

DigiSET – The Academy of Digitally Sustainable European Teacher

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OVERVIEW OF DIGISET COUNTRY REPORTS

Concerning Competences for Sustainable Digital Literacy in National
Context, Policies, and Professional Development (WP2)

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Abstract

This report presents the results of work package WP2 of the Erasmus+-funded project “DigiSET – The Academy of Digitally Sustainable European Teacher” (Project Number: 101249272, ERASMUS-EDU-2025-PEX-TEACH-ACA). The project aims to develop an integrated competence framework for teachers that connects digital competence, AI literacy, and sustainability across its three dimensions — environmental, social, and economic. The comparative analysis is based on structured country reports from eight partner countries (Austria, Bulgaria, Ireland, Italy, Norway, Romania, Spain, and Türkiye), which were compiled through a standardised desk-research instrument and subjected to a mutual peer-review process to ensure academic rigour. The reports capture the current state of national policy frameworks, initial teacher education (ITE) and continuous professional development (CPD) curricula, and training provision with regard to digital sustainability, AI in education, inclusive teaching, and OER.

Key findings reveal that DigCompEdu (2017) is the only European framework with broad cross-country adoption, while GreenComp, LifeComp, and EntreComp are scarcely applied — pointing to a structural underdevelopment of the social sustainability pillar (equity, inclusion, gender fairness in AI) across teacher education in all eight countries. None of the partner countries currently integrates all three sustainability pillars into a coherent model for digitally sustainable teaching. Austria is the only country where AI in education is classified as mandatory in ITE. Across all countries, the reports identify converging competence gaps in ethical and gender-sensitive AI use, interdisciplinary sustainability education with systems thinking, teacher autonomy in OER creation, and environmental awareness regarding digital footprints. Building on these findings, the reports converge on five core competence areas (digital pedagogy, ethical AI use, sustainability/ESD, inclusive teaching, and OER) and recommend a practice-based, modular training design with embedded reflective components, balancing structural coherence with flexibility for national adaptation pathways. The results serve as a baseline for the subsequent empirical phase, comprising teacher surveys and focus group interviews across all partner countries.

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1. Introduction and background

1.1. The need for sustainable digital teaching in Europe

European education is navigating a moment of compound transformation. The convergence of the European Green Deal (European Commission, 2019), the Digital Decade (European Commission, 2022), and the United Nations (UN) Agenda 2030 (UN, 2015) has placed education at the intersection of three interdependent sustainability imperatives: environmental, social, and economic. These are not parallel but mutually constitutive: ecological resilience cannot be achieved without social equity, and neither can be sustained without economically viable and inclusive systems. In this context, “digitally sustainable teaching” emerges not merely as a pedagogical trend, but as a strategic necessity — one that is simultaneously an instrument of environmental responsibility, a vehicle for social justice, and a condition for long-term economic relevance.

Understood in this way, digitally sustainable teaching represents the capacity to develop a resilient educational ecosystem that leverages digital tools. This would include Artificial Intelligence (AI), to enhance learning outcomes across all three dimensions of sustainability: reducing environmental impact through responsible resource use; promoting equity, inclusion, and gender fairness in learning design; and preparing learners for a labour market and civic life that demand complex, adaptive, and ethically grounded competences. This framing aligns explicitly with the UN Sustainable Development Goals (SDGs) framework, and in particular with SDG 4 (quality education), SDG 5 (gender equality), SDG 10 (reduced inequalities), and SDG 13 (climate action), recognising that education both reflects and reproduces the sustainability challenges it must help to resolve.

Current EU policy frameworks, including the Digital Education Action Plan 2021–2027 and the AI Act (European Union, 2024), underscore the critical role of AI literacy as a foundational competency for future-ready systems. However, the integration of AI presents challenges that go well beyond technical upskilling. As AI algorithms increasingly function as gatekeepers of educational content, there is an urgent need for frameworks that ensure quality, trustworthiness, inclusivity, and the absence of gender or cultural bias in AI-generated resources. Digitally sustainable teaching addresses this by empowering educators to move beyond passive consumption toward the active, ethical, and critically informed co-creation of learning environments and Open Educational Resources (OER). By engaging critically with AI-powered tools, teachers can adapt materials to diverse learner needs, counteract embedded biases, promote multilingualism, and ensure equitable access — thereby operationalising the principles embedded in DigCompEdu (2017), GreenComp (2022), LifeComp (2020) and EntreComp (2016) as an integrated, rather than parallel, competence architecture. Ultimately, this approach transforms the classroom into a site of sustainable innovation, where AI serves not as a replacement for human judgement but as a catalyst for creating learning environments that are inclusive, adaptable, ecologically conscious, and ethically grounded.

1.2. Considerations of some impressions of the current state on sustainable digital teaching

While the “digitally sustainable teaching” concepts addressed within the DigiSET project are fundamentally novel in their integrated approach, this does not imply that the intersection of sustainability and digital teaching, the integration of Open Educational Resources (OER) with artificial intelligence, and related technological

synergies have gone unnoticed by other actors in the field. Various initiatives and scholarly contributions have independently explored similar thematic connections. It should be noted, however, that the term “sustainable” is used in the relevant literature in two analytically distinct senses: first, as a descriptor of pedagogical effectiveness and durability — referring to learning approaches that are robust, transferable, and resource-efficient — and second, as a normative alignment with Education for Sustainable Development (ESD) and the SDGs, addressing environmental, social, and economic sustainability in an integrated sense. Both strands are represented in the contributions outlined below and are relevant to DigiSET, though they operate at different levels of the conceptual framework.

Strand 1 — Digital teaching as effective and durable pedagogy: Very generally speaking, academics have begun to consider, discuss and researched whether digital teaching provides a solid foundation for sustainable learning. With some reservations, this question has been answered in the affirmative (Nanjundaswamy, Baskaran & Leela, 2021; Sousa et al., 2022). Similarly, Forbes et al. (2023) conducted a survey and additional interviews with students in New Zealand during their pandemic-era studies, primarily aiming to identify which learning strategies proved to be sustainable.

Strand 2 — Digital teaching in relation to Education for Sustainable Development (ESD) and the SDGs:

- A further strand of evidence of ESD (Education for Sustainable Development) materials and offers are available in digital teaching formats such as open online course or OER (see e.g. for the Austrian higher education context Jakob et al., 2025).
- A systematic literature review by García-Hernández et al. (2022) addressing sustainability challenges in digital education identifies five core areas across 33 included studies: fostering environmental awareness, redesigning curricula to embed sustainability, tailoring digital approaches to specific scientific disciplines, and — of particular relevance to the DigiSET framework — ensuring the sustainable and inclusive use of technology. This last dimension, which the authors identify as one of the primary obstacles alongside balancing ecological goals and pedagogical effectiveness, directly addresses the social pillar of sustainability in digital education: it encompasses equitable access to digital tools, the design of inclusive learning environments, and the mitigation of bias in technology-mediated instruction. As such, it constitutes the closest point of contact between the existing literature and DigiSET's thematic areas on inclusive teaching practices and AI for adaptive learning, both of which operationalise social sustainability in teacher competence development.
- One area where the synergy between digital technologies and sustainability appears particularly successful is Maker Education, specifically learning within makerspaces and fab labs (see, e.g., Lo, 2024).
- A UNESCO paper by Pedro et al., (2019). addresses AI as both a potential and a challenge for education policy, highlighting key hurdles such as the need for comprehensive public policies on AI for sustainable development, ensuring inclusion and equity in AI-driven education, and the dual imperative of preparing teachers for AI-powered classrooms while developing AI systems capable of understanding educational contexts.

Taken together, the contributions outlined above confirm that the relationship between digital teaching and sustainability is an emerging and productive area of inquiry. However, a critical gap remains: None of the reviewed works addresses the

nexus of digital tools, AI, and the full triple-pillar sustainability framework — environmental, social, and economic — as a unified and integrated concept. The environmental and technological dimensions have received the most attention, while the social sustainability strand, encompassing equity of access, gender fairness in AI, and inclusive learning design, remains largely implicit or fragmented across separate bodies of literature. “Digitally sustainable teaching”, understood in this broader sense, has not yet emerged as a recognised disciplinary term, nor as a coherent professional competence framework for teachers. This is precisely the gap that the DigiSET project sets out to address.

