

# Digital Transformation and Environmental Legal Education: A Framework for Next-Generation Pedagogy in the Anthropocene

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**ABSTRACT:** Despite extensive scholarship on digital transformation in higher education, its application to environmental legal education remains under-examined. This article seeks to address this gap by proposing a multidisciplinary and theoretically informed framework, based on a synthesis of prior empirical studies on environmental law teaching. This study adopts a structured integrative literature synthesis approach. Relevant studies were identified through a systematic search of major academic databases using predefined keywords related to digital pedagogy, legal education, and environmental governance. The selected literature was thematically analyzed to construct a domain-specific conceptual framework for environmental legal education. Rather than reporting new empirical data, the framework is grounded in findings from existing empirical research. This article draws upon the digital competency frameworks, next-generation pedagogical models, and transformational digital learning theories of other disciplinary fields, and argues that the digital transformation of pedagogical models is not merely a technological enhancement, but is fundamentally a requirement for the teaching of environmental law in the Anthropocene. With this in mind, the article puts forward three key contributions. Firstly, it integrates frameworks of legal pedagogy and digital competence to demonstrate a particular educational model. Secondly, it collates legal pedagogy's emerging empirical research to substantiate previous theoretical contributions. Thirdly, it examines pedagogy's governance and quality assurance in terms of legal education in the EU and internationally. The article also outlines digital instruments for assessing competence in environmental law teaching and for supporting future empirical research on AI-enhanced environmental legal education.

**Keywords:** digital transformation, environmental legal education, digital competencies, hybrid intelligence learning, transformative pedagogy, HeDiCom framework, legal pedagogy.

## I. INTRODUCTION

The Anthropocene poses two key challenges for legal education: preparing future lawyers to address contemporary environmental challenges, and adapting to the transformative digital shift the profession and legal education are undergoing [1, 2]. In this study, the Anthropocene is treated primarily as an epistemological and pedagogical condition characterized by uncertainty, nonlinearity, and irreversible socio-ecological change. These characteristics directly inform pedagogical design by requiring teaching methods that cultivate systems thinking, probabilistic reasoning, and ethical reflection. Today's environmental law operates at the intersection of climate change, biodiversity, development, and justice, and the complexities of science, transnationalism, and digitized regulation. Lawyers require scientific and technical skills, as well as the ability to navigate diverse and complex levels of regulation and to communicate with multiple actors in a digital environment. The use of Information and Communication Technologies (ICT) in legal education provides a mechanism to integrate these diverse skills, and requires thoughtful, balanced implementation [3].

The challenges of integrating ICT into legal education are structural, but in the case of environmental law, it has taken an unusually long time to integrate digital pedagogy in a more coherent and robust theoretical fashion

[4]. The structural challenges are not simply a result of technology's uneven implementation; there is also resistance to change with respect to pedagogy.

The study of the environment poses unique challenges for the construction of the disciplinary framework, since it is characterized by constant change, interdisciplinary and empirical approaches, and a focus on the future and sustainability as well as the legal problems of intergenerational justice; and not merely the problems of the past. All of these issues make it difficult for legal education to proceed in a conventional manner because it is based upon a classical legal syllabus in which the law is static, and students are often trained through linear, text-centered modes of reasoning, as though the law were merely a text to be adjudicated. The result is a deepening gap between the skills contemporary environmental lawyers are required to possess, and the dominant pedagogy of environmental legal education. While professional practice is increasingly oriented toward the need for regulatory competence, and the ability to scientifically interpret, ethically reason, and think in systems, especially in digital environments, the dominant pedagogy remains the same. Addressing this gap requires not merely additional technologies but a reconfiguration of environmental legal pedagogy in which digital transformation is treated as integral rather than supplementary.

### 1. THE RESEARCH GAP

Despite the increase in academic and policy concern in the area of digital transformation in higher education, the literature still lacks an integrated account of digital pedagogy tailored to environmental legal education. This absence is not merely one of the several that exists, but is interconnected and ultimately constrains the possibility of developing integrated and context-sensitive approaches to the teaching of environmental law in a digital context. This study is novel in that it is the first to synthesize digital competence theory, hybrid intelligence pedagogy, and the epistemic and normative characteristics of environmental law into a single domain-specific framework. Unlike existing digital pedagogy models that remain generic or technologically focused, the proposed framework is tailored to the scientific uncertainty, transdisciplinary collaboration, and justice-oriented reasoning that define environmental legal education.

To begin with, while there have been significant advancements in the area of digital competence frameworks for educators in higher education, especially the HeDiCom framework, [5] the application of such frameworks to specific legal domains remains limited. The legal education literature remains focused on the adoption of technology in legal education at the general or instrumental level [6, 7], ignoring the epistemic, methodological, and normative dimensions of environmental law. This means that the literature lacks specific models that bridge the gaps arising from the application of generic digital competence frameworks to developing environmental legal education. Finally, the empirical evidence that exists regarding the pedagogical value of the digital transformation of legal education is still in early stage and has not yet reached a level characterized by methodological sophistication. Recent controlled and mixed-method studies report, for example, measurable improvements in legal writing through hybrid intelligence learning environments [8, 9]. However, the studies are concentrated in the development of general legal mastery, and are not in the specialized mastery needed for the practice of environmental law, particularly the scientific literacy, systems thinking, and transdisciplinary collaboration. Accordingly, whether digitally mediated pedagogy develops the specialized competencies required in environmental practice remains empirically under-specified.

