

DigiSET – The Academy of Digitally Sustainable European Teacher

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Teachers' Competences for Digital Sustainability in Italy

A survey amongst school teachers

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Disclaimer on Methodology and Authorship

The development of the survey instrument was a collaborative effort involving the entire consortium. However, the selection of scales and the final composition of the questionnaire were done by Dila Oral, Sezin Esfer and Sabiha Dulay (all BAU), Filiz Keser Aschenberger (UWK), Erina Guraziu (OpenCom), and Sandra Schön (TU Graz). The analysis template as well as the data analysis process — including data cleaning, selection, and the creation of all charts and diagrams — were carried out by Bettina Mair and Sandra Schön (both TU Graz). The textual descriptions, interpretations, and conclusions presented in this report reflect the views of the respective authors listed herein and are their sole responsibility. In addition, please note that certain descriptive and introductory sections of this report are based on consortium-wide templates applied uniformly across all country reports to ensure comparability. The specific analyses, interpretations, and country-specific findings remain the responsibility of the respective national teams.

Disclaimer on AI usage

Based on Academic Integrity and Transparency in AI-assisted Research and Specification Framework (Bozkurt, 2024), the authors of this paper acknowledge that the paper was reviewed, edited, and refined with the assistance of ChatGPT (mod 5.4 T), Claude Opus (4.8 T), Gemini (3.1 T) and DeepL, complementing the human editorial process. The human authors critically assessed and validated the content to maintain academic rigour. The authors also assessed and addressed potential biases inherent in the AI-generated content. The final version of the paper is the sole responsibility of the human authors."

Abstract

This report presents the Italian results of the DigiSET teacher survey, conducted within the Erasmus+ project “DigiSET – The Academy of Digitally Sustainable European Teacher” (101249272). The survey examined teachers’ self-perceived competences in digital teaching, artificial intelligence (AI), education for sustainable development (ESD) and Open Educational Resources (OER), together with four project-specific priorities: adaptive AI use, gender bias in AI, inclusive digital practices and systems thinking for sustainability. Data were collected online in 2026 using items drawn from the DigCompEdu Check-In, the Teacher AI Competence Self-Efficacy Scale and the ATOER scale, alongside DigiSET-specific items. Of 283 registered entries, 229 completed at least one full thematic block and were retained for analysis. Among respondents providing demographic information, the sample consisted predominantly of experienced teachers working in public or state-funded schools, with upper-secondary education particularly represented.

Digital teaching results were strongest for purposeful technology use, digital-resource selection, data protection and the promotion of critical and responsible digital behaviour. Lower-frequency practices concerned digital assessment, learner self-regulation, digitally mediated collaboration and personalised learning. AI competence was less consolidated: basic knowledge and content creation were stronger than AI-supported assessment, adaptive use, pedagogical integration and the ability to address gender stereotypes. ESD results showed strong agreement in values, responsibility and systems thinking, while digitally supported ESD practice was less consistent. OER readiness was moderate, with uncertainty concerning intellectual-property knowledge and practical adoption. The most frequently selected training priorities were using AI in teaching (55%), creating and sharing OER (49.1%) and ethical and responsible AI use (36.8%). The main barriers were lack of time (66.9%), suitable resources or materials (41.7%) and institutional support (36.8%).

The findings are descriptive and should be interpreted in light of the self-selected, non-probability sample, varying item-level denominators and the self-reported nature of the measures. The number of people reached is unknown, so a response rate cannot be calculated. Nevertheless, the results provide a coherent evidence base for prioritising applied AI pedagogy, OER competence, ethical and inclusive design, flexible training formats and reusable classroom resources within the DigiSET Teacher Academy.

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1. Introduction

Digital technologies, artificial intelligence and sustainability-oriented education are increasingly interconnected within teachers' professional practice. Their educational value depends not only on access to tools, but also on teachers' capacity to select, adapt and use them critically, ethically, inclusively and with a clear pedagogical purpose. The DigiSET project addresses this challenge through a European teacher academy intended to support the development of digitally sustainable teaching across different educational systems and professional contexts.

DigiSET – The Academy of Digitally Sustainable European Teacher – aims to equip educators with the competences required to create, use and adapt digital technologies, AI-supported approaches and Open Educational Resources. Its competence model brings together digital teaching, human-centred and ethical AI use, education for sustainable development, inclusive practice and collaborative knowledge creation. The project therefore requires empirical evidence on teachers' current practices, perceived strengths, competence gaps and professional-development conditions.

A common teacher survey was consequently implemented across the DigiSET countries. The Italian country report analyses the national responses as an input to D2.1 – Teacher Competence and Training Needs Analysis – and D2.2 – Framework of Learning Outcomes for the Digitally Sustainable European Teacher. It examines self-perceived competence in digital teaching, AI, ESD and OER; explores adaptive AI, gender bias, inclusion and systems thinking; and identifies the challenges, learning needs and barriers reported by participants. The survey methodology and central processing procedures are documented in the DigiSET methodology report (Keser Aschenberger et al., 2026).

Section 2 describes the methodology and the limits of the available sampling information. Section 3 presents the demographic profile of respondents. Section 4 reports the quantitative and qualitative findings, while Section 5 discusses cross-domain patterns, generalisability and methodological limitations. Section 6 translates the evidence into priorities, learning outcomes and recommendations for the DigiSET Teacher Academy and related stakeholders.

2. Methodology

This section describes the methodological approach underlying the DigiSET teacher survey in Italy, including questionnaire design, ethical safeguards, sampling, data collection, data selection and the analytical procedures used for the national report.

2.1. Survey development, ethics and analysis

The questionnaire combined established and project-specific measures. Digital teaching practices were assessed through 22 items from the DigCompEdu Check-In, grounded in the European Framework for the Digital Competence of Educators (Joint Research Centre of the European Commission, n.d.; Punie & Redecker, 2017). AI competence was assessed through 24 adapted items from the Teacher AI Competence Self-Efficacy Scale (Chiu et al., 2025), while five OER items were derived from the ATOER scale (Mishra et al., 2016). Thirteen ESD items were developed for DigiSET with reference to GreenComp and international ESD competence frameworks (European Commission, Joint Research Centre, 2022;

UNECE, 2013; UNESCO, 2017). Additional items addressed adaptive AI use, gender bias in AI, inclusive digital practices and systems thinking. The Italian version followed a functional translation and adaptation process so that terminology, school levels and subject labels were meaningful within the national educational context (Keser Aschenberger et al., 2026).

Participation was voluntary and anonymous. No names, email addresses or IP addresses were collected, and explicit consent was required before access to the questionnaire. Ethical approval was granted by the Bahçeşehir University Scientific Research and Publication Ethics Committee under approval number 2026/04. Data cleaning, descriptive statistical analysis and preparation of the standard charts were carried out centrally by TU Graz using IBM SPSS Statistics and Microsoft Excel. For this Italian country report, the national responses were interpreted descriptively and the three open-ended questions were analysed through thematic coding: responses were read in Italian, semantically related statements were grouped into recurring themes, and representative quotations were selected to illustrate the principal patterns. Theme counts are used only as descriptive indications, not as inferential statistics. No individual-level subgroup comparisons were undertaken because the Italian analysis was conducted on aggregated results and did not include anonymised individual-level records.

2.2. Sampling strategy and data collection

2.2.1. Target population and recruitment process

The target population comprised both practising teachers and future teachers preparing to enter the profession in Italy. The survey covered educational settings from primary school to upper-secondary and vocational education, involving learners approximately 6 to 20 years of age and above. It was centrally hosted on Umfrageonline.com and made available in Italian. Participation was voluntary, and Mario Giampaolo, PhD of the University of Siena was identified in the questionnaire as the national contact person.

The survey documentation does not record the complete set of dissemination channels, the geographical reach or the number of individuals contacted. The Italian sample must therefore be treated as a self-selected, non-probability sample, and a conventional response rate cannot be calculated.

2.2.2. Responses and data collection period

From 29th April to 5th May 2026, a total of 283 survey entries were registered. Fifty-two contained no answered questions, and two contained only one or two answered questions and did not complete a full thematic block. In line with the central inclusion criterion, 229 questionnaires that completed at least one full subject-specific block were retained for analysis (Table 1).

Because respondents were not required to complete the entire questionnaire, the valid number of cases varies across sections and items. The initial digital-competence block includes up to 229 cases; the AI blocks approximately 198–200; the ESD blocks 168–171; the OER and professional-development sections approximately 163–164; most demographic items 155–156; and age 142. Percentages in each figure are therefore based on the valid responses for the corresponding item or block. For multiple-response questions, the summed percentages may exceed 100%.

Table 1: Responses and used entries of the teacher survey in Italy

Responses and used data	
Total	283
No questions answered	52
Only one or two questions answered	2
Included in the analysis (n)	229

3. Demographic profile of respondents

This section presents the demographic characteristics of the Italian survey participants. Demographic information was available for 155–156 respondents for most variables and for 142 respondents for age, reflecting the progressive partial completion of the questionnaire.

3.1. Gender and age (B6, B7)

Among the 156 respondents who reported gender, 117 identified as women (75.0%), 38 as men (24.4%) and one preferred not to say (0.6%); no respondent selected a non-binary or another gender identity (Table 2).

Table 2: Gender of participants in the teacher survey in Italy

	How do you identify your gender?	
	Frequency	Percent
Woman	117	75,0
Man	38	24,4
Non-binary / Another gender identity	0	0,0
Prefer not to say	1	0,6
Total	156	100,0

Age was reported by 142 participants. The mean age was 56.3 years (SD = 6.5), the median was 57 years and the observed range extended from 38 to 76 years. Figure 1 shows a marked concentration between approximately 50 and 65 years, with relatively few respondents in the youngest and oldest age bands. Together with the experience data presented below, this indicates that the Italian sample is predominantly composed of mature, established professionals.

Age of Participants

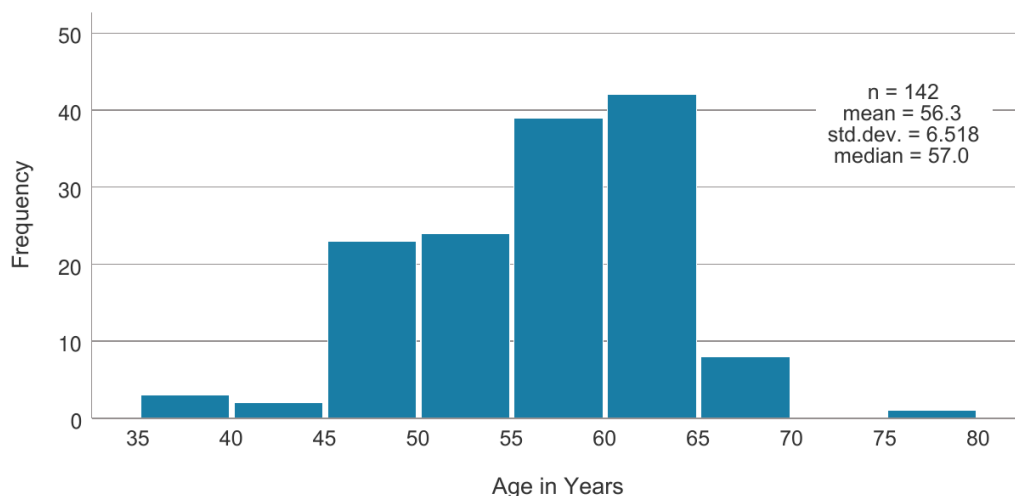


Figure 1: Age of participants in the DigiSET teacher survey in Italy.

3.2. Status of respondents (B1)

Current professional status was reported by 156 participants, who selected 160 responses because multiple options were allowed. Nearly all respondents worked in public or state-funded schools (93.6%). A smaller share worked in private or independent schools (5.1%), 0.6% were studying to become teachers and 3.2% selected “Other”. No participants reported working in a church-affiliated school or currently looking for a job. The sample therefore reflects the perspectives of practising public-school teachers far more strongly than those of pre-service teachers or educators in other institutional settings (Figure 2).

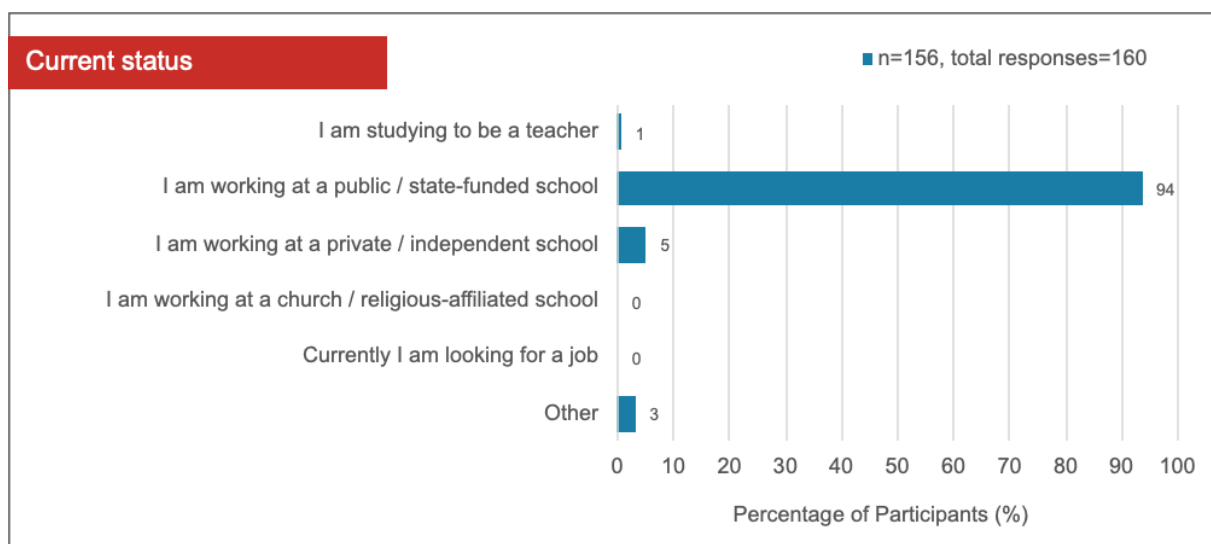


Figure 2: Current status of participants in the DigiSET teacher survey in Italy.