1.3. The DigiSET project seeks to explore and define teachers’ needs

A diverse European consortium of 16 partners and 2 associated partners from 8 countries, bringing together higher education institutions, research centres, EdTech innovators, trade unions, schools, and public authorities to build the Digitally Sustainable European Teacher Academy.

DigiSET enhances the digital skills of European educators, aligning with the DigCompEdu, LifeComp and GreenComp frameworks. It addresses the need for teacher upskilling in digital technologies through comprehensive training and a supportive community of practice, fostering a sustainable education system across Europe.

2. Methodology: Country reports and comparative Analysis

2.1. Development of DigiSET national reports via structured desk research

The foundation of the DigiSET project’s empirical basis is to identify teachers’ needs. The initial phase of DigiSET work package 2 (WP2) involves conducting a country analysis to identify teacher needs. Subsequently, participant surveys and focus group interviews will be carried out.

The country reports were generated through a desk research methodology, designed to map the current landscape of digitally sustainable teacher education across the participating DigiSET Erasmus+ partner countries.

As shown in Figure 1, the DigiSET consortium spans from Western to Eastern, Northern to Southern Europe, ensuring a comprehensive representation of diverse educational contexts and practices. This broad geographic coverage enriches the project by incorporating varied perspectives and experiences, fostering innovative solutions adaptable to different educational systems, namely Austria, Bulgaria, Ireland, Italy, Norway, Romania, Spain, and Türkiye.



DigiSET countries and consortium partners:

Austria - TU Graz, UKW
(project coordinator)
Italy UNISI, OPC,
CivicaMente
Romania PBUi, USLIP
Turkey BAU, CDDNE, TIZDER
Bulgaria SEP, OUHS
Ireland TUI, BDTC
Spain MAUDE
Norway EUROMASC

Figure 1: DigiSET partner countries and partner organisations where the country reports were delivered by the end of April 2026.

The research process for the country reports was standardised through a dedicated Country Report Feedback Template (Version 0.1, March 2026), which served as the primary instrument for data collection and analysis. This template was not merely a data entry form, but a structured guide intended to ensure consistency, academic rigor, and critical reflection across all national contexts. The methodology adhered to the following principles:

- **Evidence-Based Inquiry:** Partners were instructed to ground all findings in reliable, recent sources, prioritizing official policy documents, national strategy papers, and peer-reviewed academic literature. The goal was to move beyond anecdotal evidence to a robust description of existing frameworks.
- **Critical Analysis and Contextualisation:** While the template guided the structure, partners were explicitly required to provide their own critical voice. The reports were not intended to be raw aggregations of information or unedited AI outputs; rather, they demanded a synthesis of policy documents and local realities, offering a nuanced interpretation of how digital sustainability is conceptualised and implemented in each specific national context.
- **Structured Data Extraction:** The core of the research focused on identifying and describing concrete developments in teacher education. This was operationalised through three specific analytical tables embedded within the template. These tables required partners to categorise and detail:
 - **Policy Frameworks:** Existing national strategies and mandates regarding digital competence and sustainability in teacher training.
 - **Curricular Developments:** Specific modules, courses, or programmatic changes integrating digital and sustainable practices.
 - **Implementation Gaps and Challenges:** Barriers identified in the transition toward digitally sustainable teacher education.

By mandating that each section begin with a clear answer followed by an elaboration, the methodology aimed to ensure that the resulting reports provided both a high-level overview and deep, context-specific insights.

The preliminary findings of the Country Reports were presented at the DigiSET Kick-off Meeting in Krems (Austria) on March 26, 2026 (see Figure 2). In April 2026 all partners were engaged in a reciprocal peer-review process to provide constructive feedback on the initial report drafts before finalisation end of April 2026. The inclusion of AI disclosure requirements further ensured transparency regarding the tools used during the research and drafting phases.



Figure 2: Photos of the DigiSET Kick-off meeting held in Krems March 25-26 2026 by project coordinator UWK. Photos taken by Silvana Bermudez.

2.2. The country reports as sources

The following country reports provide the basis for this initial comparison:

- Aardal, T., & Aslaksrud Kristiansen, R. (2026). Teacher Competences for Sustainable Digital Literacy. DigiSET project, WP 2: Country Report Norway. Version 1 (April 27, 2026). Zenodo. <https://doi.org/10.5281/zenodo.19814651>
- Eşfer, S., Dulay, S., & Süzan, D. (2026). Teacher Competences for Sustainable Digital Literacy. WP 2: Country Report Türkiye, Version 1 (April 26, 2026). <https://doi.org/10.5281/zenodo.19866475>
- Giampaolo, M., Guraziu, E., Rosini, M.G., Fazzi, T., Mainardi, L., Lazzarini, I., Trasmondi, F. (2026). Teacher Competences for Sustainable Digital Literacy. DigiSET project, WP 2: Country Report Italy. V1 (April 30, 2026). <https://doi.org/10.5281/zenodo.19911116>
- Kenny, A., Lahart, S., Byrnes, R., Toomey, A.M., Murphy, C., Redmond, M. & Fortune S., (2026) Country Report Ireland - Teacher Competences for Sustainable Digital Literacy: National Context, Policies, and Professional Development, Version v2 (June 14, 2026). <https://doi.org/10.5281/zenodo.20688110>
- Lemnaru, A. C., & Casariu, A. (2026). DigiSET – The Academy of Digitally Sustainable European Teacher, Country Report_Romania. In Report. Zenodo. <https://doi.org/10.5281/zenodo.20591749>
- Savova, A. & Peykova, D. (2026). Teacher Competences for Sustainable Digital Literacy. WP 2: Country Report Bulgaria, v1 (May 21, 2026) <https://zenodo.org/records/20325482>
- Schön, S., Brünner, B., Ebner, M., Keser Aschenberger, F., Aral, N., & Aydın, D. (2026). Teacher Competences for Sustainable Digital Literacy. WP 2:

Country Report Austria, v1 (April 30, 2026) <https://doi.org/10.3217/5rybf-96s62>

- Sola, E. (2026). Teacher Competences for Sustainable Digital Literacy. WP 2: Country Report Spain. v1 (April 30, 2026) <https://doi.org/10.5281/zenodo.19919082>

All country reports – and other DigiSET publications are collected in a dedicated Zenodo community, see <https://zenodo.org/communities/digiset/>.

2.3. First comparative characteristics and cross-national overview

Following the completion of the individual country reports, the project initiated a preliminary comparative synthesis for this document. Rather than a definitive final analysis, this stage serves as a high-level overview designed to establish an initial working baseline for a more comprehensive and detailed synthesis planned in Deliverable 2.1 (D2.1).

This initial cross-national analysis highlights some first characteristics of the current state in each country aggregates the three core tables as a first overview of the situation in DigiSET consortium countries (Austria, Bulgaria, Ireland, Italy, Norway, Romania, Spain, and Türkiye). While this initial alignment provides a foundational structure, it is understood to be provisional. The insights presented here are expected to be refined in the final report of WP2 (D2.2), which will also include results from the planned surveys of teachers and focus group interviews in all DigiSET countries.

Through this iterative process, the project team aims to identify common bases and differences and potential barriers. This approach transforms as well as isolated national snapshots into a dynamic, evolving European perspective.

It allows the DigiSET project to establish a starting point for discussion and strategic planning, while remaining flexible enough to incorporate the richer insights gained from upcoming fieldwork. Ultimately, this report acts as a living baseline that will be updated and finalised in D2.1 once the full scope of survey and interview data is integrated.

3. Insights into DigiSET country reports results concerning digital sustainability in teacher education

3.1. Characteristics of the DigiSET countries' current state

Each partner country exhibits distinct starting points regarding digital sustainability in teacher education, ranging from advanced legislative frameworks to exploratory phases. The following brief profiles highlight the unique characteristics identified in the national reports and specifically the authors' presentation in the DigiSET meeting in March 2026. These serve as basic context for the comparative data in further sections.

- **Austria** features a structured policy framework anchored by the mandatory subject "Digital Grundbildung", yet the implementation landscape remains complex due to the multiplicity of overlapping national initiatives and varying levels of administrative coordination. Notably, an update of the Austrian

competence framework for teachers and their digital teaching is under development.