The connection between digital transformation and the teaching of environmental law continues to be underdeveloped. Recent educational research further supports the pedagogical relevance of artificial intelligence and digitally mediated learning for cultivating complex and adaptive thinking. It has been argued that demonstrate that AI-supported learning environments enhance higher-order cognitive engagement and reflective reasoning [10]. Similarly, other studies show that AI-assisted educational tools can foster sustainability-oriented thinking and problem-solving skills [11]. Others highlight the structural role of digitally mediated leadership and justice-oriented pedagogy in shaping educational transformation [12]. However, these insights have not yet been systematically translated into the specific epistemic and normative requirements of environmental legal education, leaving a critical gap between general digital pedagogy research and domain-specific legal instruction. Although the theory of transformative learning has been used in the teaching of other disciplines such as sustainability education, [11] and while next-generation teaching paradigms like IDEAS have been recognized as providing rich opportunities for the digitalization of higher education, [12] the use of these paradigms in the specific teaching of environmental law has not been fully theorized. In particular, there has been little focus on how digital pedagogy can foster the types of scientific and ethical uncertainties and commitments to intergenerational justice, fundamental to environmental law education, to sustain an ecological consciousness.

## 2. THE PURPOSE OF THE STUDY

The study differentiates itself from contemporary legal education and environmental law teaching by addressing the disconnect between the practice of environmental law and the methods used in legal education. As the field of environmental governance develops, the need for legal educators to reassess the digital and transnational elements of environmental governance is pressing. There is a need to address the intersection of digital transformation and environmental legal education and the convergence of the two fields to address the pressing concerns of the field.

The study contributes to the scholarship of legal education by developing a conceptual framework integrating digital competence theory and the epistemic, normative, and pedagogical dimensions of environmental law. It framed digital pedagogy as more than a means of advancing teaching; it also included the environmental legal reasoning transformation digitally, which is exemplified by scientific uncertainty, systems thinking, and intergenerational equity. This reframing adds to the discourse in digital legal education by attempting to respond, in part, to the criticism of a digital pedagogy as a one-size-fits-all approach. It also fosters clarity on the issues that must be addressed in considering the need to revisit the curricula in the field of environmental law. Furthermore, it draws attention to the alignment of learning outcomes, assessment, and professional competencies with digitally mediated regulation. The proposed framework serves as a guide for schools and educators in curriculum design, faculty development, and maintaining quality without prescribing particular technologies or models of institutions. The study highlights, most importantly, the ethics and quality assurance of digitally mediated environmental legal education policy and governance. It situates innovative pedagogy at the intersection of environmental justice ethics, risks of digital harm, and the governance of morally aligned artificial intelligence within higher education regulatory frameworks.

## 3. RESEARCH QUESTIONS

This study begins with the assumption that the digital transformation of environmental law education in the Anthropocene is a structural imperative, not just a technological add-on. The claim is examined in a systematic and theory driven manner, the article is guided by a systematic and theory-driven manner : In what ways and for what reasons is digital transformation a structural imperative for environmental law education in the Anthropocene, beyond being a merely instrumental pedagogical enhancement?

In answering this general question, the study attempts to answer the interrelated questions by analyzing the epistemological foundations of environmental law, the digitalization of professional legal practice, and the teaching and learning of law in the context of the ongoing environmental emergencies:

- In what ways do the data-intensive and digitally mediated infrastructures affecting environmental law alter the competencies needed for environmental law education?
- In what ways do the increased digitally driven practices in the field of environmental law change the expected professional competencies and the expected teaching practices concerning graduates in environmental law?
- In the face of contemporary environmental challenges, the scale, urgency, and transnationality of which are unprecedented, what is the rationale for digitally mediated teaching practices in environmental law education?
- In what ways do the structural implications of digital competence differentiate environmental law education from other fields of law where digital transformation primarily serves as an enhancement to teaching methods?
- What are the implications of viewing digital transformation in curriculum design, governance, and quality assurance as a matter of educational sufficiency and professional responsibility?

## 4. METHODOLOGY

This study employs a structured integrative literature synthesis methodology to develop a conceptual framework for environmental legal education in the digital era. Relevant literature was identified through searches conducted in major academic databases, and the inclusion criteria focused on recent peer-reviewed studies that addressed digital pedagogy, legal education, or environmental governance.

The literature was thematically coded to identify recurring patterns concerning digital competencies, pedagogical design, ethical governance, and professional formation. These themes were then synthesized to construct an integrated framework tailored to the epistemic and normative characteristics of environmental law. This methodology does not generate new empirical data; rather, it systematizes existing empirical and theoretical research to support theory-building in digital environmental legal education.

## II. THEORETICAL FOUNDATIONS OF DIGITAL COMPETENCE IN LEGAL EDUCATION

This part explains the theory behind creating a domain-specific framework of digital environmental legal education. It examines four complementary strands of scholarship: digital competence frameworks for higher education, pedagogy 2.0, transformative digital learning, and the integrative theory of hybrid intelligence in legal education. Collectively, these works provide the theoretical underpinning of why and how digital transformation in teaching environmental law should and can be done in an educational and ethical manner.

For the purposes of this study, “digital transformation” refers to structural changes in how legal knowledge is produced, taught, and evaluated through digital systems, whereas “digital pedagogy” denotes the instructional strategies used within such digitally mediated environments. “Hybrid intelligence learning” is defined as pedagogical arrangements in which artificial intelligence tools support learning processes under sustained human legal judgment and ethical oversight. These terms are used consistently throughout the manuscript.