Note: Multiple responses were allowed; therefore, totals exceed 100%.

3.3. School levels taught or expected to teach (B2)

Upper-secondary education was the most frequently represented level, selected by 55.1% of the 156 respondents. Lower-secondary education was selected by 24.4% and primary education by 22.4%, while vocational education (3.2%) and other settings (1.9%) were much less common. Because participants could indicate more than one level, the 167 selections exceed the number of respondents (Figure 3).

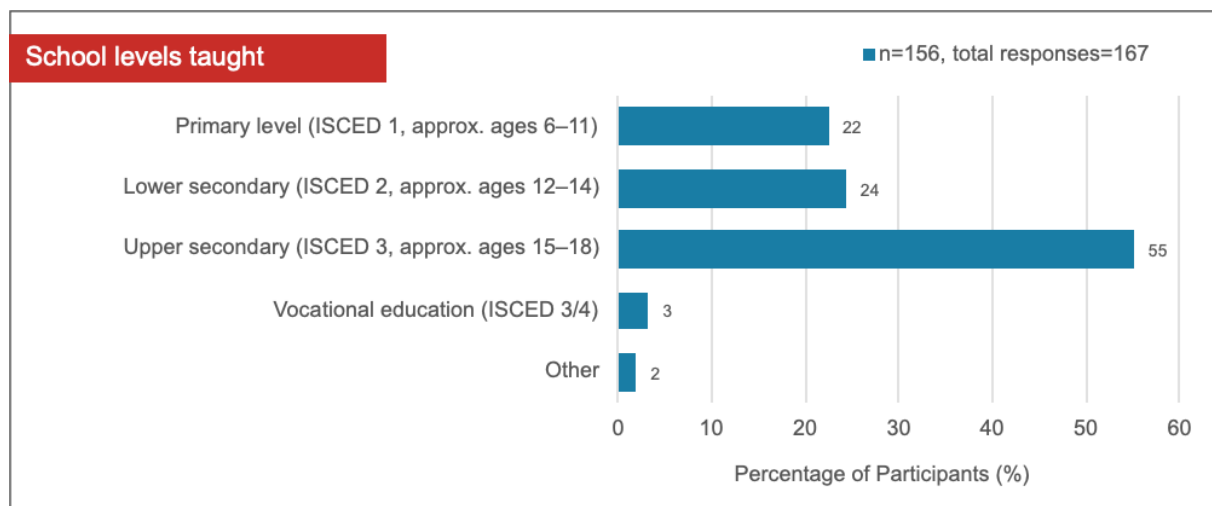


Figure 3: School levels taught or expected to be taught by participants in the DigiSET teacher survey in Italy.

Note: Multiple responses were allowed; therefore, totals exceed 100%.

3.4. Subjects currently taught or expected to be taught (B3)

A total of 155 respondents answered the question on subjects, producing 248 selections. Mathematics and natural sciences were each selected by 21.3%, followed by Italian/native-language education (20.6%), foreign languages (14.8%), computer science or digital literacy (14.2%), vocational subjects (11.6%), social sciences or history (11.0%), art or music (9.7%) and physical education (7.1%). “Other” was the largest single category (28.4%). The accompanying open entries show that this category mainly included law and economics, geography, business economics, technical and laboratory subjects, religion, design, architecture and construction-related disciplines. It should therefore be read as evidence that the standard categories did not fully capture the structure of subjects in the Italian school system, rather than as a single homogeneous discipline (Figure 4).

School subjects taught

n=155, total responses=248

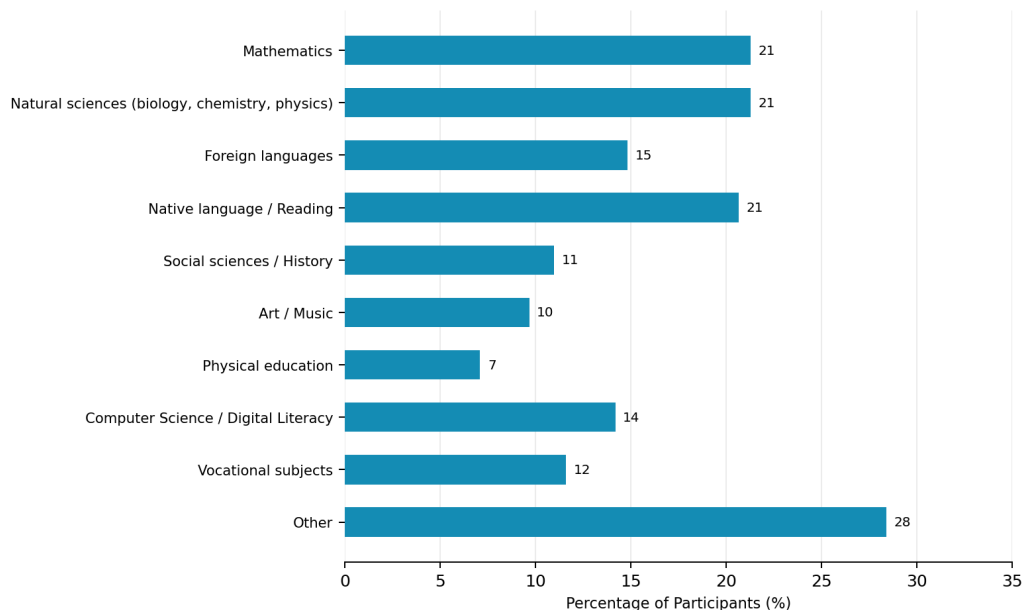


Figure 4: Subjects currently taught or expected to be taught by participants in the DigiSET teacher survey in Italy.

Note: Multiple responses were allowed; therefore, totals exceed 100%.

3.5. Teaching experience (B4)

The sample was highly experienced. Of the 156 respondents, 60.3% reported more than 20 years of teaching, 14.7% reported 11–15 years and 11.5% reported 16–20 years. Overall, 86.5% had at least 11 years of teaching experience. Only 13.5% had ten years or fewer, including 0.6% with less than one year, while no respondent reported having no teaching experience (Figure 5).

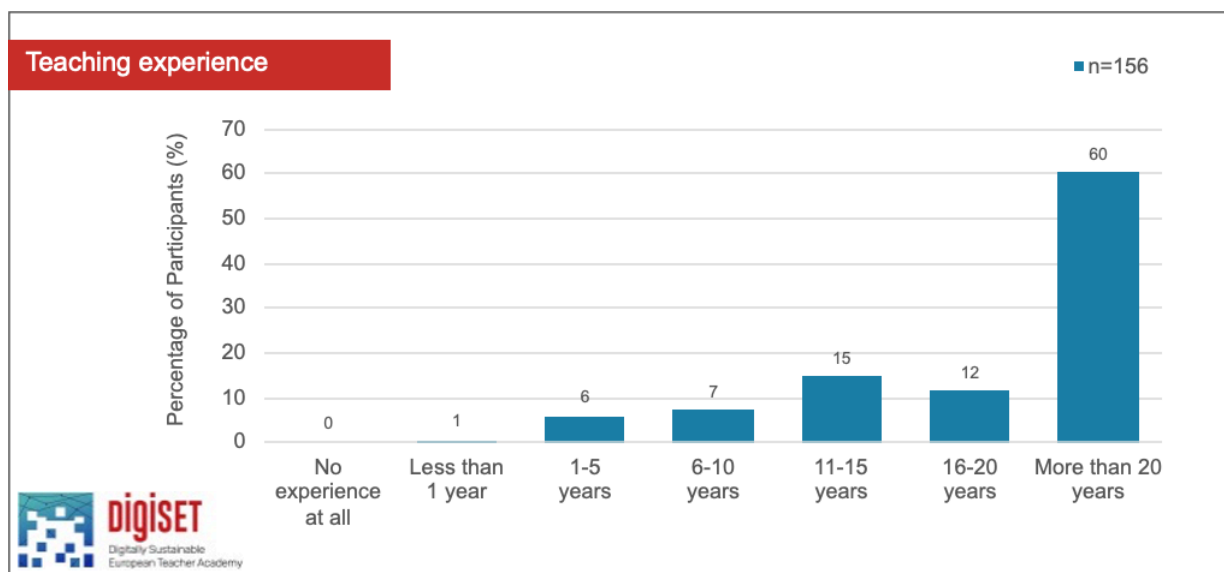


Figure 5: Teaching experience of participants in the DigiSET teacher survey in Italy.

4. Results

This section reports the Italian survey findings across four competence domains: digital teaching, artificial intelligence (AI), education for sustainable development (ESD), and Open Educational Resources (OER). It also examines four DigiSET-specific priorities and the challenges, competence needs and professional-development barriers identified by respondents. All percentages refer to valid responses for the relevant item; the number of valid cases varies because partial questionnaires were retained when at least one complete thematic block was available.

4.1. Self-perceived digital teaching competence

Across the six DigCompEdu areas, the results show a comparatively strong orientation towards professional communication, responsible use and purposeful selection of digital technologies. Lower frequencies are found for digitally supported assessment, learner self-regulation, personalised learning and tasks requiring digital collaboration or content creation.

4.1.1. Professional engagement (D1-D4)

Professional engagement was generally strong. Digital communication with learners and colleagues was reported often or always by 79.0% of respondents, and digital collaboration with colleagues by 81.1%. Active development of digital teaching competence reached 72.8% in the two highest frequency categories. Participation in online training was less established: 59.8% selected often or always, while 40.2% selected never, rarely or sometimes (Figure 6).

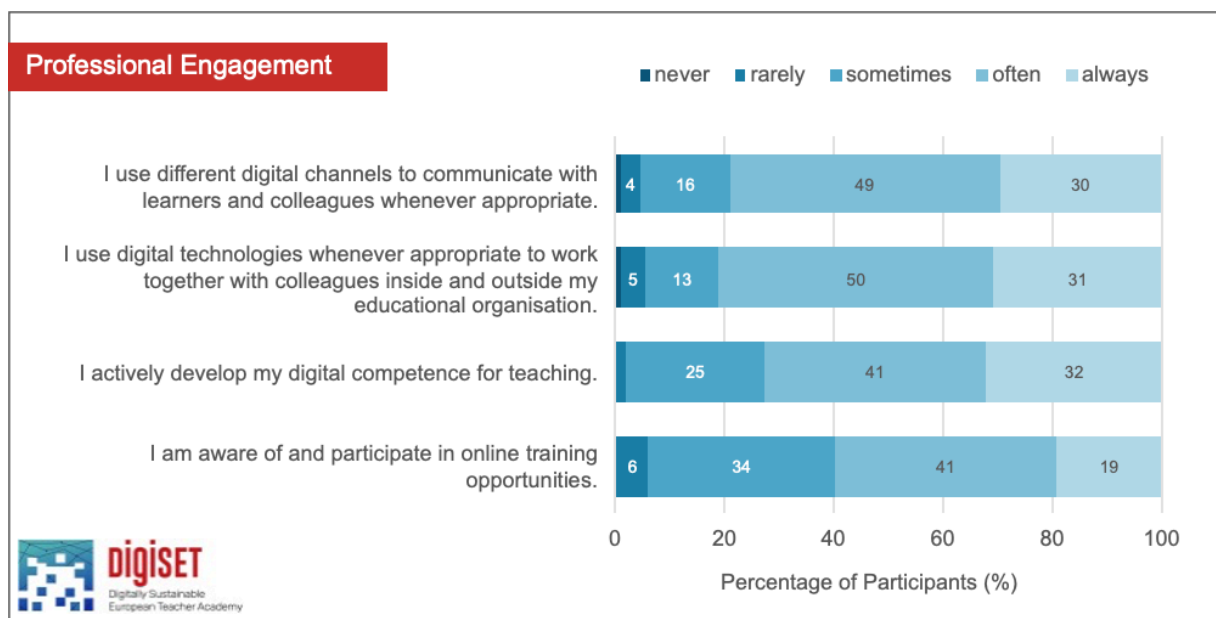


Figure 6: Self-perceived digital teaching competence – professional engagement.

Note: Responses to the DigiSET teacher survey in Italy, utilizing the items from DigCompEdu CheckIn questionnaire, area “professional engagement”, JRC, n.d., p. 11.

4.1.2. Digital resources (D5-D7)

The digital-resources area produced some of the highest results in the survey. Finding and selecting online resources was reported often or always by 81.3%, and creating or adapting digital resources by 72.5%. Protection of personal and educational data was particularly strong, with 77.3% selecting always and 93.0% selecting often or always (Figure 7).