- **Bulgaria** possesses a well-developed legislative framework for digitalization, the practical translation of these policies into classroom reality remains weak, creating a distinct divide between strategic planning and actual teacher training outcomes.
- **Ireland** stands out with a coherent governance model led by the Teaching Council, which ensures strong alignment between national policy, professional standards, and practice, facilitating a consistent and regulated approach to digital and sustainability competences.
- **Italy:** The Italian system is characterised by a rich but highly fragmented ecosystem where the absence of a unified national model leads to significant variability in teacher training approaches for digital and sustainability competences across different regions and institutions.
- **Norway** is currently undergoing a strategic shift towards a more reflective digital pedagogy, questioning extensive computer-based learning in favour of a balanced, critical approach to digital tools and AI in early education and teacher training.
- **Romania:** Implementation in Romania is currently hindered by systemic fragmentation, resulting in uneven development of digital competences and significant disparities in teacher preparation and access to training opportunities for AI and sustainability education.
- **Spain** operates a dynamic system driven by diverse regional approaches and strong private sector involvement, focusing heavily on employability and skills development, though this decentralization results in varied adoption rates for OER and AI integration.
- **Türkiye:** Despite a high volume of projects and reports, Türkiye faces a critical gap between policy production and effective implementation, lacking a clear, unified action plan and sufficient funding to ensure systemic coherence in digitally sustainable teaching.

While the eight partner countries exhibit diverse levels of digital policy maturity and implementation structures, a critical commonality emerges: none of the analysed national policy documents explicitly articulates a coherent integration of digitally sustainable teaching as defined in this project's triple-pillar framework — that is, as the simultaneous and intentional development of environmental responsibility, social equity, and economic sustainability through digitally enriched teacher practice. It should be noted that this finding is framed by the scope of that definition. Several countries already possess well-developed legislative and professional instruments that address individual dimensions of the framework: Italy's BES and DSA provisions establish a statutory architecture for inclusive education that is directly relevant to the social sustainability pillar; Ireland's Teaching Council standards embed professional accountability mechanisms that align with equity-oriented digital pedagogy. These, however, are not articulated as components of an integrated digitally sustainable teaching model, and it is precisely this integration — across all three pillars and across digital competence, AI literacy, and sustainability education — that remains absent from current national strategic frameworks across all eight partner countries.

3.2. Overview of the adoption of European frameworks related to digitally sustainable teaching in DigiSET countries

The following comparative analysis summarises in Table 1, shows how each of the eight DigiSET partner countries has adopted or adapted the key European and global competence frameworks that together constitute the reference architecture for

digitally sustainable teaching. These frameworks address the three pillars of sustainability from complementary angles: DigCompEdu (2017) maps the professional digital competence of educators; GreenComp (2022) covers sustainability competence across four interconnected areas — embodying sustainability values, embracing complexity in sustainability, envisioning sustainable futures, and acting for sustainability — extending well beyond environmental literacy into systems thinking, futures literacy, and transformative agency; LifeComp (2020) addresses personal, social, and learning-to-learn competences; and EntreComp (2016), as the EU entrepreneurship competence framework, provides the primary reference for the economic sustainability dimension of the architecture, covering initiative, resource management, and value creation in social and civic as well as economic contexts. The UNESCO AI Competency Framework for Teachers (2024) completes the picture by addressing AI literacy as a professional teaching competence. Based on responses from all national research teams, Table 1 specifies whether the application of each framework is mandatory, recommended, or currently unused within national teacher education systems. The data reveals significant variations in policy alignment and confirms that no single country has formally integrated all five frameworks into a coherent model — a finding that directly motivates the DigiSET training design.

The Irish report team (Kenny et al., 2026) did not utilise the first table and assessment in the template; however, their corresponding evaluation in the first table of their country report was developed in consultation with the author team and is based on the analyses presented in the report (p. 21).

Table 1 gives an overview of the adoption level of four related European competence frameworks in the DigiSET countries. The overview clearly shows that only the DigCompEdu framework (2017) is recommended in all countries. It should be noted that a lack of recommendation or reference to the mentioned international frameworks does not mean that there are no national frameworks or activities. On the contrary, several countries already have older national frameworks, which is why the international frameworks may not be discussed as extensively or are set as mandatory.

Table 1: Overview of Adoption Level of selected international competence frameworks in the DigiSET countries concerning national policy documents.

Aspect	AT	BG	IR	IT	NO	RO	ES	TR
DigCompEdu (2017)	■	■	■	■	■	■	■	■
GreenComp (2022)	■	■	□	■	□	■	□	□
LifeComp (2020)	■	■	□	■	□	□	□	□
EntreComp (2016)	■	■	□	■	□	■	□	□
AI Competence Framework for Teachers (UNESCO, 2024)	□	□	□	■	■	□	□	□

Note: The symbols stand for ■ mandatory, ■ recommended, and □ not used. Sources: Aardal & Aslaksrud Kristiansen, 2026, Table, p. 12; Eşfer et al., 2026, Table 10, p. 18ff; Giampaolo et al, 2026, Table, p. 7; Kenny et al., 2026, p. 21; Lemnaru & Casariu, 2026, Table, p. 9; Savova & Peykova, 2026, Table 1, p. 10; Schön et al., Table 1, p. 14; Sola, 2026, Table, p. 14.

3.3. The role of sustainability education, digital pedagogy, AI in education and OER creation in Initial Teacher Education (ITE) in DigiSET countries

Table 2 synthesises responses from all eight national research teams regarding the integration of sustainability education, digital pedagogy, AI in education, and OER creation within current Initial Teacher Education (ITE) programmes. By comparing the specific approaches taken in each country, the data highlights the varying degrees of curricular inclusion and the distinct priorities assigned to these critical competencies across the DigiSET consortium.

It is to be noted that the four categories used in Tables 2 and 3 (sustainability education, digital pedagogy, AI in education, OER creation) do not include any dimension of social sustainability — specifically gender equity in AI, inclusive education, or equity of digital access. These are central to DigiSET's thematic areas on gender-unbiased AI and inclusive teaching. So, the comparative tables are only partial with respect to the full triple-pillar sustainability framework, see paragraph 3.5.

The overview shows that digital teaching plays an important, namely mandatory, role in teacher education for most of the eight countries, with Ireland and Spain being the exceptions. Sustainability and Education for Sustainable Development are recommended in all the countries examined, with Ireland and Spain again being the exceptions here. Regarding AI in education, Austria stands out as the only country where it is mentioned as mandatory, due to its current national AI strategy and the recently updated Framework for Digital Teaching Competencies. OER plays a bigger role in initial teacher education in Austria, Bulgaria and Romania.

Table 2: Adoption Level of Digitally Sustainable Teaching Topics in Initial Teacher Education (ITE) in the analysed DigiSET countries.

Aspect	AT	BG	IR	IT	NO	RO	ES	TR
Education for Sustainable Development	■	■	□	■	■	■	□	■
Digital Pedagogy	■	■	□	■	■	■	■	■
AI in education	■	□	□	□	□	□	□	□
OER creation	■	■	□	□	□	■	□	□

Note: The symbols stand for ■ mandatory, ■ optionally, and □ not available. Sources: Aardal & Aslaksrud Kristiansen, 2026, Table, p. 15; Eşfer et al., 2026, Table 11, p. 20; Giampaolo et al, 2026, Table, p. 9; Kenny et al., 2026, Table 8, p. 27f; Lemnaru & Casariu, 2026, Table, p. 11f; Savova & Peykova, 2026, Table, p. 13; Schön et al., (2026), Table 2, p. 16; Sola 2026, Table, p. 16.

3.4. The role of sustainability education, digital pedagogy, AI in education and in Continuous Professional Development (CPD) in DigiSET countries

Table 3 outlines the availability and scope of Continuous Professional Development (CPD) opportunities for in-service teachers across all eight partner countries, specifically focusing on sustainability education, digital pedagogy, AI in education, and OER creation. The comparative data reveals significant disparities in access and content, highlighting which country's education policy framework has established structured pathways for upskilling teachers in these critical areas versus those where such offerings remain fragmented or absent.

Table 3: Adoption Level of Digitally Sustainable Teaching Topics in Continuous Professional Development (CPD) in the analysed DigiSET countries.