### 1. THE HEDICOM FRAMEWORK AND TEACHER DIGITAL COMPETENCIES

The HeDiCom (Higher Education Digital Competence) framework by Tondeur et al., [5] is among the most well developed and theoretically robust digital competencies for a higher education educator framework. The HeDiCom model, like its predecessor’s frameworks DigCompEdu and TPACK, offers a multidimensional and developmental explanation of digital competence as an interdisciplinary and multifaceted construct consisting of pedagogical, subject, communication, ethical, and developmental competencies [13]. The framework does not treat digital skills as technical proficiencies in an isolated manner, but as part of the broader pedagogical practice, discipline, and ethical considerations [14].

In the context of environmental legal education, the framework’s focus on disciplinary-specific digital literacy stands out. Environmental law educators have to grapple with not just standard legal research tools, but also socio-environmental information infrastructures such as, climate data, biodiversity information systems, pollution data, and tools for geospatial analytical procedures. Evidence-based teaching in this field, therefore, hinges on one’s capacity to assimilate legal thought with scientific and data analytical sophistication. This bridging of knowledge is underdeveloped in the disciplines of law education and remains an essential prerequisite for engaging with the realities of contemporary environmental governance.

In the setting of environmental law, the ethical part of HeDiCom is more important. Limited access to digital tools can produce procedural inequities and undermine environmental rights. This unfair lack of digital environmental information and technology can make current environmental injustices worse. Therefore, instruction should address not only privacy and academic integrity, but also equity, inclusion, and the distributive consequences of digital infrastructures in environmental decision-making.

### 2. IDEAS: NEXT GENERATION PEDAGOGY FOR HIGHER EDUCATION

While HeDiCom emphasizes educator competencies, the IDEAS framework (Innovation, Design, Evaluation, Assessment, Sustainability) developed by Guàrdia et al., [11] covers the impact of pedagogy on individual programmes and on the level of the institution. IDEAS articulates a model for higher education pedagogy focused on designing for students, authentic assessment, cooperation, learning flexibility, and sustainable pedagogy, with a specific focus on the integration of pedagogy, assessment, and the institution’s capabilities.

In the field of education for the environment and the law, the framework’s focus on authentic assessment is most needed. Ideal assessment practices in legal education, such as time-constrained exams and individual doctrinal essays, do not measure some of the competencies needed for practice in environmental law (scientific evidence interpretation, stakeholder management, regulatory negotiation). Digitally mediated pedagogies allow for the design of assessments that better reflect contexts in which environmental law is practiced, such as simulated environmental impact assessments, virtual stakeholder meetings, and collaborative regulatory drafting.

The sustainability aspect of IDEAS also parallels to a small degree the normative principles of environmental law. Any digital environmental law pedagogy should incorporate not only the technical environmental sustainability of the educational platforms, but also the pedagogical environmentally sustainable teaching and learning processes, involving the building of faculty capacity and institutional scaffolding. This also raises the environmental impact (which is often neglected) of the digital infrastructures themselves, and the need for thoughtful juxtaposition with the pedagogical approaches and environmental law’s core provisions.

### 3. TRANSFORMATIVE DIGITAL LEARNING THEORY

Combining Mezirow’s theory of transformative learning and Vindaca and Lubkina’s transformative digital learning theory, when applied to a digital classroom context, shows promise for achieving deep learning through digital tools that build diverse perspectives, structured thought, and collaborative meaning making within online

communities [14]. Environmental law education can be cognitively and normatively disruptive in a sense that it is deep and fundamental. Lawyers must radically rethink human-centered law, sovereignty and property relations, and ecological limits and intergenerational justice. This is necessary to respond to Anthropocene challenges. Digital learning environments can facilitate this by providing students with diverse perspectives on environmental justice and the relationships of laws to the natural world and by enabling them to participate in international communities focused on environmental law.

While such innovation is important, there are also some big threats to teaching methods. Environmental crises cause eco-anxiety, activist polarization, and cognitive overload. Digital platforms can also make misinformation, ideological bubbles, and polarization worse. In this context, effective and transformative pedagogy necessitates context-specific instructional planning that integrates emotional scaffolding, critical digital literacy, and structured reflection to guarantee that such transformative education enhances, rather than hinders, the cultivation of legal and professional competencies

#### 4. HYBRID INTELLIGENCE AND HUMAN-AI COLLABORATION IN LEGAL EDUCATION

Hybrid intelligence refers to the integration of human and artificial intelligence to achieve outcomes unattainable by either alone [8]. Unlike automation-centric models, hybrid intelligence approaches priorities complementarity as their objective: AI technologies enable the analysis and identification of patterns in data, whereas human students apply legal reasoning, ethical judgement, and interpretative decision-making.

Accordingly, Weber et al., [8] show results from a controlled study on pedagogy in AI-assisted legal writing in which substantial and meaningful improvements in student outcome achievements were both statistically and practically documented. Learning improvements in this case were attributable to student's metacognitive activity; that is, the ability to build, evaluate, and improve AI responses, which points to the constructive role of system design in teaching with hybrid intelligent systems. The use of hybrid intelligence in teaching environmental law is constructive. AI-powered tools can analyze complex environmental data, simulate negotiations and regulatory processes, and offer personalized, responsive feedback. However, teaching environmental law involves AI-resistant ethical dilemmas intergenerational, ecological, and distributive justice. Unresolved environmental injustices may be compounded by AI systems through the amplification of socially discriminatory gaps in the training data. Therefore, the essential AI literacy and the preservation of human control over the legal decision-making processes remain critical in developing hybrid intelligence [15].

