecologically literate, aligned with EU lifelong learning goals, SDGs, and transformative education agendas.

Table 3. Competencies framework for the MOOC[2]

Area	Competence	Descriptor
Personal	Self-regulation	Awareness and management of emotions, thoughts and behaviour (Sala et al, 2020,pp.20)
	Flexibility	Ability to manage transitions and uncertainty, and to face challenges (Sala et al, 2020,pp.20)
	Wellbeing	Pursuit of life satisfaction, care of physical, mental and social health; and adoption of a sustainable lifestyle (Sala et al, 2020,pp.20)
Social	Empathy	The understanding of another person's emotions, experiences and values, and the provision of appropriate responses (Sala et al, 2020,pp.20)
	Communication	Use of relevant communication strategies, domain-specific codes and tools, depending on the context and content (Sala et al, 2020,pp.20)
	Collaboration	Engagement in group activity and teamwork acknowledging and respecting others (Sala et al, 2020,pp.20)
Thinking*	Critical thinking	"To assess information and arguments, identify assumptions, challenge the status quo, and reflect on how personal, social and cultural backgrounds influence thinking and conclusions." (Bianchi et al, 2022, pp.14) Assessment of information and arguments to support reasoned conclusions and develop innovative solutions (Sala et al, 2020,pp.20)
	Problem-solving* | Problem framing	To formulate current or potential challenges as a sustainability problem in terms of difficulty, people involved, time and geographical scope, in order to identify suitable approaches to anticipating and preventing problems, and to mitigating and adapting to already existing problems."(Bianchi et al, 2022, pp.14) to find creative/innovative solutions to current problems
Acting*	Planning*	To identify and seek solutions in a conscious, informed, thoughtful and planned way
	Learning*	To access knowledge in an understandable way, to be informed
	Citizenship*	to know one rights and the ins and outs of politics so that one can claims and demands action from policymakers and decision-makers.
	Collective action	To gather people with the same goal and "To act for change in collaboration with others" (Bianchi et al, 2022, pp.14)
	Individual action	To identify own potential for sustainability and to actively contribute to improving prospects for the community and the planet (Bianchi et al, 2022, pp.14)

[2] *Table 3 is an adaptation of Sala et al (2020, pp 20). All * were added by the authors based on the data collected during WP2 (literature review, quantitative and qualitative studies) and Bianchi et al. (2022, pp. 14).*

Table 4. Competencies and Learning Outcomes by Module

	Competencies and Learning Outcomes		
Module	**Skill-based outcomes (Personal and social)**	**Knowledge-based outcomes (Thinking)**	**Attitudinal outcomes (Acting)**
1. Environmental Sustainability: The oxymoron of sustainability: a complex problem requiring complex thinking	Solve environmental issues	Identify the five pillars of environmental sustainability Understand the social, cultural, political and economic issues of sustainability Understand regulatory bodies and their role in environmental governance Understand the precautionary and polluter-pays principles Identify the legal issues of SDO related to environmental sustainability	
2. Perspectives of social sustainability: Is anyone living sustainably?	Advocate for social sustainability through environmental literacy	Define social sustainability Describe examples of social sustainability, cultural sustainability, economic sustainability and political sustainability (social movements) Distinguish between illegal and legal practices Understand regulatory bodies and their role in social sustainability Understand individual and business rights and duties Identify environmental crimes	Adopt a sustainable lifestyle Lead and implement sustainability initiatives

3. Climate Change: Self-awareness and paradoxes of climate footprint: mine, yours, ours… and all's	Creatively conceive new communication ideas for climate action	Explain the planetary boundaries concept Understand the impacts of the planetary boundaries Recognize the importance of a strong image in climate communication Use correctly the terms of the climate glossary Check which countries have issued climate emergency declarations Recognise legal initiatives to fight climate change Describe the causes for climate science uncertainty Justify the relevance of the IPCC reports	Have a critical perspective on the paradoxes of fighting climate change and climate activism Provide examples of individual contributions to climate change mitigation
4. Circular Economy: systemic change for climate, for people, for the planet	Suggest imaginative circular solutions Provide examples of individual contributions to a circular economy Think critically about the difficulties of circular economy models	Analyse the contribution of material consumption to climate change since the "great acceleration" Calculate the ecological footprint using an online calculator Recognize the hidden carbon footprint of ordinary products and activities Understand the uses and limitations of footprint calculators Explain the difference between linear and circular economy Enunciate the main steps of the production-consumption chain in linear economies Enunciate the main stages of the production-consumption chain in circular economies Explain the 6 Rs of circular economy Describe the overall benefits of circular economy Recognize the key product value-chains in Europe	