Aspect	AT	BG	IR	IT	NO	RO	ES	TR
Education for Sustainable Development	■	■	□	■	■	■	■	□
Digital Pedagogy	■	■	□	■	■	■	■	■
AI in education	■	□	□	■	■	□	■	■
OER creation	■	□	□	■	□	■	■	□

Note: The symbols stand for ■ mandatory, ■ optionally, and □ not available. Sources: Aardal & Aslaksrud Kristiansen, 2026, Table, p. 17; Eşfer et al., 2026, Table 13, p. 21f; Giampaolo et al, 2026, Table, p. 9f; Kenny et al., 2026, Table 9, p. 30; Lemnaru & Casariu, 2026, Table, p. 13; Savova & Peykova, 2026, Table, p. 14; Schön et al., 2026, Table 3, p. 18; Sola, 2026, Table, p. 17.

3.5. The role of social sustainability in teacher education and training in DigiSET countries

All partners were requested to analysis the four DigiSET Thematic Areas. Although, for this purpose partners were not forced to use a specific table or option to describe the current situation. Table 4 gives an overview of the texts of the country reports concerning each of the four topics, but the assessment used in the Table is based on

this report's authors. Notably, the country reports do not consistently connect systems thinking for sustainability and inclusive teaching practices directly with digital teaching or AI usage. Consequently, the assessment primarily reflects the general availability of these topics rather than their integration within the combined DigiSET project context. For example, the Norwegian report describes the situation concerning inclusive learning as follows: "While inclusion is a fundamental principle of Norwegian education, it is not translated into a coherent set of digital inclusion competences for teachers" (Aardal & Aslaksrud Kristiansen, 2026, p. 24). The overview does not reflect notes on the difference and relevance of the topics in the countries, as such AI for adaptive learning which could have, "has the most dynamic national momentum in Italy" amongst the others (Giampaolo et al, 2026 p. 15).

Table 4: The role of DigiSET social sustainability topics in teacher education and training in DigiSET countries

Aspect	AT	BG	IR	IT	NO	RO	ES	TR
Gender-unbiased AI in teaching	□	□	■	□	□	□	□	□
Systems thinking for sustainability in education	□	□	■	□	□	□	□	□
AI for adaptive learning	□	□	■	□	□	□	□	□
Inclusive teaching practices and learning difficulties	■	■	■	■	■	■	■	■

Note: The symbols stand for ■ available and □ rarely/not available. Sources: Aardal & Aslaksrud Kristiansen, 2026, p. 20ff; Eşfer et al., 2026, p. 25ff; Giampaolo et al, 2026, p. 10ff; Kenny et al., 2026, p. 34ff; Lemnaru & Casariu, 2026, Table, p. 15ff; Savova & Peykova, 2026, p. 17ff; Schön et al., 2026, p. 20ff 18; Sola, 2026, Table, p. 19ff.

3.6. Best practices examples

All partners were invited to select and describe best practice examples related to teacher education and training within the context of DigiSET project topics. It is important to note that there was no requirement to identify one example per topic. Consequently, the following overview may not include best practices for all DigiSET topics, as partners were free to choose examples, they considered most relevant or valuable in their teaching practice context. Additionally, due to the condensed nature of the descriptions, certain details may not be fully visible in this summary. For instance, it may not be evident whether specific issues such as gender bias in AI usage are addressed within examples. Despite these limitations, the overview provides a meaningful snapshot of the perspectives held across the Country Reports. It illustrates which examples the partners have identified and documented as particularly helpful for advancing DigiSET objectives.

An examination of the best practice examples reveals notable gaps in topic integration. Very few examples address two or even more of the four key general DigiSET topics simultaneously, while the four specific DigiSET themes are rarely addressed directly: Inclusive teaching with digital tools remains the only special theme appearing across several entries. This pattern reflects partners' understanding that DigiSET topics are conceived in parallel or independently rather than holistically. Only digital pedagogy and AI in education frequently overlap, which is unsurprising given their thematic connection. Furthermore, some best practice examples function as collections rather than integrated offerings. For instance, the Virtual University of Teacher Education (VPH) in Austria represents a compilation of themes and offers

for educators—not an integrated single offering or modularly designed programme, but rather an aggregated resource base.

The ÖBA project (Türkiye) stands out as one of the few examples combining multiple DigiSET topics, even though it does not directly incorporate Education for Sustainable Development (ESD) issues. Inclusive teaching with digital tools is, for example, addressed within this initiative. Notably, most AI in education best practices include the dimension of ethics and bias, yet none of the descriptions explicitly mention gender bias. Consequently, truly integrating” practice projects that could serve as immediate models for DigiSET are not currently described in the Country Reports.

It should also be noted that partners did not focus solely on content (policy, guidelines etc) in their descriptions. They also provided insights into implementation possibilities and designs for teacher continuing education from which DigiSET can learn. A pertinent example comes from the Spanish best practice Andalusia Código Escuela 4.0, which emphasises: “teacher training oriented towards digital competences produces stronger and more sustainable results when embedded within school governance structures, such as school plans, recognised institutional roles and evidence recorded in information systems, rather than being offered as isolated professional development” (Sola 2026, p. 24).

Table 5 presents the best practice examples across eight participating countries and their alignment with DigiSET topics.

Table 5: Best practice examples overview and addressed topics. Appreviations of the columns: C: Country, ESD: Education for Sustainable Development, DP: Digital Pedagog, AI: AI in education, OER: OER creation: DS1: Gender-unbiased AI in teaching, DG2: Systems thinking for sustainability in education, DG3: AI for adaptive learning, DG 4: Inclusive teaching practices and learning difficulties.

Best practice	C	ESD	DP	AI	OER	DG1	DG2	DG3	DG4
Virtual University of Teacher Education (Virtuelle PH)	AT	■	■	■	■	□	□	□	■
Prompting.school	AT	□	□	■	□	□	□	□	□
A MOOC for teacher training on generative AI as OER	AT	□	■	■	□	□	□	□	□
National Teacher Training on AI in Education (Bankya Training Programme)	BU	□	□	■	■	□	□	□	□
STEM Skills for the 21st Century Classroom – Erasmus+ Teacher Mobility Project	BU	□	■	■	□	□	□	□	□
Waterford & Wexford Education and Training Board M365 Cluster	IR	□	■	□	□	□	□	□	□
ADAPT Research Centre (Ireland), supported by Google	IR	□	■	■	□	□	□	□	□
Avanguardie Educative (INDIRE)	IT	□	■	□	□	□	□	□	□

EducazioneDigitale.it (CivicaMente)	IT	□	■	□	□	□	□	□	□
GreenComp e didattica: possibili connessioni (Scuola Futura MOOC)	IT	■	□	□	□	□	□	□	□
IA_Lab per costruire nuove competenze (Scuola Futura)	IT	□	■	■	□	□	□	□	□
The Sustainable Backpack (coordinated by the Norwegian Centre for Science Education)	NO	■	■	□	□	□	□	□	□
Digital Norway – National Platform for Digital and AI Competence Development	NO	□	□	■ *	□	□	□	□	□
EduShift: Digital pedagogy for pre-university teachers	RO	□	■	□	■	□	□	□	□
DigiLang (Erasmus+) Digital Technologies in Language Teaching	RO	□	■	□	■	□	□	□	□
CEDEC Proyecto EDIA (OER)	ES	□	□	□	■	□	□	□	□
Andalusia Código Escuela 4.0	ES	□	■	■	□	□	□	□	□
Teacher Informatics Network ÖBA	TR	□	■	□	□	□	□	□	■
Bilgelş project (MOOCs)	TR	□	■	□	□	□	□	□	□
Dijital Teachers (Blended)	TR	□	■	■	□	□	□	□	□

Note: The symbols stand for a topic that ■ is addressed, or □ is not addressed in the case description in the country reports. Analysis of the best practice examples of DigiSET country reports. Sources: Aardal & Aslaksrud Kristiansen, 2026, 24ff; Eşfer et al., 2026, p. 30ff; Giampaolo et al, 2026, p. 18ff; Kenny et al., 2026, p. 38ff; Lemnaru & Casariu, 2026, p. 19f; Savova & Peykova, 2026, p. 20ff; Schön et al., (2026), p. 23ff; Sola 2026, p. 22ff. Note: * not for education/teacher

3.7. Underdeveloped competences according to the country reports

All Country Reports part 6.1 ~~all country reports~~ described competences, that are potentially underdeveloped, a summary of key elements is provided below:

- **Austria:** According to the Austria country report (Schön et al., 2026, p. 27) three competence areas remain insufficiently addressed despite being referenced in the national digi.kompP framework: connecting digital infrastructure to ecological footprints through **systems thinking for digital sustainability** appears largely absent from both Initial Teacher Education (ITE) and CPD, competencies for **environmental impact assessment** are addressed in the framework but lack corresponding teacher training implications, and although several policies and frameworks exist on **inclusive and gender-sensitive digital practices**, a holistic approach is missing.
- **Bulgaria:** According to the Bulgaria country report (Savova & Peykova, 2026, Table, p.23 ff), the analysis of the national policy context, teacher education programmes and professional development opportunities reveals several competence areas that remain weakly addressed or insufficiently developed, specifically **ethical and critical use of AI in education** due to limited

structured training, **interdisciplinary sustainability teaching** lacking systems-based approaches, **teacher autonomy in creating and sharing learning resources** with open licenses (OER), **use of AI for personalised and adaptive learning** where potentials remain largely unexplored, and **integration of digital technologies for inclusive education** requiring additional competences for assistive tools. Addressing these competence gaps is considered essential for developing teachers who can combine digital innovation, sustainability principles and inclusion.

