Integrating digital and green education: A conceptual framework for English Language Learners

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Abstract: *The simultaneous demands for environmental sustainability and digital proficiency represent two major challenges in 21st-century education. For English Language Learners (ELLs), acquiring digital competence alongside environmental awareness presents both challenges and opportunities. By engaging in technology-driven projects, such as analysing ecological data, creating environmental documentaries, or collaborating on sustainability campaigns via digital platforms, ELLs can simultaneously cultivate three critical literacies: digital literacy, ecological understanding, and English language proficiency. This conceptual paper proposes a synergistic pedagogical framework grounded in project-based learning that integrates green education not as a separate domain, but as a meaningful, authentic context for developing digital literacy. Drawing on the principles of Education for Sustainable Development (ESD) and Content and Language Integrated Learning (CLIL), the paper outlines key pedagogical design principles, explores benefits such as enhanced motivation, collaboration, and critical thinking, and identifies implementation challenges. Ultimately, it argues that integrating digital and green education fosters learners who are both technologically proficient and ecologically responsible.*

Keywords: Digital literacy, Green education, English Language Learners (ELLs), Technology-Enhanced Language Learning (TELL), Education for Sustainable Development (ESD).

1. Introduction

The integration of digital and sustainability-oriented learning is reshaping educational practices. While digitalisation holds significant potential to enhance the sustainability of economic, social, and educational systems, its relationship with environmental goals remains complex. In response to the urgent challenge of climate change, the European Commission has placed sustainability at the core of its policy agenda (European Commission, 2018). Within this context, education is recognised as a key driver of transformation, responsible for equipping students with the competencies required for a greener and more sustainable future.

Similarly, international organisations such as UNESCO have long emphasised the need to embed sustainability within educational frameworks (UNESCO, 2017) and continue to advocate for developing learners' competencies

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for a greener and more sustainable society and economy (UNESCO, 2024). Moreover, the growing digitalisation of education and society creates new opportunities to advance both sustainability and efficiency, underscoring the interdependence between digital literacy and sustainability-oriented education.

Digital literacy, understood as the confident and critical use of technology for accessing, communicating, and creating information, has become a keystone of contemporary education. For English Language Learners (ELLs), competence in this area is crucial not only for academic achievement but also for meaningful participation in civic and social life. However, ELLs frequently face distinct challenges, including linguistic barriers, unequal access to digital tools, and different levels of prior experience with digital tools. Addressing these gaps requires pedagogical frameworks that integrate language learning with authentic and technology-mediated practices, thereby developing linguistic and digital competence.

At the same time, growing emphasis on sustainability has given rise to green education, a concept centred on environmental awareness, which has become a key element of global educational agendas. Its inclusion in curricula promotes critical thinking, ecological literacy, and a long-term commitment to sustainable development (UNESCO, 2017). While both digital innovation and sustainability are recognised as vital educational imperatives, their intersection remains insufficiently explored within language pedagogy. Connecting these two domains opens new opportunities to develop students' digital skills alongside their environmental awareness, bringing education closer to the broader goals of global citizenship.

Consequently, this article argues that for ELLs, these domains are not merely complementary but can create a powerful synergy. Environmental topics provide a meaningful, authentic, and globally relevant context for learning. When students engage in activities such as researching local ecosystems, designing digital awareness campaigns, or analysing global sustainability data, they apply digital technologies with a clear purpose. At the same time, the processes of seeking, evaluating, creating, and collaborating in English provide a holistic framework for language development.

2. Research methodology

The aim of this study is to present a conceptual model for integrating green education into English language instruction through digital technologies. Drawing on well-established pedagogical approaches, including Content and Language Integrated Learning (CLIL) and Education for Sustainable Development (ESD), launched by UNESCO (2020), the model seeks to cultivate students who are ecologically informed, digitally competent, and globally communicative.

This conceptual study is conducted within the framework of the research project *Integrating and Promoting Green Education in the Initial Training of English Language Teachers*; strategic priorities: societal challenges; strategic direction: Innovative Educational Technologies and Products; project code 25.80012.0807.56SE. The project investigates integrated approaches to green

education in English language learning contexts. Its primary aim is to explore innovative pedagogical approaches that simultaneously foster environmental awareness, digital competence, and English language skills among students.