#### 5. SCOPE AND LIMITS OF ENVIRONMENTAL LEGAL EDUCATION IN THE DIGITAL AGE

This article proposes the "Digital Environmental Legal Education Framework (DELEF)," consisting of five interrelated competency domains: (1) Digital Pedagogical Competence for Socio-Ecological Systems; (2) Competence in Environmental Data and Legal Information Systems; (3) Transdisciplinary Communicative Competence; (4) Environmental Justice and Digital Ethics Competence; and (5) Transformative Competence in Ecological Consciousness. These domains operate as a coherent system in which pedagogical design, epistemic engagement with data, ethical judgment, and professional identity formation mutually reinforce one another.

Formally, DELEF is structured as a systems-based pedagogical framework in which each competency domain performs a distinct functional role while remaining analytically interdependent with the others. Digital Pedagogical Competence for Socio-Ecological Systems constitutes the instructional core governing how complex ecological knowledge is transformed into learning designs. Competence in Environmental Data and Legal Information Systems Competence serves as the epistemic layer, enabling engagement with scientifically and legally constructed evidence. Transdisciplinary Communicative Competence operates as the relational interface facilitating collaboration across scientific, regulatory, and societal domains. Environmental Justice and Digital Ethics competence offers the framework within which the digital and legal reasoning practice is held to the standards of justice, accountability, and ethics, in particular intergenerational equity, and cross-generational fairness. Transformative Competence in Ecological Consciousness integrates the cognitive, moral, and professional identity dimensions of systems thinking and ecological consciousness.

The internal logic of DELEF is designed to be relational and not hierarchical; all domains both support and constrain the others. Pedagogical design without data competence risks being too abstract; data competence without ethical governance risks technocratic reductionism; and communicative competence devoid of ecological consciousness, risks formalism. These relations are, in the absence of qualitative metrics, visualized in figure 1, with the five domains. Components of a single pedagogical system are not isolated, and should instead be considered collaborating and reinforcing dimensions, or, interrelated skill sets.

The various competency domains cover different, yet interconnected, facets of environmental legal education. Digital pedagogical competence relates to the construction of learning activities that model intricate ecological

systems and the uncertainties of regulation. Data competence in the environment and legal systems allows students to combine legal reasoning, scientific reasoning, and computational tools. Transdisciplinary communicative competence fosters collaboration and communication with scientists, policymakers, and impacted communities. Environmental justice and digital ethics competence entails concern with the inequitable and ethically problematic access to technologies, data discrimination, and the algorithmic governance of technologies. Transformative, or critical, competence in ecological consciousness promotes systems thinking, an intergenerational sense of responsibility, and critical normative thinking about the relationships between people and nature. Constructively, Transformative Competence in Ecological Consciousness may be expressed through pedagogical designs, such as digitally mediated climate litigation simulations, transnational virtual moot courts, and data-driven exercises on environmental assessments. For instance, students could be asked to work with and interpret legal arguments based on satellite data depicting an uncertain and dynamically changing regulatory framework, a simulated regulatory hearing on deforestation data, and deforestation. Digital reflective portfolios may describe students' ethical positions on intergenerational justice and ecological responsibility. Legal reasoning strategies these teaching methods foster ecological awareness and eliminate the practice of treating environmental concerns as normative ideals.

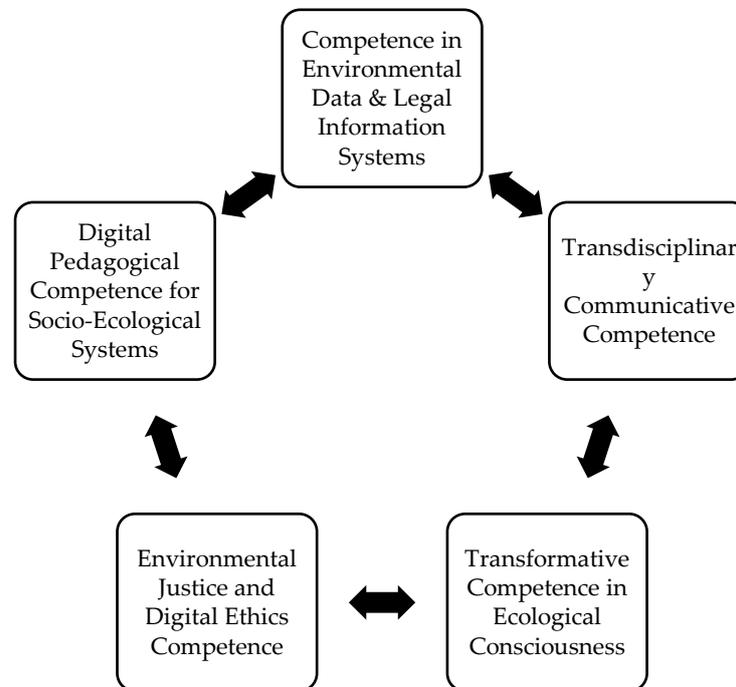


FIGURE 1. Digital environmental legal education framework (DELEF).

### III. DIGITAL TRANSFORMATION IN ENVIRONMENTAL LEGAL EDUCATION AS A STRUCTURAL IMPERATIVE

The phenomenon of digital change in environmental legal education must be considered not only instrumentally. Instrumental digitalization refers to the use of technology to increase efficiency or access within existing pedagogical models, whereas structural digital transformation entails a reconfiguration of how legal knowledge is produced, taught, and evaluated. In environmental legal education, the latter is required because core disciplinary knowledge is generated through digitally mediated scientific infrastructures and regulatory systems. Accordingly, digital transformation should be understood as structurally necessary. This is connected to the particularities of the field of study, the particularities of legal practice, and the teaching practice prompted by the scale and urgency of the environmental crisis. Taken together, these factors mean that the digital capability of educators is an integral component of the teaching and education of the law in the context of the environment and should not be seen and treated as a pedagogical improvement that can be left out.