5. Radicalization theories	Apply the models to case studies (e.g., climate activism) to formulate interpretive hypotheses and possible outcome trajectories. Design multi-level prevention strategies (macro/meso/micro), justifying the choices in light of the theories examined.	Describe the three models of radicalization (Moghaddam, Sabic, Kruglanski), identifying their assumptions, stages, and key concepts. Critically compare the models, making explicit their convergences, divergences and strengths/limitations, and distinguishing between cognitive and behavioral radicalization. Analyze the psychological, social, and structural dynamics of radicalization processes and the interactions between individual, group, and context.	
6. Radicalization Prevention Techniques: Techniques for a pro-environmental attitude	Assess the individual, cognitive, and social impacts of radicalization, and develop communication and advocacy strategies that foster a critical and inclusive ecological culture.	Distinguish the three levels of prevention (primary, secondary, tertiary) and apply the public health model to the classification of interventions. Identify early warning signs and risk/protective factors, and describe procedures for case management and interdisciplinary referral (school–services–community).	
7. Complex Problem Solving: Environmental Sustainability: activism for complex problem solving	Legal argumentation	Identify motivational and social factors contributing to the engagement in climate activism Understand the role of activism in facilitating systemic change Understand potential difficulties faced by activists	Awareness of the legislation on individual and collective behaviour Commitment to environmental justice
8. Critical Thinking for social sustainability: leaving no one behind	Practical abilities, capabilities	Theoretical knowledge	Value-based attitude towards sustainability

9. Self-Awareness in the face of climate change	Identify and cope with difficult emotions (e.g.climate anxiety), thoughts and behaviour regarding climate change	Identify rules, rights and obligations Illustrate examples of climate litigation Legal venues or avenues to climate litigation	Deeper understanding of how self-awareness impacts habits and choices, and knowledge of Tools to engage in self-awareness Engage in critical thinking and problem-solving for climate resilience strategies Develop a sense of environmental stewardship and responsibility Foster collaborative action and advocacy for climate justice
10. Systemic Change	Design collaborative action and advocacy for climate justice Engage in critical thinking on current social practices and economic trends Expand arguments to discuss the environmental and climate challenges	Understand the dual role of law as both an obstacle and a tool for effective climate action	Refine the sense of environmental stewardship and responsibility Commit to environmental justice Envision problem-solving strategies for effective climate action

A three-level progression—beginner, intermediate, and advanced — matches the cognitive complexity of understanding, analyzing, and creating. Learners advance through these stages in each competence area (Table 5).

Table 5. Progression Levels and Learning Outcomes by Module

Module	**Environmental sustainability: The oxymoron of sustainability: A complex problem requiring complex thinking**	
Level	**Description**	**Learning Outcomes**
Beginner (Understand)	Build foundational understanding of sustainability concepts and regulatory frameworks.	Identify the five pillars of sustainability; understand the social, cultural, political, and economic dimensions; describe regulatory bodies and their roles; and define the precautionary and polluter-pays principles.
Intermediate (Analyze)	Examine interactions between sustainability issues, and governance systems.	Analyze the complexity of sustainability issues; distinguish among regulatory and governance approaches; identify legal issues related to sustainable development goals.
Advanced (Create)	Formulate and propose strategies to address sustainability challenges.	Develop solutions to environmental problems; propose policy or governance reforms promoting sustainability.
Module	**Perspectives of social sustainability: Is anyone living sustainably?**	
Level	**Description**	**Learning Outcomes**
Beginner (Understand)	Comprehend key social sustainability concepts and distinctions.	Define social sustainability; describe cultural, economic, and political sustainability examples; and understand legal/illegal practices.
Intermediate (Analyze)	Evaluate social and regulatory systems that support sustainability.	Analyze the roles of individuals, businesses, and regulatory bodies; identify environmental crimes and social justice implications.
Advanced (Create)	Lead and promote sustainability in practice.	Advocate for social sustainability; adopt sustainable lifestyles; design and lead sustainability initiatives.
Module	**Climate change: Self-awareness and paradoxes of climate footprint: mine, yours, ours… and all's**	
Level	**Description**	**Learning Outcomes**
Beginner (Understand)	Grasp foundational knowledge about climate change and communication.	Explain planetary boundaries; define climate glossary terms; recognize key international climate policies and reports (IPCC, emergencies).
Intermediate (Analyze)	Critically assess climate change communication and activism.	Analyze the paradoxes of climate activism; evaluate the uncertainty in climate science; recognize legal initiatives to combat climate change.
Advanced (Create)	Develop innovative, creative strategies for climate action.	Conceive new communication ideas; justify the role of imagery in climate advocacy; propose actionable, individual mitigation strategies.
Module	**Circular economy: systemic change for climate, for people, for the planet**	
Level	**Description**	**Learning Outcomes**
Beginner (Understand)	Understand the concepts and processes of linear vs. circular economies.	Explain linear and circular models; list main production-consumption stages; describe the 6Rs and overall benefits of the circular economy.
Intermediate (Analyze)	Evaluate challenges and implications of circular systems.	Analyze the contribution of consumption to climate change; interpret ecological and carbon footprints; identify key European product value chains.
Advanced (Create)	Innovate circular economy solutions.	Propose imaginative circular strategies; design interventions that promote circularity; calculate and interpret ecological footprints to improve them.
Module	**Radicalization theories**	
Level	**Description**	**Learning Outcomes**