This research seeks to address the following questions:

1. How can digital and green education be integrated to enhance English language learning and foster eco-digital competences among learners?
2. What pedagogical principles and instructional models best support the simultaneous development of digital literacy and environmental understanding in English language education?
3. Which digital platforms and learning strategies are most effective in promoting environmental awareness and sustainable digital practices in ELL contexts?

The study adopts a qualitative, theory-based approach, drawing on established pedagogical frameworks from technology-enhanced learning, including Content and Language Integrated Learning (CLIL) and Education for Sustainable Development (ESD). Its purpose is to develop a pedagogical model to support teaching practice. The methodology focuses on identifying key principles, exploring effective strategies, and examining potential challenges in implementing an integrated digital and green curriculum.

3. Theoretical background

3.1 The Digital-Green Imperative

The growing interdependence of digital technology and environmental sustainability has resulted in what is referred to in the literature as the "Digital-Green Imperative" (Arnold et al., 2023). This concept highlights the challenge of using digital technologies to promote environmental sustainability while managing their ecological impact (OECD, 2020; UNESCO, 2023). According to the OECD (2020) and UNESCO (2023), digitalisation and sustainability are deeply connected processes, capable of enhancing both educational outcomes and societal progress. Digital tools offer innovative methods for monitoring, modelling, and addressing complex environmental issues, whereas sustainable practices provide authentic contexts in which students can apply and develop their digital skills effectively.

Within modern education, digital competence has emerged as a fundamental skill. According to the European Commission (2018), this includes not only technical proficiency but also critical thinking, collaboration, and ethical dimensions necessary for full participation in a digital society. For English Language Learners (ELLs), digital competence is particularly significant, as it facilitates access to diverse linguistic resources, enables cross-border collaborative learning, and supports engagement with authentic, content-rich materials (Godwin-Jones, 2018). Nonetheless, factors such as unequal access to resources, varying prior experience, and language barriers can impede the development of digital

literacy (Drljić et al., 2025).

Complementing this, Education for Sustainable Development (ESD), also known as green education, equips students with the knowledge, skills, attitudes, and values needed to contribute to a sustainable future (UNESCO, 2017). Introducing sustainability into curricula encourages critical thinking, ecological literacy, and responsible citizenship by connecting learning to real-world issues (Tilbury, 2011). Environmental concerns are inherently global, immediate, and socially important, providing engaging contexts in which students apply problem-solving skills and make meaningful decisions.

The Digital-Green Imperative reaches its full potential at the intersection of these two domains. Studies by Voogt et al. (2013) and Holmes et al. (2018) mention that project-based and technology-enhanced learning approaches are particularly effective in simultaneously fostering digital competence and ecological literacy. For instance, students can use digital platforms to gather and interpret ecological data, design digital awareness campaigns, or participate in collaborative simulations of energy management. Such activities not only strengthen technical and critical digital skills and deepen understanding of sustainability issues but also support holistic development of English language skills within authentic communicative contexts.

Despite this potential, the integration of digital literacy and green education remains underexplored in language pedagogy, particularly with regard to ELLs. Existing research often addresses these areas separately, focusing either on technological skill development or on fostering environmental awareness, without fully examining their synergistic potential for language learning (Godwin-Jones, 2021; Ram, 2025). Diavati (2023) argues that modern education should evolve toward sustainability-oriented and transformative learning. In this context, Content and Language Integrated Learning (CLIL) offers an effective pedagogical framework for promoting Education for Sustainable Development (ESD). By combining linguistic, cognitive, and environmental dimensions, CLIL enables students to acquire a foreign language while simultaneously developing critical, creative, and metacognitive competences essential for addressing global sustainability challenges.

In summary, the Digital-Green Imperative calls for pedagogies that integrate digital tools with sustainability content. For English Language Learners, this integrated approach provides a unique opportunity for improving digital literacy, language skills, and sustainability awareness simultaneously, cultivating globally competent citizens for the 21st century.

3.2 Digital literacy as a transversal competency

Digital competence, as defined by the European Commission's DigComp framework, encompasses the confident, critical, and responsible use of digital technologies for learning, work, and social participation (Carretero et al., 2017).