Epistemologically speaking, environmental law rests upon knowledge systems that are digital, data-driven, and probabilistic in nature [16]. Climate governance involves the use of computational modeling, scenario analysis, and probabilistic risk assessment; the regulation of biodiversity relies on digitally enabled monitoring systems, distribution records of species, and remote sensing; pollution control makes use of networks of sensors, real-time reporting systems, and algorithmic compliance monitoring; and environmental impact assessment requires geospatial analytics and digital visualization. Legal engagement in these domains presupposes doctrinal competence, along with the ability to navigate the digital systems through which environmental knowledge is generated and contested. Students will have difficulty critically evaluating climate litigation and the legal frameworks within which climate disputes are adjudicated unless they understand the evidentiary value, assumptions, and uncertainties inherent in climate models [17]. Similarly, in order to understand the classificatory logics and methodological constraints of datasets that are generated around the conservation of species, students will need to appreciate the legal complexities of biodiversity. Hence, digital competence in environmental law is more than a mere technical skill; it forms a core component of the discipline itself.

This epistemological shift is evident in environmental legal work developing wholly within digitally mediated institutional ecologies. International environmental law negotiations and adjudication, regulatory consultations, environmental impact assessments, public participation processes, and post legislative review (or all of the above) advocacy work are now digitally supported or conducted wholly via digital platforms. The accelerated digitalization of environmental governance during and after the pandemic further normalized platform-mediated legal work [18]. Environmental lawyers now have to practice within designed digital communication systems, work with and analyze sophisticated data sets, and participate in legal work within hybrid spaces. If legal education continues to marginalize the above practices, we will produce graduates who are doctrinally sound, but will fail to meet the normative expectations of legal practice in the environmental field.

The magnitude, intricacy, and timing of the crises in the environment pedagogically challenges the scope of traditional teaching models. Activities such as the development of climate change, loss of biodiversity, and the broad degradation of the environment take place with varying spatial and temporal arrangements which are difficult to characterize and describe. Digital technologies permit the pedagogically intelligible visualization, modeling, and simulation of long-term trends and systemic relationships along with uncertainty. Moreover, these technologies allow rapid transnational collaboration, iterative learning, and flexible knowledge sharing, all of which are critical in dealing with a regulatory environment within which science evolves and policies change rapidly. In this context, digital technologies are not optional pedagogical enhancements but functional necessities [19]. Unlike fields in which digital tools primarily enhance delivery, environmental law increasingly relies on digitally mediated knowledge production and governance; therefore, digital competence becomes constitutive of professional capability rather than an optional supplement.

Digitally mediated education requires integrated infrastructures rather than isolated instructional tools. These infrastructures impact teaching and learning by influencing the creation, access, interpretation, and application of environmental legal knowledge.

The most significant aspects of this ecology are the systems that collect and store environmental data. Students studying environmental law, for example, are expected to work with specific data sets such as pollution databases, biodiversity information systems, climate repositories, and environmental tracking networks. Participation requires more than basic data literacy; it requires structured training in interpreting uncertainty, methodological constraints, and the legal significance of scientific evidence. There is a need for such preparatory training to take a more systematic, sustained, and radical approach to the critical engagement with uncertainties, methods, and legal ramifications of data. Otherwise, students are left to simply accept the data outputs or quit reasoning with the evidence altogether [20, 21]. These infrastructures also intersect with digital legal information systems. Environmental law is accessed through more than conventional legal libraries; it includes regulatory frameworks, treaties, comparative environmental law sources, and specialized databases of environmental jurisprudence [22, 23]. Students can study the law-science interface as a site of active legal reasoning [22] instead of only perceiving legal rules as writings when they employ environmental data infrastructures.

Collaborative digital environments demonstrate the trans disciplinary of environmental law. Environmental governance requires collaboration between lawyers, the scientific community, policy makers, citizens, and industry. Digitally mediated collaboration tools make such collaboration pedagogically possible across disciplines, cultures, and geographies. Finally, the infrastructure of simulation and visualization fosters meaningful engagement with the environment and with the outcomes of decisions made in its governance. Digital simulation invites students to grapple with the complex trade-offs, steps in a process, and conflicting values that cannot be illustrated with paper

and pen. In so doing, these tools make legal and scientific notions that are abstract, operational and debatable, and stimulate higher order thinking and reflection.

Hybrid intelligence learning environments further extend these possibilities by combining AI-based analysis with human oversight of the analysis. In the education of environmental law, these environments may attend to the analysis of regulations, legal research, and legal writing, so long as the design of the learning activities centre on metacognition and the legal discretion of the teacher is retained. The strength of hybrid intelligence educational environments is not in the ability to automate processes, but rather in the ability to help students learn the skills of defense, evaluation, and contextualization of AI-generated outputs.

#### IV. LEARNING OUTCOMES, COMPETENCY DEVELOPMENT, AND PROFESSIONAL IDENTITY

Digitally mediated environmental legal education seeks to cultivate a holistic professional competence, prioritizing expertise in the environmental sector, advanced digital literacies, and transformative professional attitudes over the mere accumulation of discrete skills. These learning outcomes form a single developmental continuum linking technical skills, epistemic judgment, and professional identity formation. This structuring of learning goals highlights how hard it is for an environmental lawyer to do their job in a field that is very regulated, full of data, and digital.