- **Ireland:** According to the Ireland report (Kenny et al., 2026, p. 44f), underdeveloped competences comprise **AI ethics and environmental implications of technology** (where deeper knowledge on energy costs and lifecycle sustainability remains narrow), **interdisciplinary sustainability teaching** (where integration across subjects is inconsistent), **advanced digital resource production and teacher autonomy** (where OER creation skills are less consistently developed), and **socio-emotional and digital well-being competences** (which are not systematically embedded).
- **Italy:** According to the Italy country report (Giampaolo et al., 2026, p. 27), three competence areas remain underdeveloped despite their visibility in the national landscape. **Ethical and bias-aware AI use** is insufficiently developed as a stable professional competence, particularly regarding gender bias, fairness, transparency, and critical scrutiny of AI-generated outputs. **Interdisciplinary sustainability teaching** through systems thinking is present via GreenComp but not mainstreamed across the profession. Teacher autonomy in creating and **openly sharing educational resources**—including OER licensing, adaptation, and reuse—lacks consistent professional recognition.
- **Norway:** According to the Norway country report (Aardal & Aslaksrud Kristiansen, 2026, pp. 27–29), several competence areas remain insufficiently addressed despite strong foundations in digitalisation and inclusion. The **ethical and pedagogical use of AI** is weakly developed: while national principles for trustworthy AI exist, they are not translated into teacher-specific classroom competences, leaving teachers without structured preparation for evaluating AI tools, identifying bias, or making informed pedagogical choices about generative and adaptive systems. **Interdisciplinary sustainability teaching and systems thinking** represent another gap: although sustainable development is a mandated interdisciplinary topic in the so-called current LK20 curriculum, teacher education provides limited preparation in systems thinking, futures literacy, and interdisciplinary sustainability pedagogy. Teacher autonomy in **creating, adapting, and sharing OER** remains weakly recognised: teachers frequently develop their own materials, but open educational practice is not articulated as a professional competence, with no systematic preparation in open licensing or collaborative resource development. **Environmentally responsible digital practice** is largely absent from both ITE and CPD: the environmental impacts of digital technologies and AI systems—such as energy use and AI-related carbon footprints—are not addressed, leaving teachers without guidance on environmentally informed digital decision-making. Finally, a transversal gap lies in the lack of **integration across competence domains**: digital competence, sustainability, inclusion, AI, and openness are addressed

through separate frameworks and policy streams, leaving teachers to connect them independently without an integrative competence model.

- Romania:** According to Romania's country report (Lemnaru & Casariu, 2026, p. 22), several specialised digital competencies remain insufficiently addressed within Romania's teacher education system, posing significant challenges for the development of the Digitally Sustainable European Teacher framework. In particular, teachers lack training in **ethical AI integration and algorithmic bias awareness, interdisciplinary sustainability pedagogy with systems thinking skills, pedagogical agency in creating and licensing OER, critical evaluation of the digital ecological footprint including hardware lifecycle and energy consumption management**, as well as the application of **learning analytics and adaptive AI for data-informed differentiation to support students with diverse linguistic or learning difficulties**. These gaps collectively reveal a structural shortfall in advancing Romanian teacher competencies beyond foundational digital literacy toward ethically informed, sustainability-oriented, and inclusively applied digital pedagogy.
- Spain:** According to the Spain country report (Sola, 2026, p. 25), the least developed competence areas lie at the **intersection of domains**. No sufficiently consolidated professional standard exists for **ethical and gender-aware AI use** in teaching, for **systems thinking** as an explicit teacher competence, for the **environmental implications** of digital and AI choices in education, or for **OER creation** as a generally recognised professional requirement. GreenComp- and LifeComp-related dimensions are present in the wider policy environment but are not yet translated into a strongly codified teacher competence matrix. These underdeveloped areas are precisely where DigiSET can contribute most clearly by **connecting already mature digital-competence structures with sustainability reasoning, socio-emotional and reflective dimensions, inclusive pedagogies, and responsible AI-enabled resource creation**.
- Türkiye:** According to the Türkiye country report (Esfer, Dulay & Oral, 2026, pp. 42–43), four competence areas remain insufficiently developed. **OER creation**, licensing, sharing, and reuse is the most clearly underdeveloped area: despite extensive digital content infrastructure through EBA and ÖBA, there is no dedicated national OER policy, no open licensing culture within mainstream school policy, and no systematic place for OER creation within teacher competence standards or CPD—the distinction between free access and genuinely OER remains unresolved. **Interdisciplinary sustainability teaching** as a teacher competence is present in policy discourse but not institutionalised in ITE or CPD, meaning teachers encounter sustainability as content rather than as a cross-disciplinary design principle. **Ethical and equity-oriented AI competence** beyond procedural compliance is underdeveloped: while Türkiye has established an ethics board, guidance documents, and a mandatory ethics declaration, competence development has not reached systematic classroom enactment, particularly regarding bias recognition, human oversight, privacy protection, and pedagogical decisions preserving fairness and learner agency. **Teacher autonomy in resource creation and innovation** remains constrained by centralised, top-down structures that position teachers primarily as users of centrally produced

materials rather than as autonomous designers and contributors to open educational innovation.

The country reports show clear consensus on identified competence gaps, particularly regarding ethical and gender-sensitive AI use, interdisciplinary sustainability education with systems thinking, and teacher autonomy in OER creation and use. Another consistent finding is the absence of environmental awareness in the context of digital technologies (digital footprints, energy consumption). Differences mainly exist in emphasis and specific contextualisation: while countries like Norway and Spain particularly highlight the lack of integration across competence domains, Türkiye emphasises centralised governance structures, and Ireland additionally identifies socio-emotional and digital well-being competences as a neglected area.

3.8. Recommendations from the country reports

3.8.1. Implications for the DigiSET competence framework per country

The country reports provide insights for the DigiSET project framework and training programme (see paragraph 6.2.1 in country reports).

- **Austria** : According to the Austria country report (Schön et al., 2026, p. 27), three underdeveloped competence areas are identified despite their presence in the national *digikompP* framework: **connecting digital infrastructure to ecological footprints through systems thinking** remains largely absent from both initial teacher education and continuous professional development, **competencies for evaluating the environmental impact of digital technologies**—including energy consumption and e-waste—are acknowledged in the framework but lack corresponding teacher training implications, and while various policies and frameworks address inclusive and gender-sensitive digital practices, **a holistic and systematically integrated approach** across teacher education remains missing.
- **Bulgaria**: Based on the analysis of the Bulgarian educational context (Savova & Peykova, 2026, Table, p. 24f), the DigiSET competence framework should include key competence areas reflecting current policy priorities and identified gaps: **the critical and ethical use of AI in teaching**, integration of sustainability into teaching practice through **interdisciplinary learning** activities, **design of inclusive digital learning environments with emphasis on assistive technologies and accessibility**, and practical competences for **creating and sharing OER**. Particular emphasis should be placed on the interconnection between digital competence, sustainability education and inclusive pedagogy, as these elements are often addressed separately in current teacher training but **need to be integrated** within a digitally sustainable teaching approach, while ensuring compatibility with the existing national system for teacher qualification to support practical implementation within recognised professional development pathways.
- **Ireland**: According to the Ireland report (Kenny et al., 2026, p. 45ff), based on the Irish national policy and practice context, the DigiSET competence framework **should explicitly merge sustainability, AI ethics, digital pedagogy, and open education; provide a structured, scalable digital competence progression model**; develop robust **AI literacy, ethics, and**

governance competences; integrate **sustainability as a transversal competence across digital pedagogy**; and encompass **four key competence areas, namely ethical, critical and sustainable AI competence** (knowledge of AI fundamentals, ethical principles and environmental impacts), **inclusive digital pedagogy** (knowledge of UDL, SEN supports and accessibility requirements), integrated sustainability pedagogies (knowledge of systems thinking and ESD principles), and OER and open pedagogical practices (knowledge of creative commons licensing and open science principles).