This competence extends beyond technical proficiency; it involves the integrated application of cognitive, social, and ethical skills to search for information effectively, critically evaluate sources, and responsibly create digital content. For English Language Learners (ELLs), this holistic competence is indispensable. It enables access to authentic linguistic resources (*e.g., BBC Learning English, Voice of America (VOA), TED Talks*), facilitates collaboration with global peers, and supports the creation of original digital content, thereby promoting both language acquisition and the development of critical thinking skills.

The integration of digital tools (*e.g., Newsela, Learning with Texts, Google Docs, Wakelet*) creates an immersive environment for language learning that extends far beyond traditional textbooks. Engagement with authentic online materials like news articles, videos, podcasts, etc. allows students to experience language in real contexts, enhancing comprehension and cultural understanding. At the same time, technology-mediated collaboration on shared projects or virtual exchanges provides a purposeful and motivating framework for improving communicative competence. Moreover, the strategic pedagogical integration of Information and Communication Technology (ICT) transforms the traditional language classroom into a dynamic, adaptive ecosystem. These environments combine structured guidance with flexibility, enabling students to interact with multimodal materials, receive instant feedback, and embark on personalised learning trajectories. Consequently, this methodology sustains learner motivation and supports deeper, long-term learning outcomes.

Digital literacy is recognized as a transversal skill that connects with and strengthens broader educational goals. As Mantiri *et al.* (2019) note, combining student-centered learning with digital tools effectively develops critical thinking, problem-solving, and strong communication skills. This approach also increases student motivation and autonomy by providing personalized, technology-enhanced experiences. To take advantage of these benefits, teachers need a strategic pedagogical approach that integrates digital literacy into the curriculum, ensuring its application in authentic learning contexts. The transition from theory to practice is a key step of digital transformation, directly influencing instructional design, facilitation, and assessment in technology-enhanced environments.

3.3 Digital pedagogical strategies

Connectivism provides a key theoretical foundation for digital pedagogy, addressing the limitations of traditional models in explaining how learning occurs within complex information networks. Drawing on Siemens, Duke, Harper, and Johnston (2013) argue that the exponential growth of knowledge and the increasing complexity of society necessitate nonlinear models of learning. This transformation, driven by technological interconnectivity, has transformed knowledge from a static construct into a fluid, networked system. Knowledge now functions less as an established hierarchy and more as an evolving ecology of connections, valued for its applicability and relevance to real-world problem-solving.

Technology integration strengthens Project-Based Learning (PBL), an instructional system based on real, inquiry-driven experiences that aims to improve content knowledge, language proficiency, and 21st-century skills at the same time. Ginusti (2023) emphasizes that teachers must use technology in a variety of ways to build active learning environments. A key principle is that when projects are positioned as the central pillar of the curriculum and technology is used as an instrument for collaboration and exploration, students naturally engage in meaningful, real-world tasks.

Another innovative pedagogical strategy is the flipped classroom model, which reverses traditional instructional paradigms. By delivering direct instruction outside of class through digital platforms, classroom time is transformed into an interactive workshop for active, collaborative problem-solving under teacher guidance. According to Preeti (2021), this approach enables students to learn at their own pace and review difficult topics as needed. Research indicates that the flipped classroom promotes increased engagement, deeper understanding, and active knowledge application, resulting in more personalized, interactive, and successful learning. This approach can also complement project-based activities in technology-mediated contexts.

In addition, digital learning environments encompass a wide range of pedagogical strategies, including blended learning, gamification, adaptive learning technologies, interactive multimedia content, and frequent feedback (Duterte, 2024). Integrating these strategies to improve digital education and address diverse learner needs requires careful evaluation of their long-term impact, the role of emerging technologies, and their effectiveness across different educational situations. Such integration ensures equitable, meaningful, and engaging learning experiences for all students.

In a green-focused curriculum, pedagogical strategies like Project-Based Learning (PBL) and the Flipped Classroom are greatly enhanced when applied to real-world ecological issues. This approach aligns with the core purpose of environmental education. As Krasny (2020) emphasizes in *Advancing Environmental Education Practice*, the goal is to achieve environmental quality and support climate adaptation, wherein psychological and social factors act as intermediate outcomes that lead to meaningful environmental actions rather than serving as endpoints in themselves. Lombardi (2007) states that authentic learning enables students to engage in meaningful, real-world activities. This is accomplished through web technology-enhanced learning environments that enable students to access professional resources, and analyze complex data, thus engaging with phenomena that would otherwise be inaccessible. Integrating digital pedagogy with environmental education transforms language learning into a holistic experience that fosters linguistic, digital, and ecological civic competences.