Legal-technical practice is increasingly shaped by digital infrastructures. The current approach to legal research requires not only an understanding of legal research databases but also an understanding of data environmental platforms that structure claims for evidence in environmental regulation and litigation. Students and future practitioners must integrate doctoral reasoning with scientific and technical evidence, including models with probabilities and data visualizations. AI-augmented drafting environments transform legal writing as well, facilitating higher-order skills and greater oversight by students, and moving away from passive drafting environments, while legal problem-solving becomes more systems- and computation-oriented. Evidence from Weber et al. shows that writing quality can improve with legal hybrid intelligence through AI, but only if course design incorporates human oversight, metacognition, and cognitive engagement, illustrating how design, rather than technology, is primary [8]. There are also technical legal skills, as well as skills related to environmental subject matter, including knowledge of both legal doctrine and relevant scientific evidence. Students of environmental law must learn the structure of various sets of environmental law while also gaining the skills to analyses and interpret environmental information, understand uncertainties of science, and think about the implications of a law or other form of regulation. Digitally mediated learning environments support these competencies by enabling access to environmental datasets, facilitating the visualization of ecological processes, and supporting engagement with interdisciplinary research. These environments situate legal norms within their empirical and socio-ecological contexts, countering the abstraction that often characterizes doctrinal legal instruction [24, 25].

It is also necessary to further interdisciplinary environmental legal education skill development that involves collaborative work across a variety of fields. Activities in environmental governance are often transdisciplinary, interdisciplinary, and multi-institutional. As a result, lawyers need the ability to communicate and work alongside a wide range of professionals, such as scientists, policymakers, the public, and industry. Digitally mediated learning environments are designed to foster collaboration with a diverse set of participants and build skills in deliberation, negotiation, and integration of knowledge. These skills are crucial due to the collaborative work in environmental governance that extends beyond a single discipline and spans multiple jurisdictions.

Digitally mediated environmental legal education aims to develop competencies and professional identity of students. This article argues that there is a need to equip students with not only the ability to use technology, but also the ability to exercise responsibility, as without these attributes, they will not be able to facilitate the desired socio-ecological transformation. Students ought to possess a solid understanding of the environment and a conviction that responsible stewardship of the environment is a matter of social justice and fairness to posterity. They also ought to realize that the attainment of these objectives may not be achievable through law. The author suggests that law may constrain to students' goals. Law may constrain as well as enable environmental action. Digital platforms assist in achieving this by providing students with new environments, which compel self-reflection, and assist students to self-organize into collaborative teams to practice environmental law across borders. The integration of these technologies in a digital classroom environment may assist students to go beyond basic competencies in a practice-oriented environment. The integration of technologies may assist students to practice and more importantly, shape students' professional identity.

Equally, in addressing the challenges of environmental law teaching and teaching in digitally mediated environments, there are certain challenges that need to be managed. Individuals who work with environmental issues face eco-anxiety, fatalism, disengagement, misinformation, and conflict. In digital education, environmental

law educators face similar issues. For digital environmental law teaching to be effective, lessons must be carefully designed and include emotional and psychosocial support, critical media, and structural reflection. These measures help ensure that legal and professional reflection isn't lost in an environment where overlearning and transformative learning are beneficial.

While digital environmental legal education literature is sparse, there is also an absence of research on gaps in digital legal education, even though legal education literature is more extensive. In a recent study Weber et al., [8] propose that, contrary to superficial and short-term outcomes, AI nurtured pedagogy can foster and achieve deep learning, and that research and legal practice preparation, especially when frameworks, skills, and digital competencies are integrated and cross within legal education, adds to the evidence. These findings are pertinent to digital environmental legal education, especially when the substantive legal reasoning digitized in the digital competence framework is critical [9]. Some other cross studies allude to the fact that online legal education, when designed to certain specifications, is capable of achieving the same learning outcomes as in person education and, among other things, improved student participation and flexibility. These advantages are dependent on the supportive and intentional constructive quality indicating that pedagogy design is more than a technology and even a digital one [6].

Digital pedagogy can support deeper legal understanding by linking digital literacy, knowledge construction, and professional legal practice. The significant lack of systematic empirical studies in the context of environmental law, in particular, the advanced development of professional identity and the pathways associated with it, represents an urgent and valuable area of inquiry. Nonetheless, the lack of systematic empirical studies concentrating on environmental law and the formation of and pathways to professional identity remains a critical gap in research. In the future, empirical studies might frame the suggested domains of competency within definable boundaries, such as the ability of students to understand environmental data sets and perform supervised AI-supported legal analyses, as well as ethically reason through digitally mediated simulations of regulation. To assess the application of concepts, hybrid intelligence in environmental law, and pedagogy, a combination of surveys, assessments of performance, and design of courses to enact learning objectives may be used.

Future studies can use different measurable criteria to define each DELEF competency domain. For example, Digital Pedagogical Competence for Socio-Ecological Systems might assess how teachers create digitally mediated learning activities on ecological complexity, such as simulation-based regulatory exercises or data-driven case studies. Competence in Environmental Data and Legal Information Systems might evaluate students' skills in understanding environmental datasets, integrating scientific uncertainty into legal reasoning, and evaluating digitally produced evidence. Transdisciplinary Communicative Competence might be assessed through students' engagement in collaborative activities with scientists, policymakers, and community members, such as virtual stakeholder negotiations and interdisciplinary project-based assessments. Environmental Justice and Digital Ethics Competence might be assessed through students' ability to discern algorithmic bias and assess data governance and to defend an equitable and intergenerational just position legally in the trust of equity. Transformative Competence in Ecological Consciousness might be assessed through longitudinal reflective portfolios that relate to systems thinking, ethics, and professional identity in the environmental domain [27, 28].