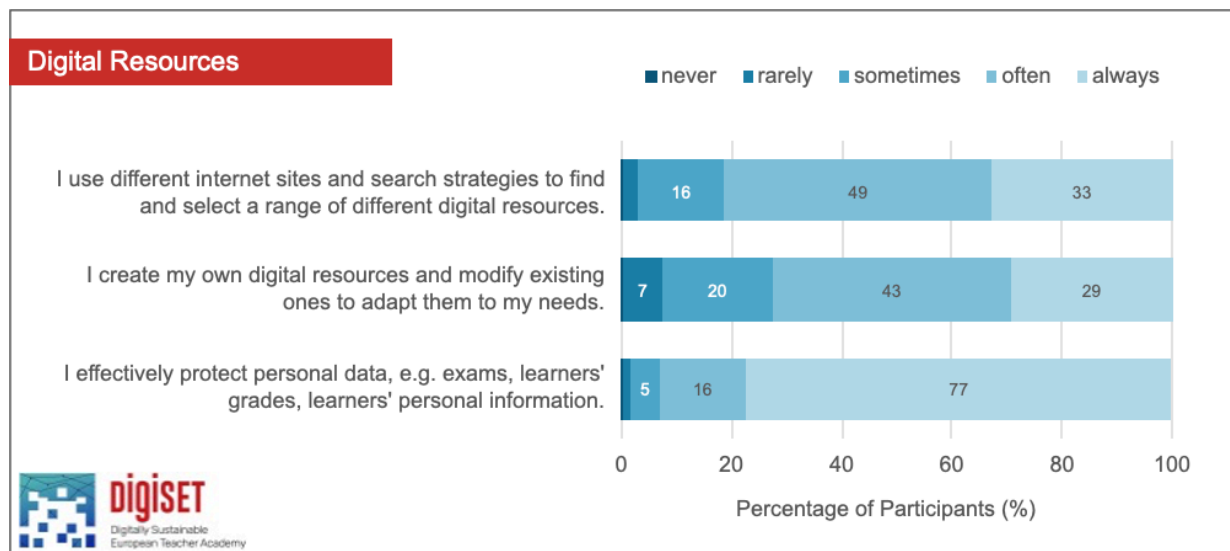


Figure 7: Self-perceived digital teaching competence – digital resources.

Note: Responses to the DigiSET teacher survey in Italy, utilizing the items from DigCompEdu CheckIn questionnaire, area “digital resources”, JRC, n.d., p. 17.

4.1.3. Teaching and learning (D8-D11)

Respondents reported highly deliberate use of technology in teaching: 89.1% stated that they often or always consider how, when and why digital technologies add value. Monitoring learners in collaborative online environments was also relatively common (65.4% often or always). By contrast, digital support for group work reached 53.9%, while only 39.8% often or always used technology to help learners plan, document and monitor their own learning. Learner self-regulation therefore emerges as the weakest aspect of this area (Figure 8).

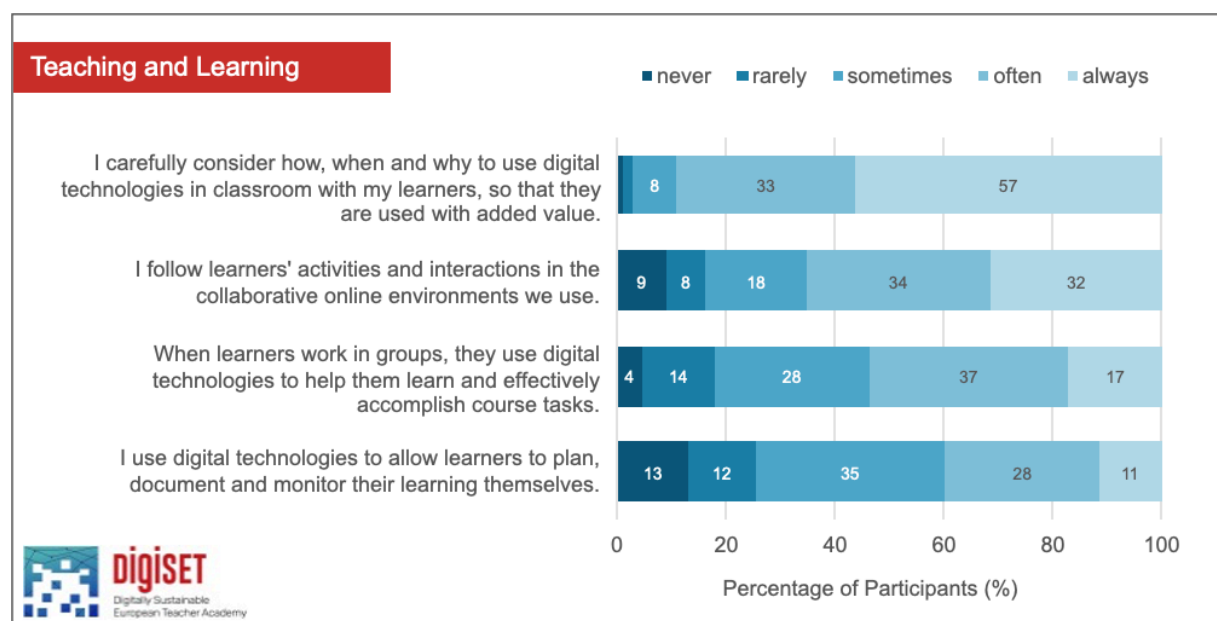


Figure 8: Self-perceived digital teaching competence – teaching and learning.

Note: Responses to the DigiSET teacher survey in Italy, utilizing the items from DigCompEdu CheckIn questionnaire, area “teaching and learning”, JRC, n.d., p. 21.

4.1.4. Assessment (D12-D14)

Digital assessment was less established than most other digital practices. Only 36.7% often or always used digital assessment tools to monitor progress, whereas 34.1% selected never or rarely. The use of available data to identify learners needing support was more frequent (60.8% often or always). Digital feedback occupied an intermediate position, with 46.0% selecting often or always and 46.9% selecting sometimes or often (Figure 9).

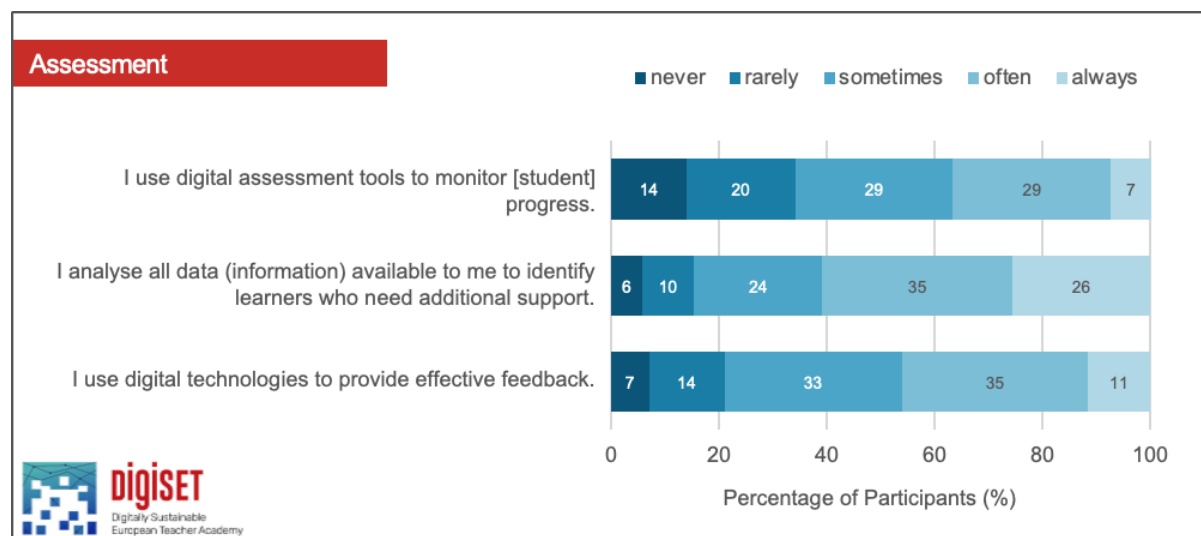


Figure 9: Self-perceived digital teaching competence – assessment.

Note: Responses to the DigiSET teacher survey in Italy, utilizing the items from DigCompEdu CheckIn questionnaire, area “assessment”, JRC, n.d., p. 27.

4.1.5. Empowering learners (D15-D17)

When designing digital assignments, 74.3% often or always considered practical or technical difficulties. Personalised learning opportunities were offered often or always by 59.4%, and digital participation in class or online learning by 56.4%. These results suggest attention to accessibility and participation, but less consistent use of digital technologies for systematic personalisation (Figure 10).

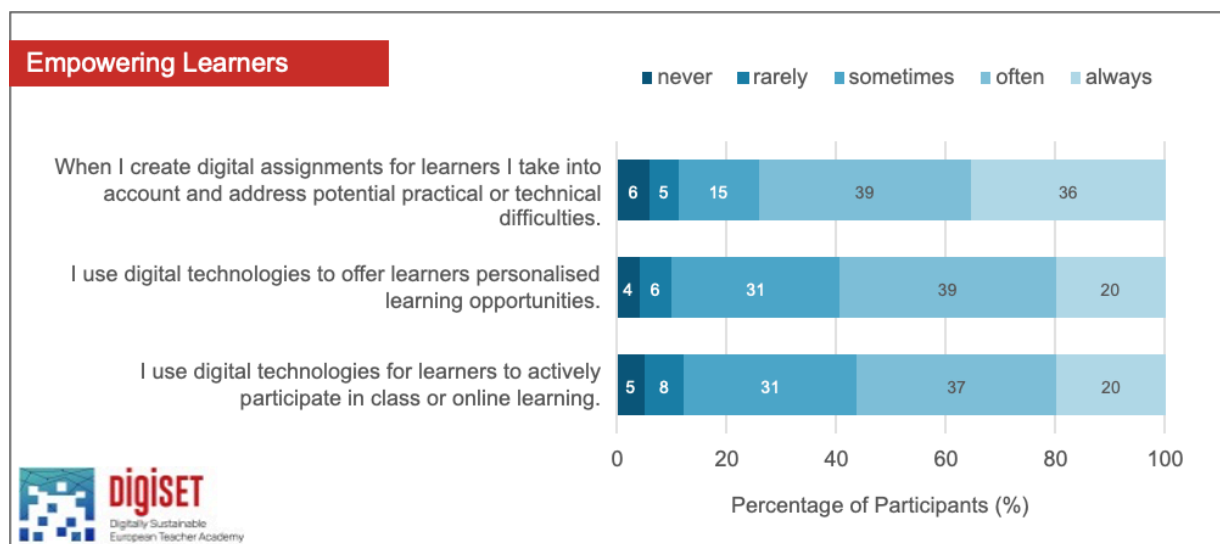


Figure 10: Self-perceived digital teaching competence – empowering learners.

Note: Responses to the DigiSET teacher survey in Italy, utilizing the items from DigCompEdu CheckIn questionnaire, area “empowering learners”, JRC, n.d., p. 32.

4.1.6. Facilitating learners' digital competence (D18-D22)

The strongest practices in facilitating learners' digital competence concerned critical and responsible use: 77.0% often or always taught learners to assess information reliability, and 76.2% taught safe and responsible technology use. Creative problem-solving reached 55.5% in the highest categories. Less frequent were assignments requiring digital-content creation (43.2%) and, especially, tasks requiring learners to communicate or collaborate digitally with peers or external audiences (36.6%) (Figure 11).

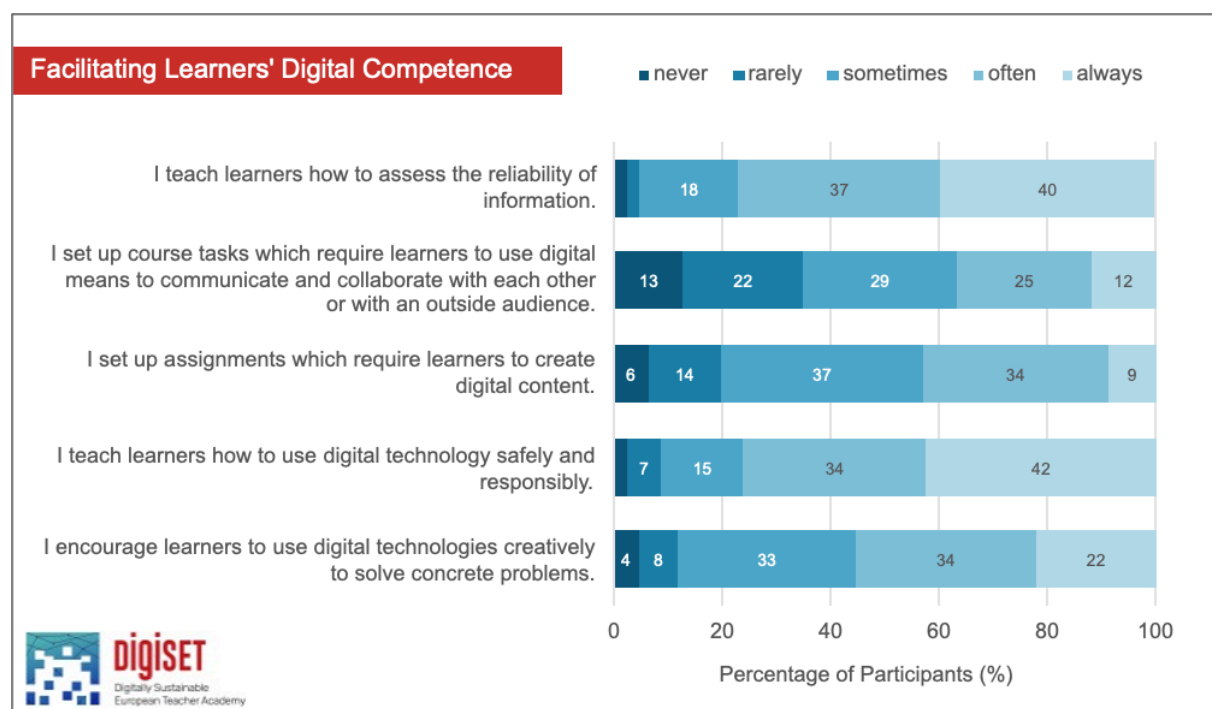


Figure 11: Self-perceived digital teaching competence – facilitating learners' digital competence. Responses to the DigiSET teacher survey in Italy, using items from the DigCompEdu Check-In questionnaire, area “facilitating learners' digital competence” (JRC, n.d., p. 37ff.).