- **Italy:** According to the Italy country report (Giampaolo et al., 2026, pp. 27–28), the DigiSET competence framework should include five interconnected clusters: **digital pedagogy, ethical and critical AI competence, inclusive digital learning design, systems thinking for sustainability, and OER creation, adaptation, and sharing**—supplemented transversally by creative thinking in the use of AI and digital technologies. Each area should be defined through knowledge, skills, and attitudes, following an **integrative rather than additive approach**, treating these domains as mutually reinforcing parts of one coherent professional profile.
- **Norway:** According to the Norway country report (Aardal & Aslaksrud Kristiansen, 2026, pp. 29–30), the DigiSET competence framework should define five integrative competence areas: **critical and ethical digital competence with emphasis on AI-related pedagogical decision-making; inclusive digital learning design** integrating accessibility and differentiation directly into digital competence; **sustainability competence grounded in systems thinking**, supported by digital tools and inquiry-based learning; **open educational practice** covering open licensing, collaborative development, and resource sharing; and **reflective professional judgement** as a transversal competence across all domains. Three aspects require special emphasis: **prioritising integration across competence domains**, emphasising **practice-based competence demonstration** through OER creation, and **foregrounding ethical and environmental responsibility** in digital decision-making—areas currently absent from national teacher competence frameworks.
- **Romania:** Based on the Romania country report (Lemnaru & Casariu, 2026, p. 23), the DigiSET competence framework should bridge the gap between existing digital standards and emerging sustainability and ethical innovation requirements by **integrating digital pedagogy with environmental responsibility** while establishing **pedagogical agency** as a core competency that enables teachers to autonomously **design, remix, and license OER** adapted to diverse classrooms. The framework must additionally incorporate **critical AI literacy components** addressing algorithmic bias mitigation and data privacy, introduce the concept of the **digital ecological footprint to foster sustainable digital practices** regarding energy consumption and infrastructure management, and emphasise inclusive teaching through adaptive technologies and learning analytics—all aligned with Romanian national professional standards and the DigCompEdu benchmark to facilitate seamless integration into the country's continuous professional development system.
- **Spain:** According to the Spain country report (Sola, 2026, pp. 26–27), the DigiSET competence framework should include at least five key areas:

professional digital pedagogy linked to planning, implementation, assessment and reflective improvement; **OER literacy** including legal, technical and pedagogical capacity to create, adapt, attribute, share and improve resources; **critical, ethical and bias-aware AI use** in teaching with explicit attention to transparency, privacy, inclusion and human oversight; **sustainability-oriented pedagogical design including systems thinking** and interdisciplinary connections between digital practices and environmental, social and economic sustainability; and **inclusive design for diverse learners using digital and AI-supported strategies** without weakening accessibility or equity. The framework should adopt a balanced knowledge-skill-attitude model, with knowledge covering regulatory environments, ethical principles and framework literacy, skills covering design, adaptation, implementation, evaluation and collaborative improvement, and attitudes covering critical reflection, commitment to inclusion and sustained willingness to learn.

- **Türkiye:** According to the Türkiye country report (Esfer, Dulay & Oral, 2026, pp. 44–45), the DigiSET competence framework should include five interrelated competence areas: **digital pedagogical design, critical and ethical AI use, inclusive and equity-oriented digital teaching, sustainability integration across teaching practice, and OER creation and collaborative sharing**. The framework should adopt a balanced knowledge, skills, and attitudes model to counter Türkiye's persistent overemphasis on technical and instrumental understandings of digital competence. Particular emphasis should be placed on three issues: **treating ethics as a transversal dimension** across all competence areas rather than an add-on; **explicitly including equity-sensitive pedagogy** given documented **urban-rural** and **public-private disparities**; and making **teacher-led openness and collaborative authorship visible** as a competence expectation—one of the clearest gaps between the current Turkish context and the broader European direction of digitally sustainable education.

The country reports converge on five core competence areas for the DigiSET framework—digital pedagogy, ethical AI use, sustainability/ESD, inclusive teaching, and OER creation—with broad agreement on adopting an integrative rather than additive approach and a knowledge-skills-attitudes model. However, national contextualisations vary: Ireland emphasises scalable progression models, Norway foregrounds reflective professional judgement as a transversal competence, Spain details regulatory and evaluative dimensions, Türkiye highlights equity-sensitive pedagogy addressing urban-rural and public-private disparities, while Romania and Bulgaria stress alignment with existing national qualification systems and DigCompEdu benchmarks. This suggests the framework should maintain structural coherence while allowing flexibility for national adaptation pathways.

3.8.2. Implications for DigiSET learning outcomes

In the following an overview of country reports implications on learning outcomes in the DigiSET framework are given (see paragraph 6.2.2 in country reports)

- **Austria:** Within the Austrian report (Schön et al., 2026, p. 27), the authors highlights as implication for learning outcomes that the DigiSET framework should holistically integrate **digital and sustainability competencies through explicit intersection** points, establish **AI ethics as a mandatory core component**, and prioritise **actionable skills like OER creation over abstract knowledge**.

- **Bulgaria:** Based on the Bulgaria country report (Savova & Peykova, 2026, Table, p. 25), the DigiSET training programme should enable teachers to demonstrate clearly defined and assessable learning outcomes expressed in observable terms, including **evidence of practical application** such as lesson scenarios, adapted digital materials and documented classroom implementation through reflective or portfolio-based approaches. Specifically, teachers should be able to **design and implement learning activities** using AI tools responsibly and pedagogically meaningfully, integrate sustainability concepts through interdisciplinary and project-based learning connected to real-world contexts, adapt their teaching using digital tools and differentiated instruction strategies to support diverse learners including students with learning difficulties, and create, adapt and share OER collaboratively within professional communities.
- **Ireland:** According to the Ireland report (Kenny et al., 2026, p. 46), teachers completing DigiSET training should be able to design and implement learning activities that **incorporate** AI responsibly, ensuring human oversight and mitigating ethical risks; integrate sustainability concepts across subjects using systems thinking approaches; **use digital tools to differentiate instruction**, personalise learning, and support diverse learners; **create, adapt, and openly share OER** demonstrating digital authorship, accessibility, and licensing competence; and **reflect critically on digital practices**, considering well-being, equity, and environmental impact.
- **Italy:** According to the Italy country report (Giampaolo et al., 2026, p. 28), DigiSET learning outcomes should be **demonstrable, practice-oriented, and progression-based**. Teachers should be able to **design learning activities using AI creatively and responsibly, evaluate AI tools for pedagogical usefulness and bias-related risks, integrate sustainability concepts** across subjects using creative and systems thinking approaches, adapt teaching **using digital tools for diverse learners**, and create, adapt, and share **OER materials** collaboratively—with progression moving from conceptual understanding to application, evaluation, and creation.
- **Norway:** According to the Norway country report (Aardal & Aslaksrud Kristiansen, 2026, pp. 31–32), DigiSET **learning outcomes should be demonstrable, practice-oriented, and integrative**. After completing DigiSET training, teachers should be able to design and justify learning activities that use AI responsibly, including selecting AI tools based on pedagogical relevance, critically interpreting AI-generated outputs, and recognising bias while safeguarding learner data. Teachers should be able to **integrate sustainability meaningfully across subjects** using systems-oriented approaches, designing interdisciplinary learning sequences that connect environmental, social, and economic dimensions through digital tools supporting inquiry and critical reflection. They should be able to **adapt digital learning designs to diverse learner needs**, modifying materials, tasks, and assessment formats to support linguistic diversity, different learning speeds, and accessibility requirements. Teachers should be able to create, adapt, and share **at least one openly licensed OER**, applying appropriate open licences and documenting conditions for reuse. Finally, teachers should demonstrate reflective professional judgement by critically reflecting on their digital and pedagogical choices, articulating ethical and sustainability

considerations, and justifying how their practice aligns with inclusive and responsible educational values.