Evaluating the framework can include a variety of methods, including surveys, rubrics-based assessments, learning analytics, and experimental teaching. To assess the pedagogical value of hybrid learning environments in the teaching of environmental law, an empirical testing design may incorporate controlled comparisons of digital and traditional methods of teaching. These various methods of collecting data will promote the validation of DELEF in different contexts and curricular frameworks.

## V. GOVERNANCE, ETHICS, AND QUALITY ASSURANCE

The changes to teaching and educational practice described above require changes in governance and ethics and the construction of frameworks for sustaining quality. If the digital transformation of environmental legal education is seen as an imperative rather than an innovative idea, it places responsibilities on institutions beyond a single course or instructor. The durability of digital environmental legal education lies in the presence of quality assurance mechanisms that safeguard equity in the teaching, technology, and learning triad. If digital transformation is viewed as a structural necessity rather than a discretionary option, quality assurance takes on a more regulatory role: it functions in justifying and sustaining the relevance and constructive operationalization of environmental legal education. This chapter proposes a vertical quality model centered on environmental law, integrating European perspectives on quality in e-learning [26], and the most recent developments in digital legal education [4].

When it comes to quality assurance at the program level, this implies alignment and coherence of the program outcomes. Digital pedagogies should be purposefully designed to be embedded in the environmental law learning

outcomes, rather than considering them as marginal, ancillary components of the outcomes. At this stage of the outcomes formulation process, reliable assessment of the learning outcomes is critical because teaching and learning should prepare the students for tasks that are aligned to the knowledge and skills that are required of an environmental law practitioner, including regulatory law, laying evidence, and stakeholder law. Moreover, to avoid the problem of dilapidated capacities, digital skills should be incrementally introduced to facilitate vertical professional growth [29].

On the other hand, quality assurance for a course will cover aspects such as lesson structure, accessibility, and feedback provision. Digital mediation in teaching environmental law entails the formation of competencies, which in this context will include legal reasoning, science, and the articulation of ethics. Given the circumstances, the main task of the digital transformation of courses will be to promote the use of tech-based and portable learning materials, coupled with teaching strategies that are truly evidential. The digitally mediated environment will require the use of a variety of materials that will be assessed in different ways; therefore, it will be necessary to provide students with continuous formative assessments. Particular attention should be paid to the study of the structures of governance in all the systems of governance of the institution. The institution must ensure the availability of adequate digital tools, the provision of training to faculty on a regular basis, and the harmonization of activities related to digital transformation with the objectives of the environmental law programs. The institution must demonstrate commitment if it aims to achieve coherence, equity, and innovation in the pedagogical techniques employed. In the absence of this commitment, digital initiatives are likely to be scattered, uncoordinated, and randomized, with each person leading their own initiative.

While offering student support, the level of student support of the quality assurance frameworks needs to take the conditions of equitable participation into account. Environmental law education conducted through digitally mediated instruction must be supported with sufficient technical support, digital literacy education, accessibility supports, and mental health and emotional support. Support structures that incorporate mental health support, which is critical to engagement during the ongoing crises, are needed to address the emotional and cognitive burden that comes with the study of the law as it relates to the environment and the crises that affect it [30]. There are, however, ethical dilemmas in the use of artificial intelligence and the education of environmental law. Given that the field of environmental law is concerned with the elements of fairness, transparency, and the common good, it is imperative that such education includes elements of morals and ethics. The most significant of these concerns relates to the intersection of artificial intelligence bias and environmental justice. AI technologies are designed based on historical legal and regulatory frameworks, which are likely to compound existing structural inequities and prejudice further vulnerable and environmentally marginalized populations. Thus, the education of environmental law must foster the critical use of AI by equipping students to deal with algorithmic outcomes, to recognize and interrogate biases, and to counter the ideology of AI neutrality.

Data privacy and confidentiality represents a second ethical dimension. Legal education on the environment often deals with sensitive data on environmental damage, communities that suffer harm, and the corporations that engage in such behavior. The use of AI that processes such data needs careful oversight, especially around data protection, informed consent, and community interest. Therefore, ethical data governance is a necessary component of environmental law education.

Legal education in general, and environmental law teaching in particular, is especially attentive to transparency and explainability. The AI tools used in teaching environmental law ought to aid, and not obstruct, the student's engagement with the legal reasoning. Systems that explain their functioning to end users ought to permit students to engage with the AI outputs critically, and not relinquish their legal interpretative and adjudicative authority to another AI. Legal education ought to appreciate and explain the functioning of systems that operate like black boxes, providing outputs that may appear legal but rest on opaque reasoning. Broad-based, continued, and integrated faculty development for teaching, technology, and environmental expertise is the linchpin for the governance of digital environmental legal education. Transdisciplinary digital transformations do not happen at the level of the educator alone. Professional learning and collective capacity building at the institutional level are necessary. A staged model of faculty development is particularly fitting and the early stages are foundational digital literacy. Educators can learn to use learning management systems, digital communication, and online assessment tools. In later stages, the focus is on advanced digital pedagogy, including the design of learning experiences for hybrid and online instruction, tech-mediated assessment, and the facilitation of digital collaborative work

Even more advanced stages focus on integrating environmental expertise, helping educators to work with environmental data, interdisciplinary research, and transdisciplinary teaching. At the summit, development should foster innovation, educational scholarship, and building the field of digital environmental legal education for concerned educators. Inevitably, there must be continuity in faculty development efforts as opposed to an event-

based approach. Support from institutions, including consultations for instructional design, assistance for new technologies, and rewards for teaching experimentation are fundamental for the promotion of self-sustained engagement and avoiding surface or fragmented implementation [30]. Without this, the risk of differential digital transformation towards inequity at the levels of institutions and educators is real, and the need for quality education and professional accountability is undermined.