4.2. Self-perceived AI competence

AI competence was more uneven than general digital teaching competence. Moderate confidence was the most common response in many items. Respondents appeared more confident in basic knowledge, content creation and human-centred reflection than in AI-supported assessment, pedagogical integration and peer leadership.

4.2.1. AI knowledge (A1-A4)

AI knowledge showed a mixed but broadly intermediate profile. The highest combined proportions of very or completely confident responses concerned explaining AI (43.0%) and creating content with AI (42.5%). Confidence was lower for explaining generative AI (30.5%) and distinguishing whether a tool is AI-based (25.5%). For three of the four items, “moderately confident” was the most frequent response, indicating partial familiarity rather than consolidated expertise (Figure 12).

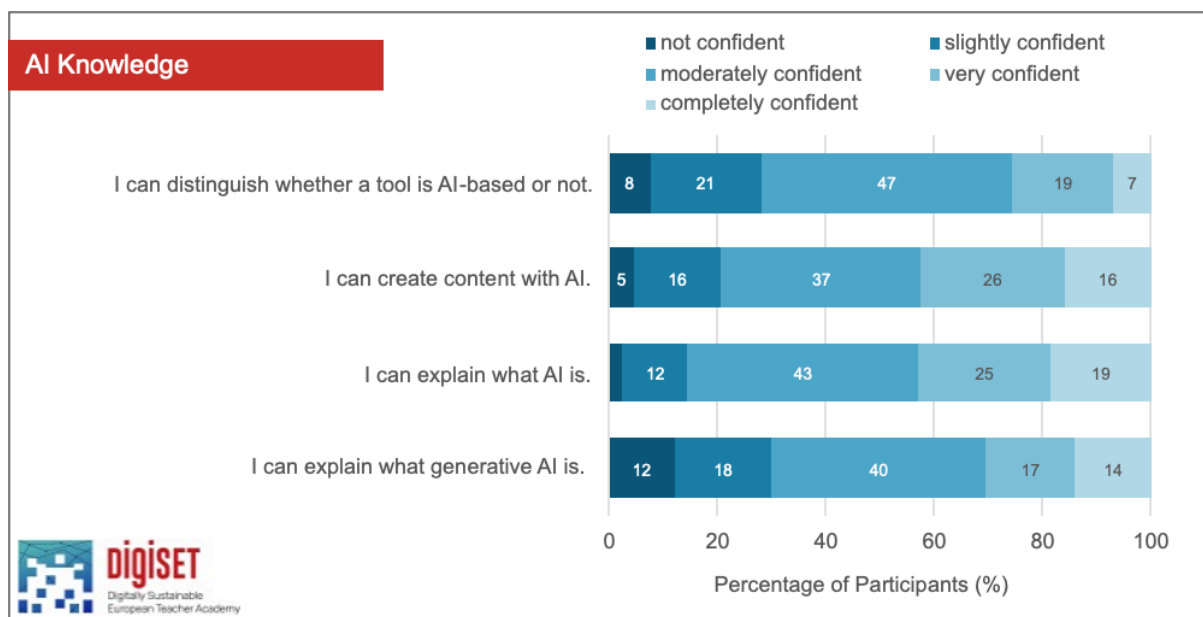


Figure 12: Self-perceived AI competence – AI knowledge. Responses to the DigiSET teacher survey in Italy, utilizing items from Chiu, Ahmad, & Çoban (2025) section “AI knowledge”.

4.2.2. AI pedagogy (A5-A8)

Confidence in AI pedagogy was moderate to low. Around one third felt very or completely confident in selecting an AI tool for classroom use (30.3%) or for subject-content enhancement (32.0%). The corresponding share was 27.5% for integrating subject content, AI tools and pedagogy in lessons. Supporting colleagues was the weakest item: 46.0% were not or only slightly confident, compared with 27.0% who were very or completely confident (Figure 13).

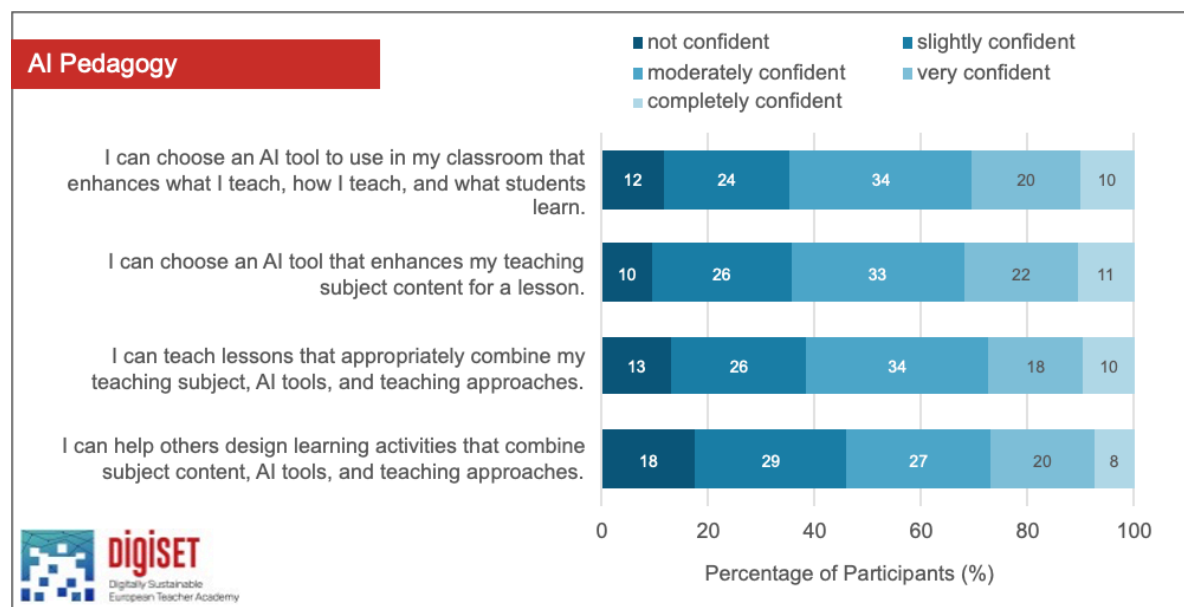


Figure 13: Self-perceived AI competence – AI pedagogy. Responses to the DigiSET teacher survey in Italy, utilizing items from Chiu, Ahmad, & Çoban (2025) section “AI pedagogy”.

4.2.3. AI assessment (A9-A12)

AI-supported assessment was the weakest AI dimension. Depending on the item, 48.2% to 59.0% were not or only slightly confident. Only 17.0% felt very or completely confident in assessing student learning in an AI-based environment; the comparable shares were 21.6% for designing an AI-based assessment approach, 22.1% for AI-supported grading and 22.6% for formative assessment. The results point to a clear need for pedagogically and ethically grounded assessment training (Figure 14).

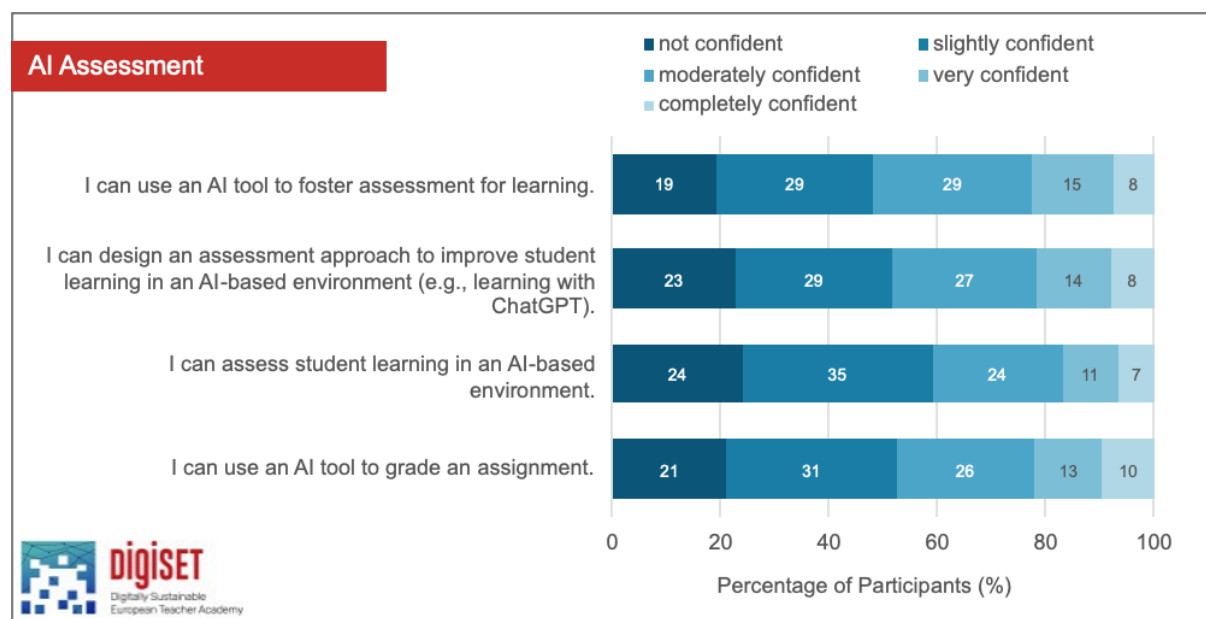


Figure 14: Self-perceived AI competence – AI assessment.

Note: Responses to the DigiSET teacher survey in Italy, utilizing items from Chiu, Ahmad, & Çoban (2025) section “AI assessment”.

4.2.4. AI ethics (A13-A16)

AI ethics produced a differentiated pattern. Teaching ethics attracted the highest confidence, with 37.5% very or completely confident. Confidence in maintaining personal well-being while using AI reached 36.7%, and teaching safe and responsible behaviour 33.5%. Protecting sensitive content from AI tools was more problematic: 43.5% were not or only slightly confident, compared with 31.5% in the two highest categories (Figure 15).

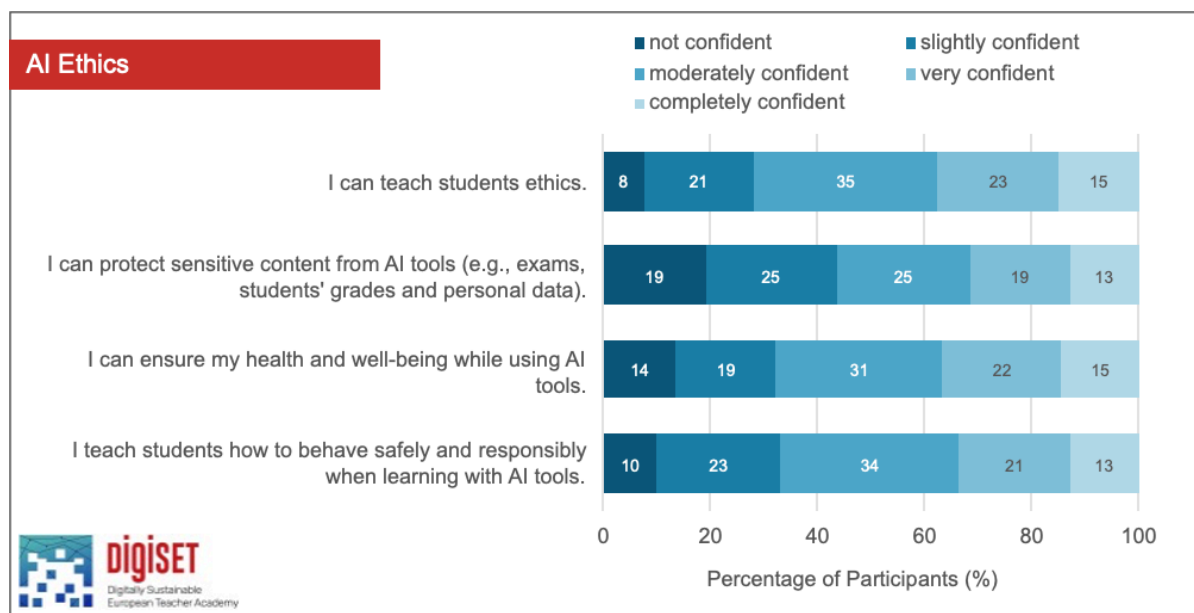


Figure 15: Self-perceived AI competence – AI ethics.

Notes: Responses to the DigiSET teacher survey in Italy, utilizing items from Chiu, Ahmad, & Çoban (2025) section “AI ethics”.