4. Findings and discussion

4.1 Mapping Digital and Language Skills

The transversal nature of digital competence is operationalised through the interconnected domains defined by the *DigComp 2.2 framework* (Vuorikari et al., 2022). To move from theory to practice, teachers and students benefit from an integrated model illustrating how each digital domain could support specific dimensions of language proficiency. The table below presents a model linking the five *DigComp* domains to key language skills. This interrelation provides a practical model for systematically embedding digital tasks and suggested tools, ranging from critically evaluating online information to collaboratively creating digital content, into the language curriculum, ensuring that technology is used purposefully and pedagogically.

Table 1. A Digital-Linguistic Competence Framework

DigComp Domains and Competence	Key Descriptors and Digital Tasks	Supported Linguistic Competences
1. *Information and Data Literacy* (ability to search, evaluate, and manage digital information critically)	Critically evaluating online sources (*Learning with Texts, Google Docs)*; Comparing information from different news sites (*BBC News, Reuters, Associated Press*)	Receptive skills: reading comprehend-dsion, listening, mediation.
2. *Communication and Collaboration* (using digital tools to interact, communicate, and col-laborate responsibly)	Participating in online forums; Collaborative writing on shared docu-ments (*Google Docs*); Video conferencing with peers (*Meet, Teams*)	Interactive skills: speaking, writing, negotiation, inter-cultural communica-tion.
3. *Digital Content Creation* (producing and editing digital content; understanding copyright and licenses)	Creating digital posters (*Canva*), videos, or blogs (*WeVideo*); Designing infographics (*Piktochart*); Remixing content for a new audience (*Book Creator*)	Productive skills: writing, speaking, structuring discourse
4. *Safety* (protecting devices, personal data, health, and the environment)	Understanding privacy settings (privacy settings on platforms like *Instagram, TikTok, and Google Ac-count*); Recognizing digital well-being (*Digal Detox Apps*); Assessing the envi-	Socio-pragmatic and ethical competence: appropriate, respectful communication

	ronmental impact of digital habits (*Carbon Calculator*)	
5. *Problem-Solving* (dentifying and solving digital challenges creati-vely; reflecting on digital skills)	Using digital tools to analyze data sets; Critical examination of issue (*MindMeister*); Designing a solution to a real-world problem (*Canva*, *Tinkercad*)	Metacognitive competence: monito-ring understanding, regulating learning.

This mapping demonstrates that digital and language skills strengthen each other when integrated systematically. By linking the five *DigComp* domains to CEFR-aligned language skills (Council of Europe, 2020), the model validates digital literacy's role as a transversal competency. Within integrated pedagogical frameworks such as CLIL and ESD, this synergy is essential: it allows students to acquire language naturally through engaging, sustainability-oriented digital tasks.

4.2 Integrating CLIL, ESD and digital practices

When CLIL, ESD, and digital practices intersect, they create more than complementary dimensions of learning; together, they form a transformative educational ecosystem. Within this framework, *Content and Language Integrated Learning (CLIL)* provides the pedagogical foundation for combining content and language acquisition; *Education for Sustainable Development (ESD)* offers an authentic, value-oriented context; and *digital practices* function as mediators for exploration, creation, and communication. This synergy enables technology-enhanced, project-based learning, such as producing environmental videos or conducting data analyses, that cultivates the three core literacies central to this study: linguistic, digital, and ecological literacy.

Current literature highlights opportunities to integrate environmental awareness and digital competence in language learning. Hauschild et al. (2012) suggest that embedding sustainability topics into language learning increases learner engagement and promotes authentic communicative use of English. Similarly, Kazazoglu (2025) points out the potential of strategies such as digital storytelling, analyzing collections of environmental texts, and project-based learning to improve language skills while developing eco-literacy and global awareness. However, effective implementation depends largely on the teacher's understanding of sustainability concepts and their ability to critically evaluate materials in order to align content and linguistic objectives (Hauschild et al., 2012).