Finally, the environmental footprint of the digital infrastructure gives rise to a self-reflexive ethical tension. Digital transformation comes at a cost to the environment in the form of energy use, resource depletion, and electronic waste. Therefore, environmental legal education needs to model self-reflexive engagement with these trade-offs, incorporating sustainability into the design of the curriculum and the technology chosen at the institutional level. By addressing this tension, the practice of pedagogy is further aligned with the law's substantive principles, especially in environmental pedagogy.

This study is based on a structured synthesis of existing theoretical and empirical literature and does not involve the collection of original primary data. Consequently, the proposed framework has not yet been empirically validated in applied teaching contexts. In addition, the scope of the analysis is necessarily shaped by the availability and distribution of published studies on digital legal education and environmental law pedagogy, which remain uneven across jurisdictions and methodological traditions. These limitations do not undermine the conceptual contribution of the framework but indicate the need for subsequent empirical research employing experimental designs, longitudinal classroom studies, and mixed-method approaches to assess its pedagogical effectiveness and contextual adaptability.

## VI. CONCLUSION

This article has suggested that digital transformation and environmental legal education are two concepts that are crucial to preparing lawyers to meet the challenges of the Anthropocene. Reconceptualizing environmental legal education through the lens of digital transformation extends beyond concerns of efficiency or instructional enhancement. Its consideration as a structural transformation is a function of many relevant concerns of environmental legal education's practices. First, the field's information is multifaceted and requires an array of digital technologies to collect and analyze. Second, the practice of environmental law is increasingly digital. Third, there is no shortage of complex and escalating socio-ecological crises requiring responsive pedagogy that ensures the practice of environmental law is increasingly digital. This article discusses the HeDiCom digital Competence Framework, the IDEAS Next Generation Pedagogy Model, and Transformed Digital Learning to propose a Theory of Digital Transformation for Environmental Legal Education. The Theory of Digital Transformation for Environmental Legal Education consists of five core domains of competence. These are Digital Pedagogical Competence for Socio-Ecological Systems, Competence in Environmental Data and Legal Information Systems, Transdisciplinary Communicative Competence, Environmental Justice and Digital Ethics Competence, and Transformative Competence in Ecological Consciousness. Together, these domains of competence describe the minimum that digital environmental legal education must include.

Integrated digitally mediated pedagogies, including hybrid intelligent learning environments, digitally mediated stakeholder engagement, simulation-based learning, reflective digital portfolios, and the data-driven case studies, can plausibly respond to the epistemic and normative tensions of environmental law, even in the absence of direct empirical validation at present. However, there is a theoretical rarity with respect to empirical evidence on environmental law, and data emerging from the scholarship on legal education research is more than adequate to support the plausibility of the constructs contained within. This allows the framework to be evaluated conceptually while recognizing that its practical value depends on pedagogical design, institutional support, and ethical governance [30, 31]. The Anthropocene requires legal professionals capable of integrating legal reasoning with scientific knowledge and transdisciplinary collaboration. Legal practitioners who combine law and science, work within frameworks, and collaborate trans disciplinarily and trans jurisdictionally to promote environmental justice; ecological integrity. Digital, legally framed, ethically governed, and empirically constructed education has the potential to shape such practitioners.

Based on the theoretical framework and subsequent analyses of this article, several propositions are extended to legal educators, legal education institutions, and legal education researchers seeking to implement digital environmental legal education in a thoughtful and precise manner.

First, environmental legal education programmes need to incorporate the use of digital competencies more frequently and in a more structured manner. Digital technologies and approaches, as well as the use of digital technologies, should not be confined to separate classes or skills workshops. They should be integrated into all core environmental law courses and used as tools for developing professional skills and substantive academic skills.

There is also a need to focus on hybrid intelligence pedagogy that retains human legal reasoning and ethical decision-making while using AI for feedback, simulations, and data analytics. Since environmental law is based on social mores, the comprehension and understanding of AI's application and interpretation should be an integral part of the curriculum.

It is also recommended to revise how faculties assess students. Assessments should reflect real-world scenarios, digitally mediated environments, and techniques found in environmental law. These include data-driven case study analysis, simulations of regulatory processes and stakeholder engagement, and reflective digital portfolios to support the construction of professional identity. On the other hand, the digital disruption of the teaching of environmental law needs to be a holistic approach from institutional leaders rather than a number of windswept initiatives. The teaching of digital methods in law and pedagogy for environmental law must mature within a given set of digital tools and a defined set of support and instruction in technology and pedagogy from the teaching faculty. The need for faculty development is more pronounced than ever. Institutions need to provide periodic and regular development in a staggered and sequenced manner in digital pedagogy, the environment, and ethics. Without this, the attempt to pivot to digital tools will lag and lose relevance while pedagogy will lose cohesion and create gaps.

Furthermore, the systems of ethical governance, educational institutions and policy makers must include algorithmic bias, data security, AI transparency, and the environmental impact of computing in ecosystem in their education and policy frameworks. The current study highlights the need for greater depth and relevance in primary research for the field of digital environments and legal education, more so for the field itself. The primary purpose of these types of studies is to design and measure frameworks for digital literacy, AI-enabled curricula in environmental law, and the advancement of legal education and professional training. Finally, policymakers must recognize the importance of digital skills as an integral part of the professional profile of an environmental lawyer. They need to ensure that this is reflected in the accreditation criteria and quality assurance frameworks of professional licensing bodies. Otherwise, this will only increase the gap between legal education and the evolving needs of environmental law.

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### Conflicts of Interest

The authors declare no conflicts of interest.

### Data Availability Statement

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