4.2.5. AI human-centred education (A17-A20)

Human-centred AI education was characterised by substantial moderate confidence. Assessing AI benefits and risks received almost identical results, with approximately 36% very or completely confident and about 41% moderately confident. Recognition of human responsibility for AI bias was the strongest item (44.5% very or completely confident). Explaining the societal impact of AI was weaker, with 30.2% not or only slightly confident and 28.7% very or completely confident (Figure 16).

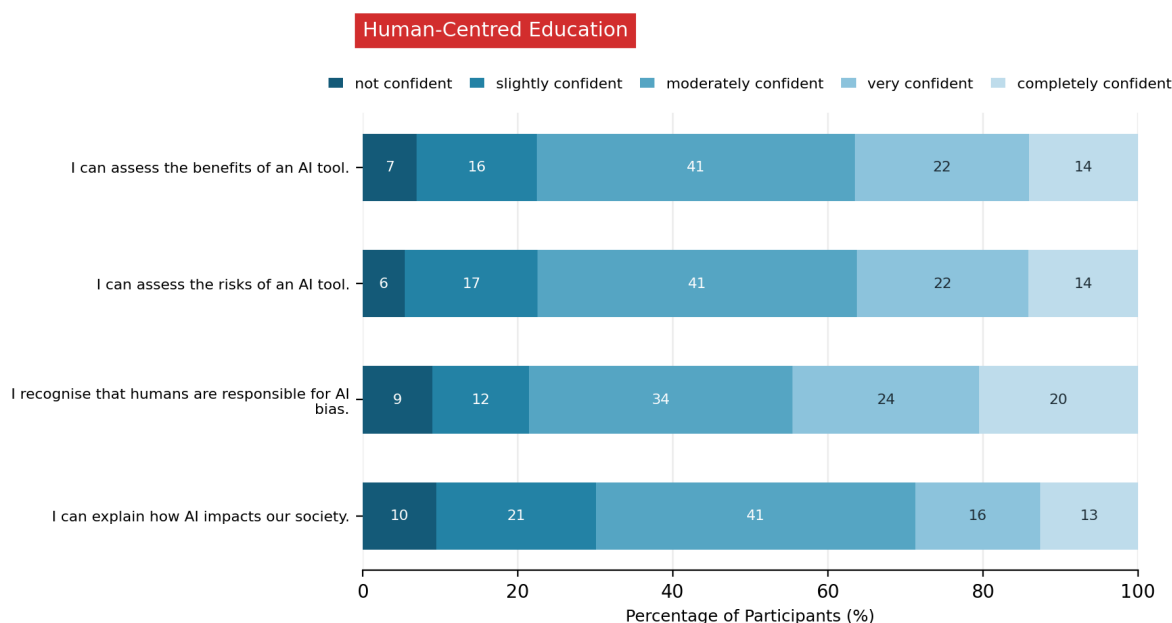


Figure 16: Self-perceived AI competence – human-centred education.

Note: Responses to the DigiSET teacher survey in Italy, utilizing items from Chiu, Ahmad, & Çoban (2025) section “human-centred education”.

4.2.6. AI professional engagement (A21-A24)

Professional engagement in AI was stronger for individual learning than for knowledge exchange. Seeking continuing professional-development opportunities was reported with very or complete confidence by 40.4%. Finding and selecting AI tools reached 31.0%. Active sharing of AI teaching experience (24.7%) and helping colleagues design AI activities (25.5%) were substantially lower, while roughly half of respondents were not or only slightly confident in these peer-oriented practices (Figure 17).

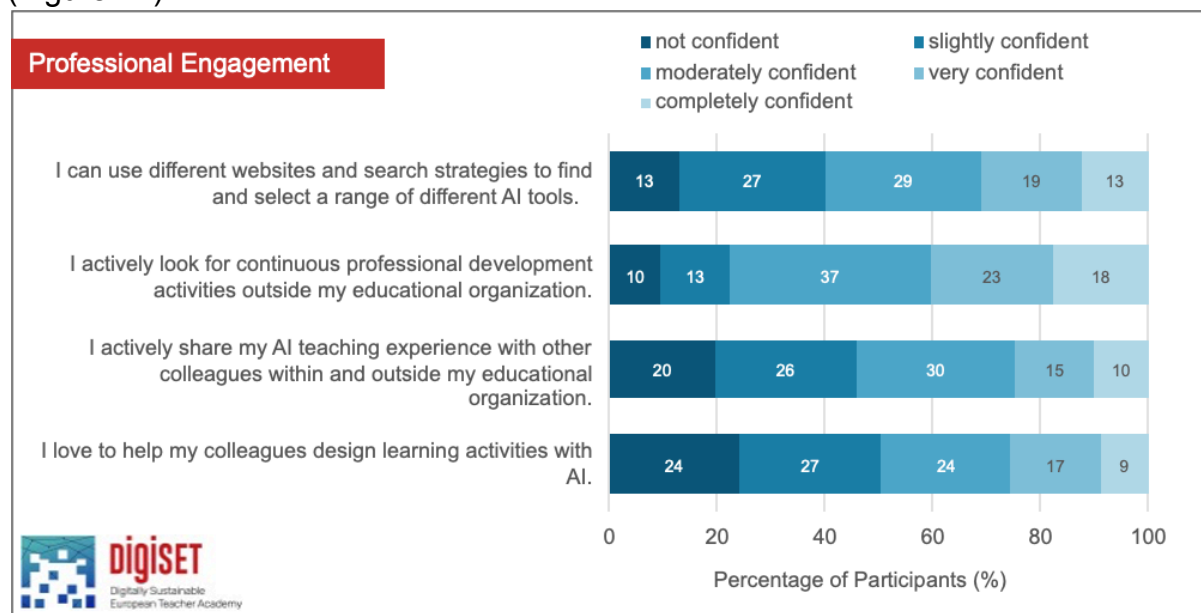


Figure 17: Self-perceived AI competence – professional engagement.

Note: Responses to the DigiSET teacher survey in Italy, utilizing items from Chiu, Ahmad, & Çoban (2025) section “professional engagement”.

4.3. Self-perceived education for sustainable development (ESD) competence

ESD responses were generally positive, particularly for values, responsibility and systems thinking. The Italian questionnaire used an agreement scale with a matching instruction, so these results should be interpreted as respondents' agreement that the statements describe their current or intended practice. The clearest relative weakness concerns the use of digital technologies to engage learners with real-world sustainability challenges.

4.3.1. Systems and critical thinking (S1-S3)

Systems and critical-thinking items are reported in Section 4.5.4 because they also represent one of the four DigiSET-specific priorities.

4.3.2. Pedagogical practice for ESD (S4-S7)

Sustainability was widely integrated into teaching practice: 87.6% agreed or strongly agreed with this statement. Participatory and learner-centred approaches reached 79.4%, while designing activities for active engagement with sustainability reached 80.6%. Use of digital technologies for real-world sustainability challenges was less

established, with 59.6% agreement, 29.2% neutral responses and 11.1% disagreement (Figure 18).

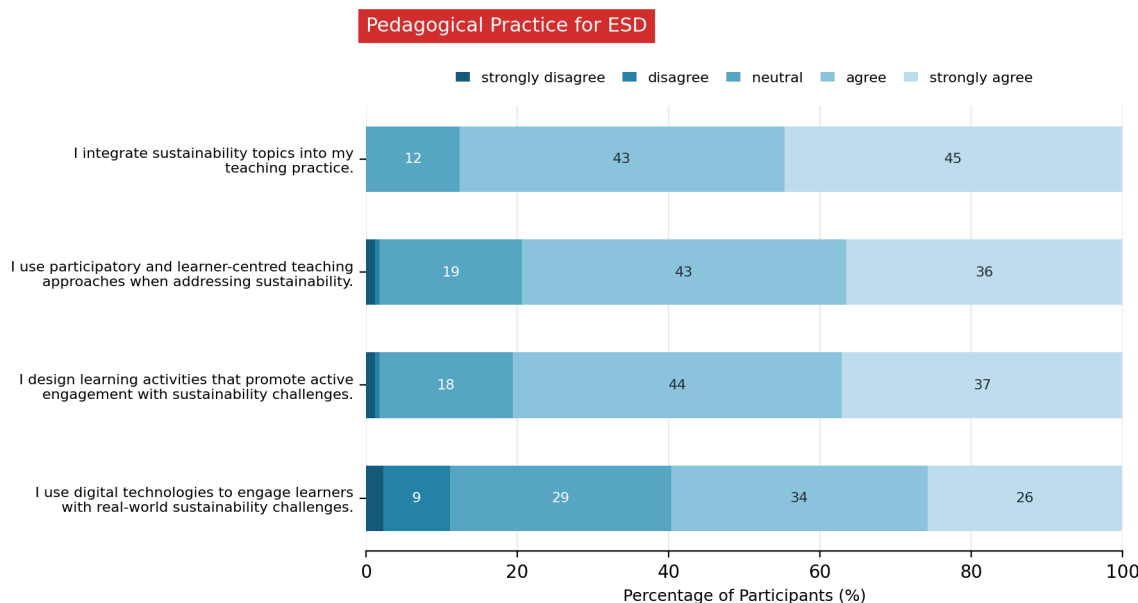


Figure 18: Self-perceived ESD competence – pedagogical practice for ESD.

Note: Responses to the DigiSET teacher survey in Italy, items were created for the DigiSET survey.

4.3.3. Values and responsibility (S8-S10)

Values and responsibility were the strongest ESD dimension. Responsibility, equity and respect for diversity were promoted by 97.0% of respondents who agreed or strongly agreed. Ethical reflection on sustainability issues reached 92.9%, and support for learners' sense of responsibility for sustainable development reached 97.0%. Strongly agree alone accounted for 52.0% to 67.8% across the three items (Figure 19).

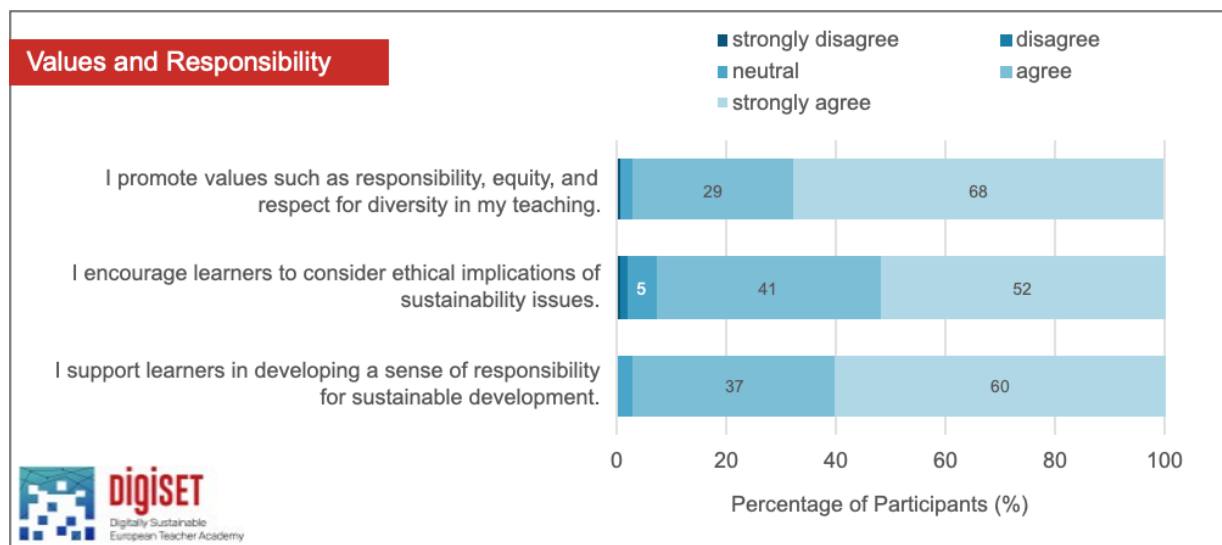


Figure 19: Self-perceived ESD competence – values and responsibility

Note: Responses to the DigiSET teacher survey in Italy; items were created for the DigiSET survey.

4.3.4. Reflective and action-oriented practice (S11-S13)

Reflective and action-oriented practice was also strongly endorsed. Continuous reflection and improvement in sustainability teaching reached 88.2% agreement, and helping learners apply sustainability knowledge to real-life situations reached 89.3%. Facilitating discussions on complex or controversial sustainability issues was comparatively weaker, although still positive: 74.3% agreed or strongly agreed and 22.2% were neutral (Figure 20).