- **Romania:** Based on the Romania country report (Lemnaru & Casariu, 2026, p. 24), the proposed learning outcomes expect teachers to demonstrate the responsible and critical use of AI in designing learning activities—particularly by **evaluating AI-generated content for algorithmic bias and ethical transparency**—while **integrating sustainability concepts across disciplines** through systems thinking that connects digital choices to broader ecological impact. Upon completion of training, educators should further be able to employ adaptive technologies and learning analytics to support students with **special educational needs or linguistic barriers**, and to collaboratively **create, remix, and share OER**, thereby transitioning from passive technology consumers to **autonomous pedagogical agents** who contribute to a sustainable, inclusive, and open European educational commons.
- **Spain:** According to the Spain country report (Sola, 2026, pp. 26–27), DigiSET learning outcomes should be both **pedagogically meaningful** and demonstrable through **evidence**. Teachers should be able to **design learning situations** in which digital tools are used purposefully rather than merely instrumentally; **create or adapt OER** with open licenses, attribution and pedagogical coherence; integrate sustainability perspectives into subject teaching through **interdisciplinary and context-sensitive approaches**; critically evaluate and **use AI tools accounting for bias**, privacy, fairness and educational relevance; **adapt digital teaching strategies to diverse learners**; and collaborate within professional communities to improve resources and practices. Learning outcomes should not be expressed only as general awareness but should be **observable through adapted teaching materials**, OER outputs, designed learning situations, reflective commentaries, evidence of inclusive decision-making, documented use or non-use of AI tools based on educational and ethical judgement, and collaboration evidence—aligning with Spain's existing culture of digital competence evidencing through **accreditation procedures**.
- **Türkiye:** According to the Türkiye country report (Esfer, Dulay & Oral, 2026, p. 45), following DigiSET training, teachers should be able to **design and justify AI-supported learning activities** that are pedagogically appropriate, ethically responsible, and aligned with learner needs—moving beyond awareness toward **demonstrable instructional decision-making**. Teachers should be able to integrate sustainability concepts across subject areas using inquiry-based and context-responsive teaching approaches, connecting sustainability to disciplinary learning, local issues, and digital tools. They should be able to **adapt digital teaching for diverse learners and educational contexts**, including students with differing needs, institutional constraints, and levels of access. Finally, teachers should be able to create, adapt, license, and collaboratively share educational resources in alignment with **OER principles**—a transformative competence area for Türkiye, where current systems support content use and limited creation but not systematic openness, licensing literacy, or distributed sharing cultures.

The country reports show broad consensus regarding demonstrable, practice-oriented learning outcomes with a focus on responsible AI use, OER creation, sustainable pedagogy, and inclusive teaching practice. While all reports emphasise

the transition from theoretical knowledge to applicable competence, national specificities differ: Norway highlights reflective professional judgement as an independent learning outcome, Spain links outcomes explicitly to existing accreditation procedures, Bulgaria emphasises portfolio-based evidence, and Türkiye identifies the shift from mere content consumption to systematic openness and licensing literacy as a transformative challenge. Overall, the outcomes point towards a coherent learning outcome model that integrates practical application, ethical reflection, and collaborative practice.

3.8.3. Implications for DigiSET training design

In the following an overview of country reports implications for training design is given (see paragraph 6.2.3 in country reports):

- **Austria:** According to the Austria country report (Schön et al., 2026, p. 27), training approaches require **practice-based learning** where **hands-on OER creation and AI tool experimentation** proves more effective than theoretical instruction alone, interdisciplinary **workshops combining digital pedagogy with sustainability perspectives** to bridge current silos, and reflective components featuring **critical reflection on technology choices** and their broader impacts essential for sustainable digital literacy.
- **Bulgaria:** The analysis suggests for Bulgaria (Savova & Peykova, 2026, Table, p. 25f) that the DigiSET training programme should adopt **practice-oriented and collaborative learning approaches**, including **hands-on experimentation** with digital and AI tools, **collaborative co-design of learning materials in blended formats** combining accredited **external training with school-based professional learning communities**, and **interdisciplinary workshops** exploring the integration of sustainability, digital technologies and AI through **project-based and inquiry-based approaches**. Additionally, the training should incorporate structured **reflective learning activities** encouraging teachers to analyse pedagogical and ethical implications of digital technologies, and utilise **modular, practice-based training formats** providing flexibility for teachers with varying workloads and digital competence levels.
- **Ireland:** according to the Ireland report (Kenny et al., 2026, p. 46), an effective DigiSET training should include **practice-based learning** with hands-on experimentation with AI tools, **OER creation**, and **digital pedagogies applied to real-world classroom scenarios**; **collaborative and co-design approaches** modelled on wwetb's m365 digital cluster (see good practice) including joint development of digital and sustainability-focused resources; **interdisciplinary workshops** integrating sustainability, AI, digital inclusion, and pedagogy with cross-subject teams designing shared learning activities; and **reflective practice** providing structured opportunities for teachers to analyse ethical, social and environmental implications of digital practices linked to national guidance and school digital strategies.
- **Italy:** According to the Italy country report (Giampaolo et al., 2026, p. 28), DigiSET training design should be **practice-based, modular, and community-oriented**, combining **conceptual input with production tasks**, collaborative design, testing, and reflective revision. Drawing on national models like Avanguardie Educative (coaching and peer exchange), the GreenComp MOOC (scalable framework-based CPD), and IA_Lab

(laboratory components and guided experimentation), training should include resource-production components that enable teachers to adapt, document, and share their outputs—supporting progression from conceptual understanding to situated application and OER development.

- **Norway:** According to the Norway country report (Aardal & Aslaksrud Kristiansen, 2026, pp. 32–33), DigiSET training should be designed as practice-based, collaborative, and modular rather than content-heavy or purely theoretical. **Practice-based learning** should centre on concrete production tasks such as designing digitally supported sustainability lessons, developing inclusive digital activities, and creating OER demonstrating responsible AI use. **Collaborative design** through professional learning communities should support peer feedback and shared problem-solving in developing learning materials and OER. Interdisciplinary workshops should connect subject perspectives with digital competence, sustainability, AI, and inclusion, positioning digital tools as supports for inquiry rather than ends in themselves. Reflective learning should be embedded throughout, providing structured opportunities to examine ethical trade-offs, sustainability implications, and inclusion challenges. Finally, training should **adopt modular and flexible structures with potential micro-credential recognition**, enabling integration into Norway's decentralised Continuous Professional Development (CPD) landscape across diverse institutional contexts and career stages.
- **Romania:** Based on the Romanian country report (Lemnaru & Casariu, 2026, p. 24) the training design should shift from traditional theoretical instruction toward a **practice-based learning** model grounded in real-world classroom application, enabling teachers to test digital tools and sustainability strategies directly within their own teaching environments while **collaboratively designing and peer-reviewing OER** in professional networks. To address the complexity of integrating digital literacy with environmental ethics, the training should further incorporate **interdisciplinary workshops** that foster systems thinking across subject areas, complemented by structured **reflective activities** that encourage educators to critically evaluate their own digital habits—including identifying algorithmic bias and assessing the energy footprint of digital infrastructure—through modular, flexible learning pathways aligned with both Romanian educators' professional needs and the overarching goals of the DigiSET framework.
- **Spain:** According to the Spain country report (Sola, 2026, pp. 27–28), training design should be **practice-based, modular, evidence-rich and closely linked to school reality**, as stand-alone theoretical familiarisation is unlikely to be sufficient. A strong training model should combine **short, guided modules, school-linked application tasks, collaborative OER design, peer review, scenario-based discussion of ethical AI use, and reflective activities focused on inclusion and sustainability trade-offs**. Existing public infrastructures such as Procomún, CEDEC, Proyecto EDIA and the Andalusian eAprendizaje ecosystem demonstrate compatibility with **resource-based, open and applied learning formats** that DigiSET should leverage. Where possible, training should be **stackable and aligned with existing recognition logics**—designed to facilitate future partial recognition, portfolio-based validation or integration into existing CPD routes, particularly

given Spain's strong administrative culture of teacher competence accreditation.