Beginner (Understand)	Learn core radicalization models and theories.	Describe the Moghaddam, Sabic, and Kruglanski models and their assumptions.
Intermediate (Analyze)	Compare and apply models to real-world contexts.	Critically compare models; analyze psychological and social dynamics; distinguish between cognitive and behavioral radicalization.
Advanced (Create)	Design preventive frameworks and interventions.	Apply models to case studies; design multi-level prevention strategies justified by theory.
Module	**Radicalization prevention techniques: Techniques for a pro-environmental attitude**	
Level	**Description**	**Learning Outcomes**
Beginner (Understand)	Identify the key concepts of radicalization prevention.	Describe the three levels of prevention and the public health model; identify risk/protective factors.
Intermediate (Analyze)	Evaluate prevention methods and communication strategies.	Assess the impact of radicalization; analyze case management and interdisciplinary cooperation.
Advanced (Create)	Develop inclusive prevention and advocacy initiatives.	Design communication and advocacy strategies that promote a critical and inclusive ecological culture.
Module	**Complex problem solving: Environmental sustainability: activism for complex problem solving**	
Level	**Description**	**Learning Outcomes**
Beginner (Understand)	Understand the relationship between activism, law, and systemic change.	Identify motivational and social drivers of activism; understand legislation and obstacles.
Intermediate (Analyze)	Evaluate the impact of activism on systemic environmental change.	Analyze activist challenges; assess legal and policy frameworks; critique forms of engagement.
Advanced (Create)	Create actionable strategies for environmental problem-solving.	Formulate arguments for environmental justice; design campaigns or interventions for systemic sustainability.
Module	**Critical thinking for social sustainability: leaving no one behind**	
Level	**Description**	**Learning Outcomes**
Beginner (Understand)	Develop foundational critical thinking and sustainability values.	Understand sustainability as a value system; recognize key social challenges.
Intermediate (Analyze)	Examine social and ethical dimensions of sustainable practices.	Apply critical reasoning to evaluate sustainability strategies; assess inclusion and equity principles.
Advanced (Create)	Design equitable solutions promoting "no one left behind."	Generate new frameworks for socially sustainable actions; integrate ethical, social, and environmental reasoning.
Module	**Self-awareness in the face of climate change**	
Level	**Description**	**Learning Outcomes**
Beginner (Understand)	Build awareness of emotional and cognitive responses to climate change.	Identify emotions like eco-anxiety; understand rights and obligations.
Intermediate (Analyze)	Reflect on personal behavior and its legal/environmental implications.	Evaluate the relationship between awareness and habits; analyze case examples of climate litigation.
Advanced (Create)	Integrate self-awareness into climate resilience strategies.	Develop tools for resilience; engage in critical thinking and problem-solving for climate action.
Module	**Systemic Change**	
Level	**Description**	**Learning Outcomes**
Beginner (Understand)	Understand the systemic nature of environmental and legal structures.	Recognize law's dual role as obstacle and enabler of climate action; describe key social and economic trends.
Intermediate (Analyze)	Critically evaluate social practices and systemic interactions.	Engage in critical discussion of climate and environmental challenges; identify leverage points for change.
Advanced (Create)	Design integrated, justice-oriented change strategies.	Envision collaborative advocacy; create problem-solving strategies for effective climate action; commit to environmental justice.

6. Final notes

The ELCRA MOOC is a transformative educational experience that draws on a rich mix of learning theories and frameworks designed to empower learners as agents of change. By combining Bloom et al.'s taxonomy and its reverse, LifeComp, GreenComp, constructivist pedagogy, and posthumanism, the course goes beyond traditional teaching to promote deep, reflective, and action-driven learning.

Learners progress through cognitive skills—from remembering and understanding to analyzing, evaluating, and creating—while also developing personal and social abilities, such as empathy and tools to face eco-anxiety. They can also move from creating, posing new questions, which can lead to knowledge and enhance critical thinking. These are not just abstract ideals but real practices, integrated into the course's design, and that can be continued improved after the course completion.

Through the lens of GreenComp, participants develop sustainability skills that help them think systemically, act responsibly, and imagine futures based on ecological balance and social equity. Constructivist pedagogy and a posthumanist approach ensure that this learning is active rather than passive, centered on real-world challenges and adaptable to different contexts.

Looking ahead, future plans could further boost the impact of the ELCRA MOOC, especially through integrating emerging technologies, such as AI. AI-powered tools can improve environmental literacy by offering personalized learning paths, adaptive feedback, and immersive, data-rich simulations that help learners understand complexity. Additionally, AI can assist with early risk detection, scenario modelling, and community-level forecasting, enhancing learners' ability to anticipate and address climate-related threats. Incorporating these innovations into future education practices would not only increase engagement but also prepare learners with advanced skills needed to navigate a more uncertain environmental world.

Together, these frameworks create a holistic learning ecosystem where knowledge, values, and action intersect. The ELCRA MOOC does not merely inform—it intends to transform. It equips learners with the tools to navigate complexity, challenge injustice, and co-create resilient communities in the face of the climate crisis.

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Learning outcomes and competencies framework to foster environmental literacy and prevent radicalized environmental activism

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Environmental Literacy

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