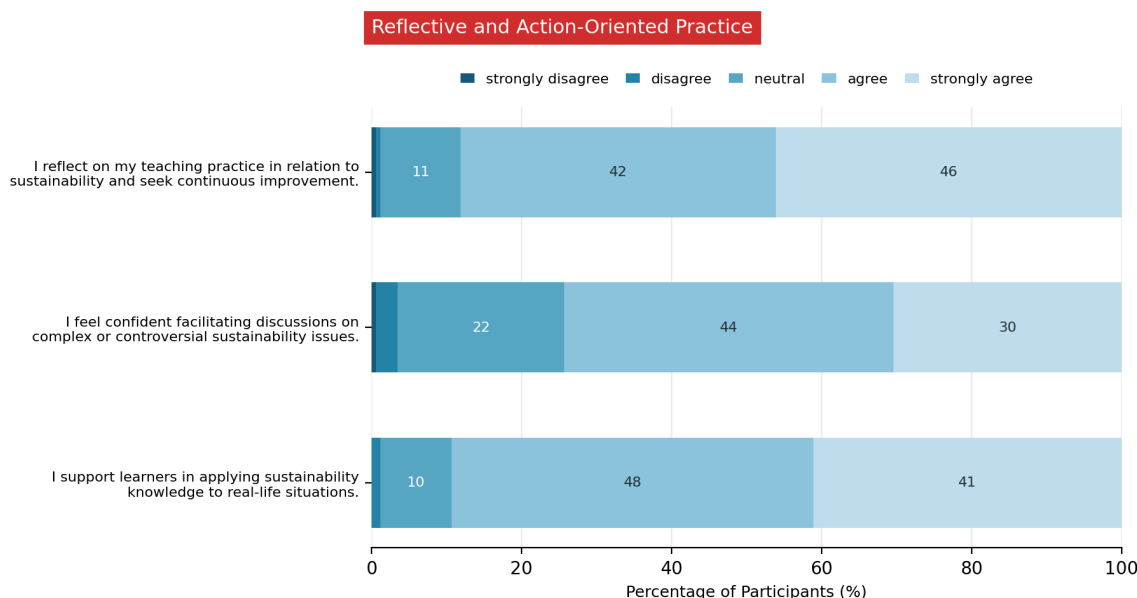


Figure 20: Self-perceived ESD competence – reflective and action-oriented practices.

Note: Responses to the DigiSET teacher survey in Italy, items were created for the DigiSET survey.

4.4. Self-perceived Open Educational Resources (OER) competence (O1-O5)

OER results should be interpreted as perceived experience, knowledge and readiness rather than as an objective competence test. The distribution is markedly more cautious than for ESD: neutral responses are frequent, and fewer than half of respondents agree or strongly agree with any individual item.

Prior OER experience was reported by 49.4% who agreed or strongly agreed, while 22.6% disagreed and 28.0% were neutral. Perceived knowledge of intellectual-property rights reached 47.0% agreement, and ICT capacity to adopt OER 48.8%. Actual adoption for learners' academic needs was lower (43.6%), while only 39.3% agreed that their own knowledge and competences facilitated OER participation or adoption. Neutral responses rose to 38.7% on the latter item, signalling uncertainty and a substantial training opportunity (Figure 21).

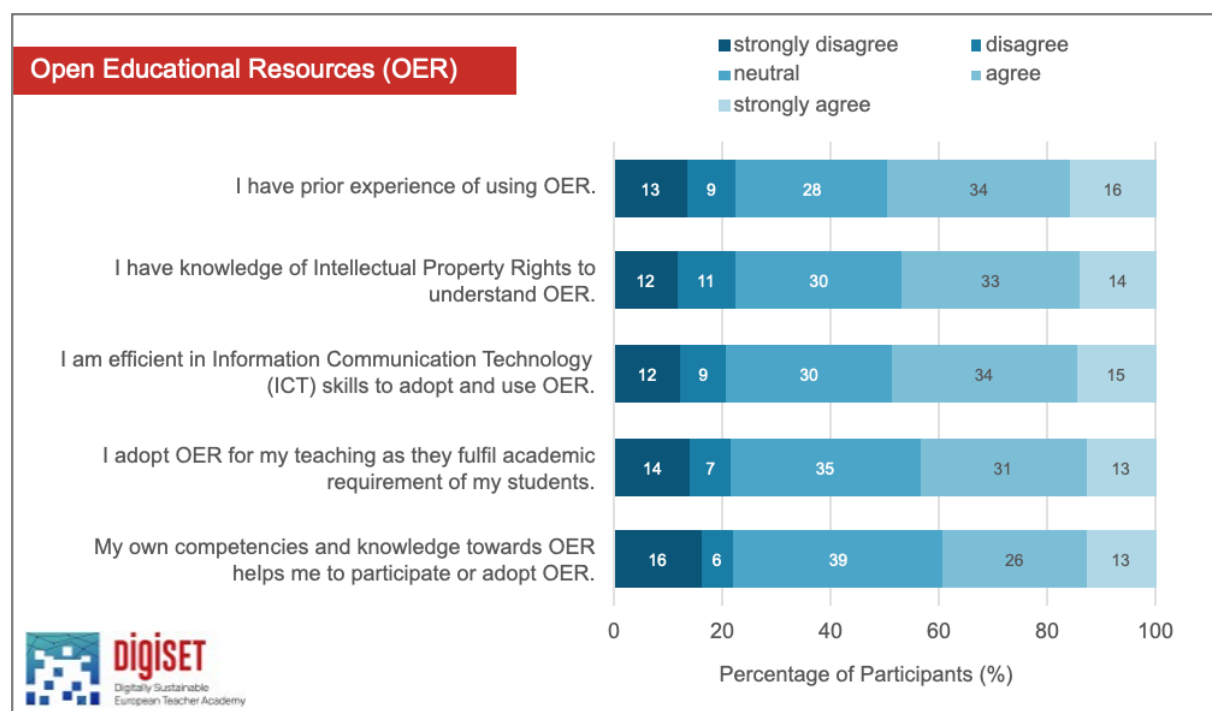


Figure 21: Self-perceived OER competence.

Note: DigiSET teacher survey results for Italy, utilizing a subset of items from Mishra et al. (2016).

4.5. Self-perceived competences in specific DigiSET topics

The four DigiSET-specific priorities reveal a pronounced contrast. Respondents reported strong inclusive digital practices and systems thinking, whereas adaptive AI use and the ability to address gender bias in AI were less secure. Because the AD and GD items were phrased as behavioural, awareness or knowledge statements but answered on a confidence scale, their results require cautious interpretation.

4.5.1. Adaptive AI use (AD1, AD2)

Adaptive AI use was not yet consolidated. For personalising learning, 40.5% were not or only slightly confident and 26.0% were very or completely confident. For differentiated instruction based on learner needs, low confidence increased to 45.0%, while 28.0% selected the two highest categories. These results are consistent with the moderate-to-low confidence observed in AI pedagogy (Figure 22).

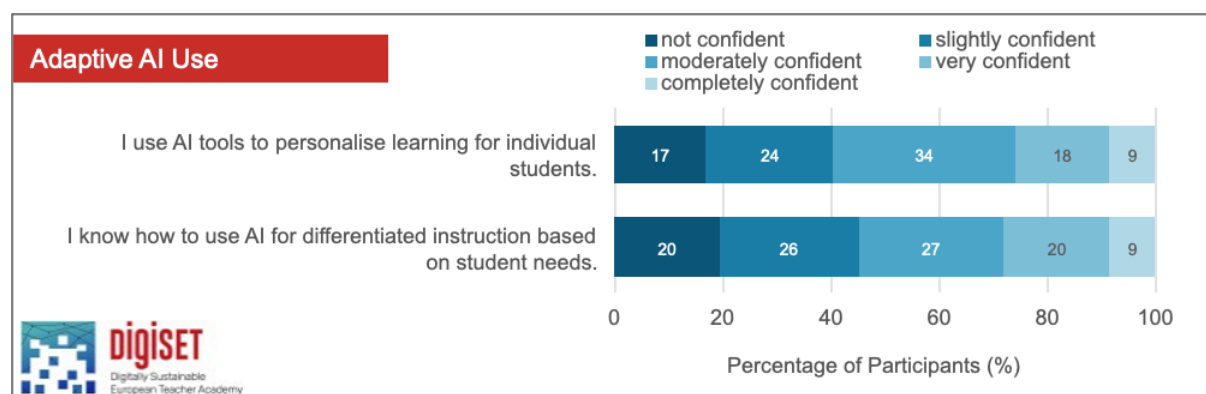


Figure 22: Adaptive AI use.

Note: Responses to the DigiSET teacher survey in Italy, items were created for the DigiSET survey.

4.5.2. Gender bias in AI (GD1, GD2)

Awareness of gender bias in AI-generated content was stronger than the ability to respond pedagogically. While 32.0% were very or completely confident in their awareness, only 22.0% reported equivalent confidence in addressing gender stereotypes during AI-supported teaching. Conversely, 46.5% were not or only slightly confident in addressing stereotypes, identifying this as a specific area for intervention (Figure 23).

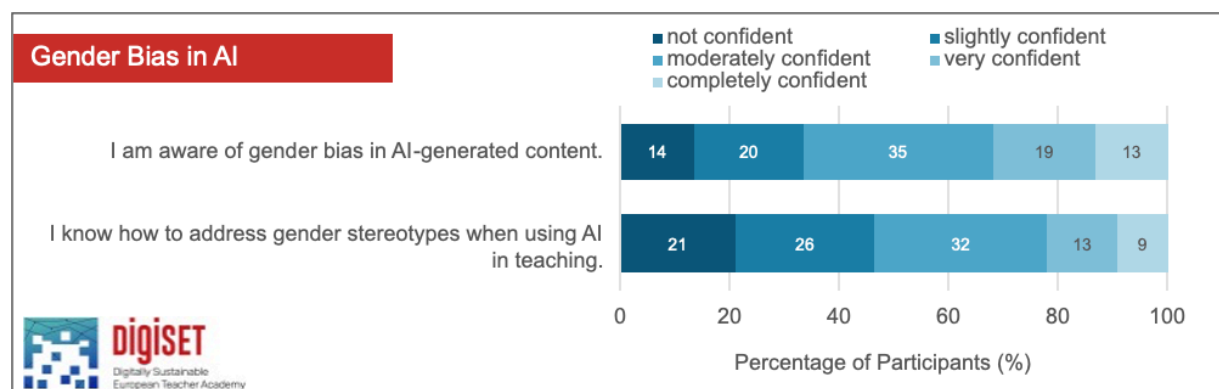


Figure 23: Gender bias in AI.

Note: Responses to the DigiSET teacher survey in Italy, items were created for the DigiSET survey.

4.5.3. Inclusive practices for students with learning difficulties and special educational needs (I1, I2)

Inclusive digital practices were comparatively strong. Digital tools were used often or always to support students with learning difficulties by 64.3% of respondents. Adaptation of digital learning materials for students with special educational needs was even more frequent, reaching 73.6%. The latter item also recorded 36.1% in the “always” category (Figure 24).

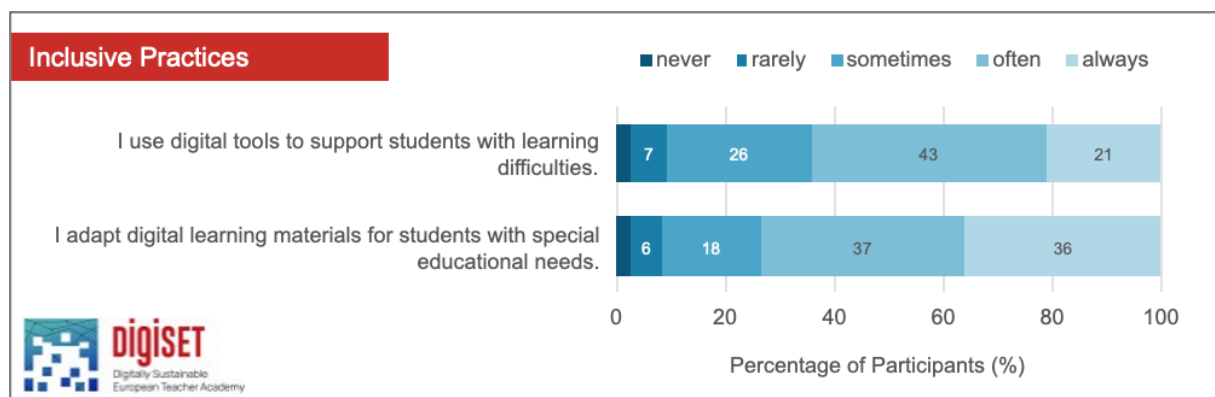


Figure 24: Inclusive practices.

Note: Responses to the DigiSET teacher survey in Italy, items were created for the DigiSET survey.

4.5.4. Systems thinking (S1-S3)

Figure 25 presents the systems and critical-thinking items within the ESD section. Systems thinking received very high agreement. Understanding interconnections among environmental, social and economic dimensions reached 91.2% agreement; critical reflection on sustainability issues reached 96.5%; and analysis of complex sustainability problems from multiple perspectives reached 89.4%. These results make systems thinking the strongest of the four DigiSET-specific areas in the Italian sample (Figure 25).

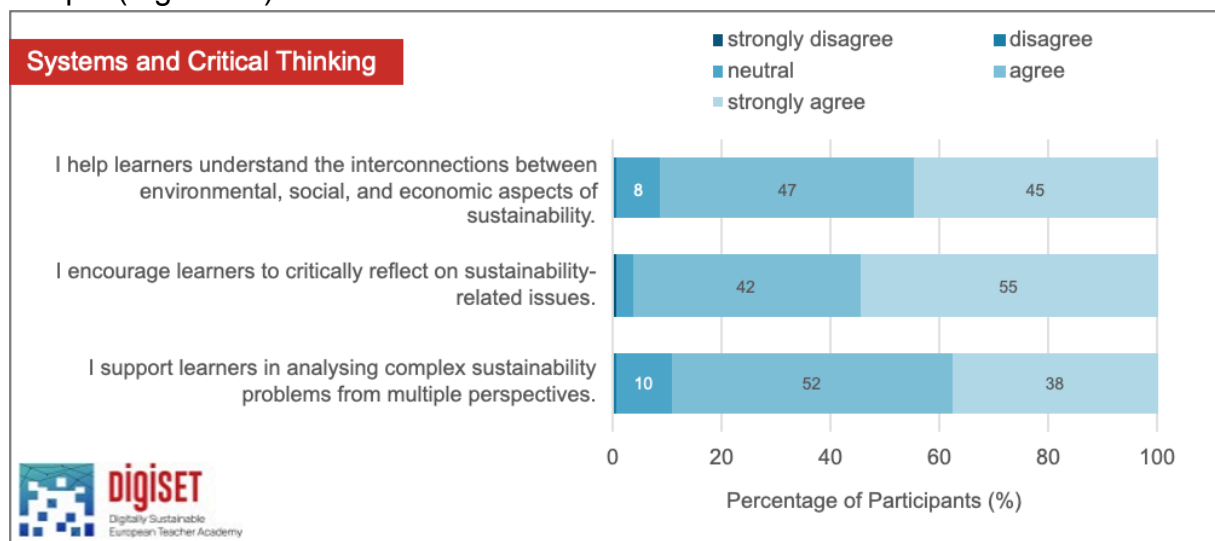


Figure 25: Education for sustainable development – systems and critical thinking.