- **Türkiye:** According to the Türkiye country report (Esfer, Dulay & Oral, 2026, pp. 45–46), DigiSET training should be designed as **practice-based, scaffolded, and sustained over time rather** than as one-off awareness sessions. Training should move beyond fragmented, episodic, hardware-centred CPD models and adopt **blended, staged, and mentor-supported structures**, drawing on national examples such as the Dijital Öğretmenler model, which combines asynchronous learning, live academic support, assessment-based progression, and advanced specialisation. The programme should include **collaborative design tasks** where teachers develop and critique lesson plans, AI-supported activities, accessibility adaptations, and OER-oriented materials, with opportunities to apply competences in authentic pedagogical contexts. **Interdisciplinary workshops** connecting sustainability, AI, inclusion, and curriculum design should be incorporated, and reflective activities should be embedded throughout as a core training mechanism—not an optional add-on—to strengthen professional judgment, ethical awareness, and contextual adaptation.

The country reports converge on practice-based, modular training design emphasizing hands-on OER creation, AI tool experimentation, interdisciplinary workshops, collaborative co-design, and embedded reflective activities rather than theoretical instruction. National contextualisations vary notably: Spain and Norway stress alignment with existing accreditation systems and micro-credential recognition, respectively; Türkiye highlights sustained, mentor-supported structures over episodic CPD; Bulgaria and Ireland reference specific professional learning community models; and Italy draws on established national frameworks like Avanguardie Educative. This suggests the training programme should maintain methodological coherence while allowing flexibility for integration into diverse national CPD landscapes and recognition pathways.

4. Conclusions and implications

This chapter synthesises findings from the comparative analysis of digital sustainability in teacher education across the eight DigiSET partner countries, interpreted against the triple-pillar sustainability framework established in Section 1 of this report. The conclusions below highlight structural patterns, identify consistent competence gaps, and outline implications for the design and implementation of the DigiSET training programme.

4.1. Main conclusions

First, DigCompEdu (2017) is the only internationally recognised framework with broad cross-country adoption, while GreenComp, LifeComp, and EntreComp remain scarcely used or recommended, partly because several national systems already rely on established domestic frameworks. This pattern of adoption carries a structural implication that extends beyond institutional inertia. Read against the triple-pillar framing of this report, the frameworks with the weakest adoption — GreenComp, with its systems thinking and futures literacy dimensions; LifeComp, with its personal and social competence focus; and EntreComp, with its economic and civic agency orientation — are precisely those that address the social and economic pillars of digitally sustainable teaching. The predominance of DigCompEdu, which foregrounds

digital tools and pedagogical practice, means that the framework most widely embedded in national systems is also the least equipped to address equity, inclusion, and gender fairness as sustainability dimensions. The cross-country data therefore reveals not merely a gap in framework harmonisation, but a structural underdevelopment of the social sustainability pillar in teacher education across all eight DigiSET partner countries.

Second, there is a notable asymmetry between initial teacher education and continuous professional development that reflects not only structural differences between the two phases but also divergent priorities in what counts as essential teacher preparation. Some countries, such as Spain, have integrated sustainability and digital pedagogy into CPD but not into ITE, while others show the reverse pattern — for instance, ESD is present in ITE but absent from CPD in Türkiye. This asymmetry is significant beyond its descriptive value: where social sustainability dimensions such as inclusive pedagogy and equity-oriented AI use are present at all, they tend to appear in CPD rather than ITE, suggesting they are treated as specialist upskilling rather than as foundational professional competences. The implication for DigiSET is that the training programme must engage both phases deliberately, with particular attention to embedding social sustainability as a core competence from the outset of teacher education rather than as an add-on at the CPD stage.

Third, Austria is the only country where AI in education is classified as mandatory in ITE, reflecting its current national AI strategy and recently updated framework for digital teaching competencies — a contrast to all other partner countries where AI remains optional or absent from ITE curricula. The Austrian case demonstrates that rapid institutional adaptation is fundamentally possible and may already be underway in other contexts: notably, the authors of the Austrian country report were surprised by a framework update published just one week before submission (Schön et al., 2026).

Taken together, these three findings point to a fourth and overarching conclusion: across all eight partner countries, the social sustainability pillar of digitally sustainable teaching — encompassing equity of access, inclusive learning design, gender fairness in AI, and the counteraction of algorithmic bias — is the dimension most consistently absent from national policy frameworks, competence standards, and CPD provision. This is not a peripheral gap but a central one, given that three of the four DigiSET thematic areas are grounded in this dimension. It is here that the project's training programme has the strongest and most clearly evidenced added value, and it is here that the upcoming surveys and focus group interviews should be designed to gather the most detailed empirical grounding.

4.2. Synthesis of findings from country reports

Analysis of social sustainability topics across the partner countries reveals that gender-unbiased AI, systems thinking, adaptive learning, and inclusive teaching are inconsistently addressed and rarely integrated with digital teaching or AI usage. This indicates a structural separation between digital competence development and social sustainability considerations in current teacher education frameworks. Examination of best practice examples further shows that existing initiatives predominantly address individual DigiSET topics rather than demonstrating holistic integration. While digital pedagogy and AI in education frequently overlap, truly integrating projects combining multiple thematic dimensions are scarce, confirming a clear opportunity for DigiSET to develop models that bridge these typically siloed domains.

All country reports identify converging competence gaps: ethical and gender-sensitive AI use, interdisciplinary sustainability with systems thinking, teacher autonomy in OER creation, and environmental awareness regarding digital footprints. National variations exist in emphasis—Norway and Spain highlight cross-domain integration, Türkiye foregrounds governance structures, and Ireland adds socio-emotional well-being—yet the core deficit areas remain consistent across contexts. Correspondingly, country reports converge on five core competence areas (digital pedagogy, ethical AI, sustainability, inclusive teaching, OER), advocate for an integrative rather than additive approach, and agree on practice-based, modular training design with embedded reflection. However, successful implementation requires flexibility for national adaptation pathways, including alignment with existing accreditation systems, recognition models, and CPD infrastructure. The framework must balance structural coherence with contextual responsiveness to ensure practical applicability across diverse European teacher education landscapes.

5. Outlook: Empirical grounding through teacher surveys and focus groups

To deepen the understanding of teachers' actual needs across the DigiSET partner countries, further empirical analyses will be conducted in the upcoming project phase. While the comparative country report analysis has provided a robust policy and structural perspective, it is essential to complement these findings with direct insight into teachers' lived experiences, perceived competence gaps, and professional development interests. Specifically, this next phase aims to better understand which competences teachers themselves identify as lacking, where they see the greatest need for further training, and how their professional contexts shape their engagement with digital sustainability topics. In particular, the empirical phases are designed to test whether the structural gaps identified in this report -- the systematic underdevelopment of the social sustainability pillar across national frameworks, the asymmetry between initial teacher education and continuous professional development, and the limited integration of equity, inclusion, and gender fairness as teacher competence areas -- are reflected in teachers' own perceptions of their professional preparation and development needs.

To achieve this, DigiSET has designed a dedicated teacher survey that will be administered across all eight partner countries, targeting a minimum of 100 respondents per country. The survey captures quantitative and qualitative data on teachers' current digital competences, their familiarity with DigiSET thematic areas, their attitudes towards AI, sustainability, inclusion, and OER, and their preferred modes of professional development. In addition to the survey, focus group interviews will be conducted in all partner countries to allow for more nuanced, context-sensitive exploration of the themes identified. These focus groups will provide space for teachers to articulate their experiences, challenges, and aspirations in their own terms, thereby enriching the survey findings with deeper interpretive depth. The focus groups will pay particular attention to the dimensions identified as most consistently absent from current national frameworks: teachers' understanding of gender fairness in AI use, their approaches to inclusive digital pedagogy, and their capacity to engage with sustainability as an integrated environmental, social, and economic concern rather than as a subject-specific content area.

The combined results of the survey and focus group analyses will be synthesised and presented in a comprehensive report scheduled for publication at the end of October 2026 (DigiSET Deliverable D2.1). This report will serve as the empirical

foundation for the subsequent development of the DigiSET competence framework and training programme, ensuring that both are grounded not only in policy analysis but also in the authentic voices and needs of teachers across the partner countries. This document thus marks the conclusion of the desk research phase and the opening of the empirical one. The gaps it has identified are not limitations to be set aside; they are the research questions that make the subsequent work both necessary and meaningful.

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