Building on these insights, the following table presents a conceptual framework for operationalising the integration of CLIL, digital competence, and ESD, linking linguistic competences with ESD-related skills and illustrative digital practices to support integrated lesson design. The table bellow demonstrates that the integration of digital tools, language learning, and Education for Sustainable Development is not merely complementary but inherently synergistic. Each digital task simultaneously engages specific linguistic and ESD competences, creating a

rich and authentic learning context. For example, mediating a text by designing an infographic on the greenhouse effect (a cognitive-linguistic task) directly fosters systems thinking (an ESD competence) while developing digital content creation skills.

Table 2. Content and Language Integrated Learning through digital practices

Linguistic Competence (CEFR / CLIL)	ESD Integration	Example of digital Practice
Receptive skills: Reading and Listening	Researching sustainability topics; Evaluating eco-related information	Conduct web-based research on climate change or renewable energy; Compare different news sources; Analyze authentic environmental texts (*BBC Learning English, The Guardian Environment Section, Breaking News English, National Geographic Kids, Duolingo, LingQ*).
Interactive skills: Speaking, Writing, Negotiation, Intercultural Communication	Participating in cross-cultural sustainability projects; Discussing eco-friendly practices	Engage in virtual discussions, online forums, peer feedback; Collaborative writing on shared documents (*Google Docs, Padlet, Wakelet, Microsoft Teams, eTwinning*).
Productive skills: Writing and Speaking, Structuring Discourse	Creating awareness campaigns; Presenting sustainability solutions	Develop digital posters, blogs, videos, infographics about environmental issues (*Google Slides, Canva, Piktochart, Book Creator, WeVideo, Clipchamp*).
Socio-pragmatic and Ethical competence	Promoting responsible digital citizenship; Ethical communication	Evaluate sources; Discuss netiquette; Practice responsible online communication (*Seesaw, Edmodo, Kahoot!, ClassDojo*).
Strategic and Metacognitive competence	Problem-solving sustainability challenges; Reflecting on learning and environmental impact	Analyze data sets on environmental issues; Plan and propose solutions; Design sustainability projects *(Miro, Jamboard*; *Google Sites* to create a digital project hub; *ArcGIS StoryMaps, Scratch*).

Furthermore, this table highlights the central role of digital competence as a key facilitator within this triad. Platforms such as *Padlet, Google Docs*, and other collaborative tools function not merely as technological supports but as dynamic environments that promote communication, cooperation, and written interaction.

Likewise, the process of evaluating online sources for research tasks inherently develops critical thinking, which underpins both digital literacy and ESD. By mapping these connections, the table offers a practical model for teachers to design integrated "digital-green-language" tasks. Ultimately, this framework prepares students not only to use English and technology effectively but also to apply both as responsible, informed, and proactive citizens in a globalised world.

While Table 2 synthesizes insights from existing CLIL, ESD, and digital learning literature, the stated benefits remain conceptual in nature, as the proposed framework represents an early-stage research initiative. To empirically evaluate the effectiveness of this matrix, future research should include an initial pilot study implemented in selected ELL classrooms. This pilot phase could examine the impact of integrated digital–green CLIL tasks on learners' linguistic competences, sustainability awareness, and digital skills. The findings would contribute empirical evidence to refine and support the proposed model across diverse ELL contexts.

5. Conclusions

The integration of digital and sustainability-focused learning is progressively reshaping contemporary education, ofering a transformative, future-oriented pedagogy. For English Language Learners (ELLs), digital tools support collaboration, inquiry, and creative expression in English, while sustainability topics provide authentic contexts for communication. Embedding these themes into technology-enhanced language training simultaneously fosters linguistic proficiency, ecological awareness, and digital literacy.

The conceptual frameworks developed in this study, namely the digital-linguistic competence matrix and the CLIL-ESD integration model, provide practical blueprints for such integration. Grounded in CLIL principles and Education for Sustainable Development, they demonstrate how integrated approaches prepare students to be ecologically conscious, technologically proficient, and globally engaged communicators. Ultimately, this framework positions language education as a platform for cultivating the skills and values essential for sustainable living in the 21st century.

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