Note: Responses to the DigiSET teacher survey in Italy, items were created for the DigiSET survey.

4.6. Challenges, competence needs and barriers in digital and sustainable teaching

This section combines the qualitative responses on current challenges and required competences with the closed questions on training priorities and barriers to professional development.

4.6.1. Challenges in integrating digital technologies and sustainability into teaching (Q1)

The 91 Q1 responses reveal interconnected organisational, technical and pedagogical challenges. Lack of time and workload pressures recur throughout the answers, often alongside crowded curricula, administrative duties and insufficient time for shared planning. A second cluster concerns unreliable connectivity, shortages of devices, limited access to laboratories, outdated software and the absence of technical support. Respondents also describe the difficulty of keeping pace with rapid technological change and finding high-quality, practical and affordable training.

Pedagogically, teachers emphasise that digitalisation requires more than the availability of devices. They report challenges in designing meaningful, inclusive and differentiated activities; maintaining learners' attention and motivation; evaluating work potentially produced with AI; and balancing digital support with independent thinking and genuine knowledge construction. Sustainability is sometimes perceived as difficult to integrate concretely across subjects, while several respondents highlight the energy use, hardware obsolescence and resource consumption associated with digital technologies and AI. Collaboration with colleagues and families is another recurrent concern.

Two responses capture these patterns particularly clearly: "L'integrazione del digitale non è solo una questione di 'accendere un tablet', ma di cambiare paradigma didattico", and "la mancanza di tempo, di spazi attrezzati, di laboratori e classi meno numerose". A small number of participants reported no current challenge.

4.6.2. Competences that would help address these challenges (Q2)

The 85 Q2 responses confirm demand for continuous, practice-oriented professional development. The most recurrent needs concern general digital competence and confident use of AI, including the selection of reliable tools, prompt use, content creation, assessment, data protection and recognition of AI-generated errors or bias. Respondents also request pedagogical and instructional-design competence: integrating technology into subject teaching, developing concise and reusable learning units, personalising activities, managing heterogeneous classes and evaluating digital learning outcomes.

A further theme is critical, ethical and systemic literacy. Teachers refer to information and data literacy, source evaluation, media literacy, cybersecurity, responsible AI use and the environmental impact of technology. Inclusive design, relational competence and strategies for learners with different needs also feature prominently. Some responses underline that competence development alone is insufficient without adequate devices, stable connectivity, technical personnel, peer tutors and institutional support.

The desired profile is summarised effectively by one respondent: "Occorrono competenze sistemiche, etica digitale e alfabetizzazione ai dati". Another stressed that "una formazione più mirata potrebbe agevolare l'uso consapevole dei nuovi strumenti".

4.6.3. Professional development needs related to digital and sustainable teaching (P1)

Among 163 respondents, the most frequently selected training priority was using AI in teaching (55%), followed by creating and sharing OER (49.1%). Ethical and

responsible AI use was selected by 36.8%, adaptive learning tools by 34.4% and inclusive digital teaching by 31.3%. Sustainability integration was selected by 20.2%, gender bias in AI by 15.3% and systems thinking by 13.5%. The lower demand for systems thinking contrasts with respondents' already high self-perceived competence in that area, whereas the strong demand for AI, OER and adaptive learning aligns closely with the gaps identified in Figures 13–14 and 21–23 (Figure 26).

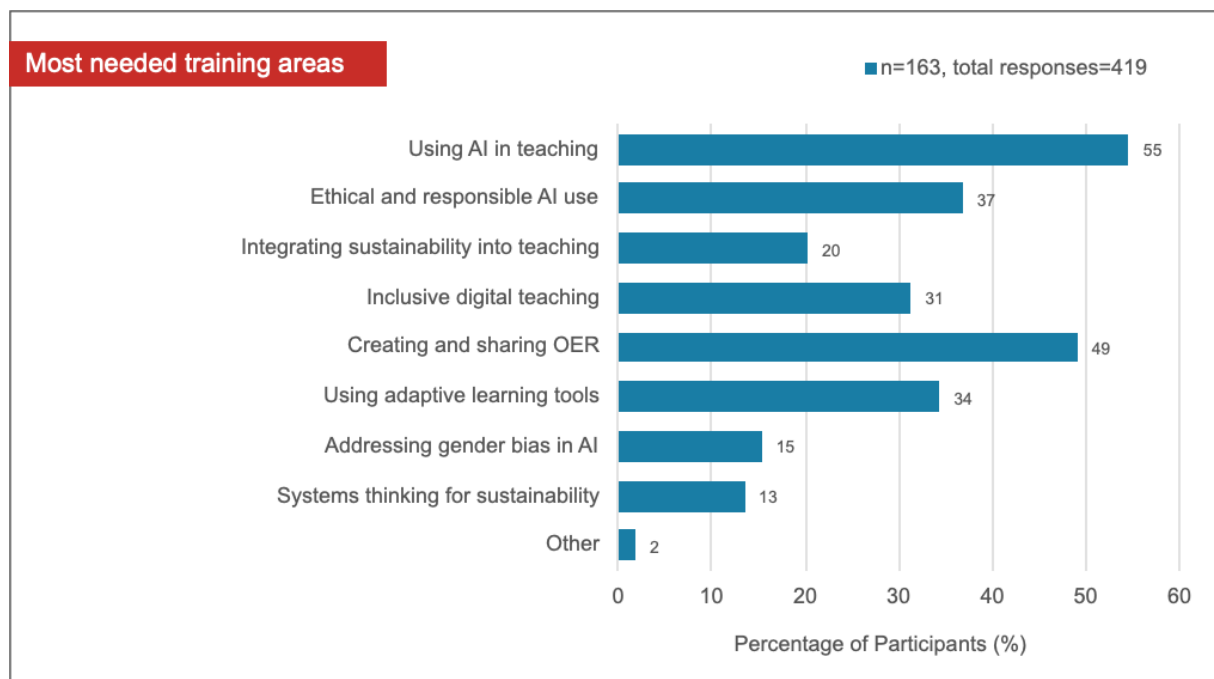


Figure 26: Most needed training areas.

Note: Responses to the DigiSET teacher survey in Italy. Note: Multiple responses were allowed; therefore, totals exceed 100%.

4.6.4. Main barriers to professional development (P2)

Lack of time was by far the most frequently reported barrier, selected by 66.9% of the 163 respondents. Lack of suitable resources or materials followed at 41.7%, institutional support at 36.8% and available training at 28.8%. Infrastructure problems were selected by 16.0%, while 6.1% chose "Other". The results indicate that competence development cannot rely only on additional course content: it must also minimise time demands, provide ready-to-use materials and be supported by school-level organisation (Figure 27).

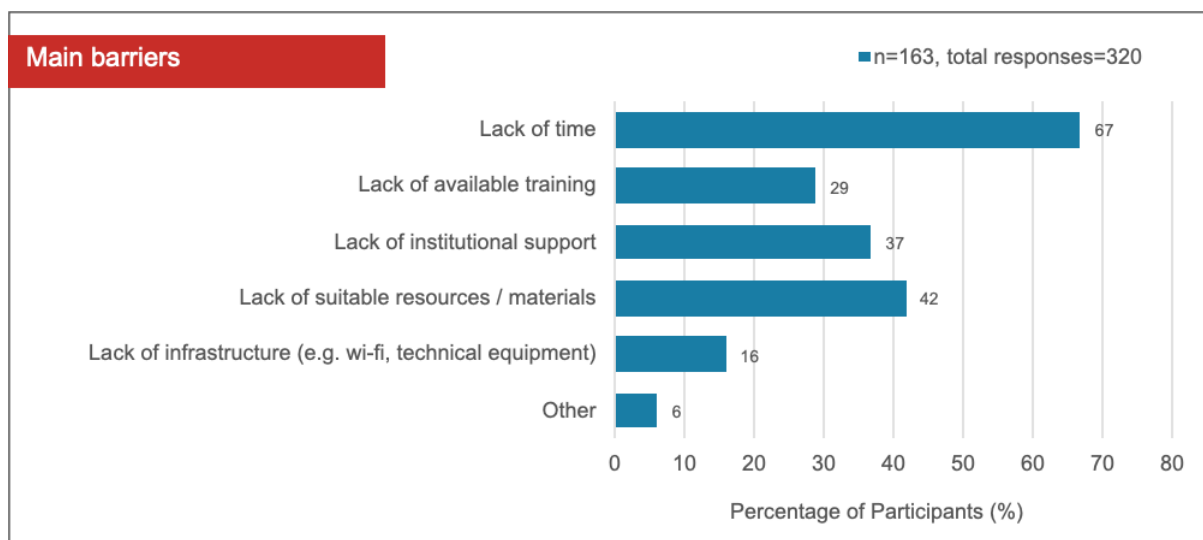


Figure 27: Main barriers to professional development in the addressed areas.

Note: Responses to the DigiSET teacher survey in Italy. Multiple responses were allowed; therefore, totals exceed 100%.

4.6.5. Additional insights and comments (Q3)

Of the 64 Q3 entries, many respondents indicated that they had nothing further to add. The substantive comments nevertheless reinforce several themes from Q1 and Q2. Teachers call for practical, preferably in-person or blended training, sustainable economic support, adequate equipment, technical assistance and opportunities for peer exchange. Several comments advocate a balanced rather than technology-driven approach, particularly for younger learners, and express concern about uncritical reliance on AI, inaccurate outputs, regulatory uncertainty and the possible erosion of independent thinking. Other respondents see AI as a valuable teaching resource when used under educator supervision.

The comments also broaden the concept of sustainability to include device life cycles, electronic waste, resource use and what one respondent called “sostenibilità cognitiva”: protecting human autonomy and well-being from excessive delegation to automated systems. Collaboration is presented as a key enabling condition, with one participant noting that “sarebbe fondamentale la condivisione di pratiche e risorse tra colleghi”.

5. Discussion

This section synthesises the principal findings from the Italian survey, identifies cross-domain patterns and considers their implications in light of the study's methodological and sampling characteristics. Interpretations are linked to the corresponding tables and figures in Section 4.

5.1. Key results concerning teachers' competences

The results represent self-perceived practice, agreement or confidence rather than objectively tested competence. The methodological cautions concerning the AD and GD response format are addressed below; the instruction-response mismatch reported for the English ESD master version does not apply to the Italian questionnaire, where the instruction and agreement scale were aligned.

5.1.1. Teachers' competence in digital teaching, AI, ESD and OER

The digital teaching results describe a sample with well-established routine practice but less consolidated use of technology for advanced pedagogical functions. Professional communication, collaboration, digital-resource selection and data protection are strong (Figures 6-7). Respondents also report deliberate use of technology for added value and attention to accessibility (Figures 8 and 10). The weaker areas are digital assessment, learner self-regulation, digitally supported collaboration and assignments requiring content creation (Figures 8-11). This pattern suggests that digital tools are widely used, but are less consistently embedded in assessment design and learner-centred knowledge construction.

AI confidence is clearly less mature. Basic knowledge and content creation are stronger than pedagogical orchestration, AI-supported assessment and peer leadership (Figures 12-17). AI assessment is the most pronounced gap, with only around one fifth of respondents very or completely confident across its four items (Figure 14). ESD shows the opposite profile: values, responsibility, systems thinking and action-oriented practice receive very high agreement, although the use of digital tools for real-world sustainability challenges and confidence in controversial discussions are relatively weaker (Figures 18-20 and 25). OER readiness is more cautious, with fewer than half agreeing that they possess experience, intellectual-property knowledge, ICT capacity or sufficient competence for adoption (Figure 21). Across domains, respondents appear stronger in established digital practice and sustainability-oriented values than in newer, technically and pedagogically complex applications of AI and OER.

5.1.2. Teachers' competence concerning the four DigiSET topics

The four DigiSET priorities divide into two comparatively strong and two weaker areas. Systems thinking is the strongest: around nine in ten respondents agree that they address interconnections, critical reflection and multiple perspectives in sustainability education (Figure 25). Inclusive digital practice is also established, particularly the adaptation of materials for special educational needs (Figure 24). Adaptive AI use is not yet consolidated, with 40.5%-45.0% reporting low confidence in personalisation or differentiated instruction (Figure 22). The gap is sharper for gender bias: awareness is stronger than pedagogical response, and 46.5% are not or only slightly confident in addressing gender stereotypes when using AI (Figure 23).

These results are consistent with the broader competence profile: strong ESD and inclusive-practice findings correspond to established professional experience, while the adaptive-AI and gender-bias gaps mirror the lower confidence in AI pedagogy and assessment. The greatest need for intervention therefore lies in translating AI awareness into concrete, inclusive and bias-conscious teaching strategies. Because AD1-AD2 and GD1-GD2 used a confidence scale for behavioural or knowledge statements, the exact level should be interpreted cautiously, but the relative pattern remains informative.

5.1.3. Teachers' learning needs and interest

The qualitative responses and closed training-priority items are mutually reinforcing. Teachers identify time pressure, workload, inadequate equipment, unstable connectivity, insufficient technical support and difficulty keeping pace with rapid

technological change. They also describe pedagogical challenges: designing meaningful and inclusive activities, evaluating work produced with AI, maintaining critical thinking and integrating sustainability across subjects (Sections 4.6.1 and 4.6.5). Desired competences include AI literacy, digital instructional design, assessment, data protection, source evaluation, ethics, inclusion and systems thinking (Section 4.6.2).

The selected training priorities closely match the measured gaps: using AI in teaching ranks first, followed by creating and sharing OER, ethical AI, adaptive learning and inclusive digital teaching (Figure 26). The comments add a broader concern for the environmental and cognitive sustainability of technology, including device life cycles, energy use and excessive delegation to automated systems. As one respondent observed, digital integration requires "cambiare paradigma didattico", not merely providing devices.

Training design must also respond to the barriers reported in Figure 27. Lack of time is dominant, followed by insufficient materials and institutional support. The Academy should therefore offer modular and flexible learning, ready-to-adapt resources and authentic classroom tasks, while building peer exchange and school-level support into the programme. Three immediate design implications are: prioritise applied AI and OER competence; integrate ethics, inclusion and assessment into every technical module; and minimise participation costs through reusable materials and manageable learning units.

5.2. Contextualisation within the national framework and current state of research

This country report focuses on the survey findings. The national policy, curriculum and research context for Italy is examined separately in the companion DigiSET WP2 desk research country report (Giampaolo et al., 2026), which analyses the national policy framework, teacher competence frameworks, initial teacher education and continuing professional development, and the four DigiSET thematic areas. The two reports are complementary and together form the Italian input to D2.1 and D2.2; readers seeking contextualisation within national strategies, curriculum requirements and the state of research are referred to that report.

The Italian sample nevertheless presents a coherent internal profile. It consists mainly of experienced public-school teachers, particularly from upper-secondary education, and shows strong established digital routines, responsible data practices, inclusive adaptation and sustainability-oriented values. Readiness is lower where recent technological developments require specialised pedagogical knowledge, notably AI-supported assessment, adaptive AI, bias-aware AI teaching and OER licensing and reuse. For DigiSET, this indicates that the national training offer should not start from generic digital literacy alone, but should connect teachers' existing experience to more advanced, evidence-informed practices.

5.3. Limitations

The findings of the Italian DigiSET teacher survey should be interpreted in light of several methodological limitations affecting the comparability, and generalisability. The study employed voluntary, non-probability sampling, and the total number of

individuals reached through the recruitment process is unknown. Consequently, a response rate cannot be calculated. Furthermore, the survey did not collect regional information, and national benchmark statistics were not incorporated into the analysis. It is therefore not possible to assess the geographical balance of the sample or compare its demographic profile directly with that of the wider Italian teaching population.

The internal sample profile nevertheless reveals a clear concentration of particular groups. Women accounted for 75.0% of respondents, 93.6% worked in public or state-funded schools, 55.1% taught at the upper-secondary level, and 60.3% reported more than 20 years of professional experience. The mean age was 56.3 years (Table 2 and Figures 1–5). By contrast, pre-service teachers, private-school staff, vocational educators, and early-career teachers were only marginally represented. The findings therefore primarily reflect the perceptions of experienced, practising teachers working in public schools, with a particularly strong representation of upper-secondary education.

This sample composition may partly explain respondents' relatively high confidence in established digital practices, inclusive teaching, and ESD-related values. At the same time, the findings may underrepresent the perspectives and professional-development needs of less experienced and pre-service teachers, as well as those working in private schools, vocational education, and other underrepresented settings. The results should therefore be treated as analytically useful evidence for programme and training design rather than as population estimates. Although they reveal internally consistent patterns of perceived competence and training needs among the respondents, they should not be used to estimate their prevalence within the national teacher population.

Partial completion of the questionnaire resulted in different numbers of valid responses across the survey sections. Although 229 cases were retained for analysis, participation declined in later sections, with only 142 valid responses for the age item. Percentages were calculated using the valid responses to each item; nevertheless, this attrition may have introduced additional bias if respondents who completed the later sections differed systematically from those who discontinued the survey. Moreover, because the analysis was based on aggregated results, robust subgroup comparisons could not be conducted.

All competence measures were based on self-reports rather than objective assessments of performance. They capture respondents' perceived frequency of practice, level of agreement, or confidence and may be influenced by social desirability, differences in personal standards, and the over- or underestimation of individual ability. Accordingly, the findings should not be interpreted as direct evidence of respondents' demonstrated competence.

Several aspects of the questionnaire design also require caution. Items AD1–AD2 and GD1–GD2 consisted of behavioural, awareness, or knowledge statements but were answered using a confidence scale, which may have affected how respondents interpreted and rated them. However, the Italian ESD version corrected the inconsistency between the instructions and response scale found in the English master questionnaire, while the functional translation resolved most terminological inconsistencies. The voluntary open-ended questions provided useful qualitative

insights, but the depth of the responses varied, and not all participants answered them.

Taken together, these limitations do not invalidate the descriptive patterns identified in the survey, but they restrict the precision, comparability, and generalisability of the conclusions. The findings should primarily be used as an input for the DigiSET needs analysis and the design of the Teacher Academy. Further evidence based on more representative sampling, objective competence measures, and disaggregated subgroup analysis would be required to support population-level conclusions about Italian teachers.

6. Implications

By grounding project design in the Italian survey evidence, DigiSET can translate its competence frameworks into a practical pathway for digitally sustainable teaching across primary, lower- and upper-secondary, and vocational education. The implications below identify priority competence areas, training-design requirements and learning outcomes that are directly traceable to the results reported in Sections 4 and 5.

6.1. Implications for DigiSET

6.1.1. Priority competence areas

The strongest stated training priorities were using AI in teaching (55%), creating and sharing OER (49%), ethical and responsible AI use (37%), adaptive learning tools (34%) and inclusive digital teaching (31%) (Figure 26). These priorities are consistent with the weaker confidence observed in AI assessment (Figure 14), adaptive AI use (Figure 22), pedagogical AI integration (Figure 13), and with the moderate OER profile and uncertainty concerning intellectual property rights (Figure 21).

The DigiSET Teacher Academy should therefore give first priority to pedagogically grounded AI integration rather than stand-alone technical familiarisation. Teachers need to move from basic awareness and content generation towards selecting AI tools for specific learning objectives, designing AI-supported activities, using AI in formative assessment, and evaluating the quality of AI-supported student work. Ethical judgement, protection of sensitive data, human responsibility for bias and the ability to address gender stereotypes should be embedded throughout these activities rather than treated as an isolated module.

A second priority is practical OER competence. Training should cover searching and evaluating open resources, understanding open licences and intellectual property, adapting materials for local needs, correctly attributing sources, and publishing resources in reusable formats. Since OER was both a substantial perceived need and a central project output, every participant should produce at least one openly licensed artefact that can be reviewed, improved and shared within the DigiSET Community of Practice.

Inclusive and adaptive digital pedagogy forms a third priority. The relatively positive results for supporting learners with difficulties (Figure 24) provide a useful foundation, but personalised learning, learner self-monitoring and digitally mediated collaboration were less consistently embedded in practice (Figures 8, 10 and 11).

Training should therefore connect accessibility, differentiation and adaptive technologies with concrete classroom design decisions. The strong results for ESD values and systems thinking (Figures 19 and 25) can serve as a transversal context in which teachers apply digital and AI tools to authentic sustainability problems, while strengthening the more operational dimension of digitally supported ESD practice.

6.1.2. Training format and accessibility

Lack of time was the dominant barrier to professional development (67%), followed by lack of suitable resources or materials (42%), insufficient institutional support (37%) and lack of available training (29%) (Figure 27). The open responses similarly highlighted workload, fragmented provision, infrastructure constraints and the need for practical guidance.

The Academy should respond through a modular and flexible architecture: short self-contained learning units, clear estimated completion times, flexible online access, and focused synchronous workshops for demonstration, feedback and peer exchange. Each unit should lead to an immediately usable output, such as a lesson plan, assessment rubric, AI-use protocol, adapted OER or inclusive activity. Ready-to-use templates, examples and checklists should reduce preparation time and help teachers transfer the training into practice.

Learning should be organised around authentic tasks and iterative design cycles rather than information delivery alone. Participants should test tools, analyse risks, revise materials after peer feedback and document the rationale for their choices. A mentoring and peer-support structure within the Community of Practice would address the demand for continuing support, while downloadable and openly licensed resources would mitigate the reported shortage of suitable materials. Accessibility requirements should apply to both the Academy platform and all participant-created outputs.

6.1.3. Proposed learning outcomes for the Italian pathway

- critically select AI and digital tools according to subject content, learner characteristics, pedagogical purpose, accessibility and added educational value;
- design and facilitate AI-supported learning activities that promote active participation, collaboration, creativity, self-regulation and differentiated learning;
- use digital and AI tools for formative assessment and feedback while recognising limitations, validating outputs and maintaining teacher responsibility for educational decisions;
- identify and mitigate ethical, privacy, safety and bias-related risks, including gender stereotypes and the handling of student data and assessment materials;
- find, evaluate, licence, adapt, attribute, create and share OER in technically accessible and pedagogically reusable formats;
- design inclusive digital resources and learning pathways for students with learning difficulties and special educational needs, applying accessibility and universal-design principles;
- apply systems thinking and digital technologies to sustainability-related learning scenarios that connect environmental, social and economic dimensions and support action-oriented learning.

These outcomes should be represented in D2.2 through observable performance descriptors and assessed through authentic products and reflective evidence, not only through self-report. A progression model should distinguish basic tool awareness, guided classroom application, independent instructional design and the capacity to support colleagues or contribute resources to the DigiSET community. Because the Italian sample consists almost entirely of in-service teachers, the learning outcomes relating to initial teacher education should be developed in conjunction with the initial-teacher-education analysis in the companion desk research report (Giampaolo et al., 2026), rather than from the survey evidence alone.

6.2. Additional insights

6.2.1. Recommendations for national policymakers

The following recommendations extend beyond the survey evidence into the wider national and institutional context. They are offered as broader considerations that complement, rather than derive directly from, the questionnaire findings.

Policy measures should recognise time as a structural condition for effective professional learning. Funding or regulatory initiatives should encourage protected training time, recognition of modular or micro-credentialled learning, and access to validated national resources on educational AI, data protection, open licensing and accessibility. Guidance should be sufficiently operational to help teachers translate principles into classroom decisions, while preserving professional judgement and avoiding reliance on particular commercial tools.

Investment should also support interoperable repositories and open professional-development materials. This would respond simultaneously to the demand for OER training and to the reported shortage of suitable resources, while enabling schools with different levels of local capacity to access a common baseline of quality materials.

6.2.2. Recommendations for school leadership

School leaders should provide scheduled collaborative time, identify local mentors and create small interdisciplinary teams that can test AI, OER and sustainability activities before wider adoption. Institutional protocols should clarify acceptable AI use, data handling, assessment integrity and accessibility responsibilities. Leadership support should include not only infrastructure, but also pedagogical coordination, technical assistance and recognition of teachers who create and share reusable resources.

A practical starting point would be a school-level action plan linking one priority learning challenge to a limited set of tools, a shared resource bank and a review cycle. This would reduce fragmented experimentation and help convert individual training into organisational learning.

6.2.3. Recommendations for teacher education and professional - development providers

Pre-service and in-service programmes should integrate AI pedagogy, OER, inclusive design and digital sustainability across subject methodology rather than confining them to optional technology courses. Assessment should require participants to demonstrate competence through designed lessons, adapted

resources, risk analyses and reflective implementation reports. Programmes should also explicitly prepare teachers to evaluate AI outputs, preserve human oversight and discuss contested ethical and sustainability issues with learners.

Providers should offer differentiated entry points for teachers with different experience levels, while ensuring that advanced participants can act as peer mentors and resource creators. The highly experienced profile of this sample suggests that training should value existing pedagogical expertise and connect new technologies to established classroom practice rather than assuming a novice professional audience.

6.2.4. Future research

Further Italian research should use a broader and more systematically recruited sample, including more pre-service teachers, private-school staff, vocational educators, younger teachers and respondents from documented geographic areas. Access to anonymised individual-level data would allow subgroup comparisons and analysis of relationships among experience, school level and competence profiles. Future studies should also complement self-assessment with performance-based tasks and follow participants longitudinally to determine whether training produces sustained changes in classroom practice.

6.2.5. Transferability across the DigiSET consortium

The principal implications - practical AI pedagogy, ethical and bias-aware use, OER capability, inclusive design, flexible training and institutional support - are likely to be relevant across the DigiSET partnership because they correspond directly to the project's common competence domains. However, the relative priority of each topic and the most effective delivery arrangements should be adjusted to national samples, school systems, recruitment profiles and policy contexts. A common European core combined with country-specific examples, optional modules and local validation would therefore offer the most appropriate balance between comparability and contextual relevance.

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