INVESTIGATING THE DIGITAL COMPETENCE OF IN-SERVICE TEACHERS THROUGH THE DIGCOMPEDU FRAMEWORK

Bianca De Vivo[1]
Pegaso Telematic University
bianca.devivo@unipegaso.it

Valeria De Padova[2]
Pegaso Telematic University
valeria.depadova@unipegaso.it

Anna Dipace[3]
Pegaso Telematic University
anna.dipace@unipegaso.it

Andrea Tinterri[4]
Pegaso Telematic University
andrea.tinterri@unipegaso.it

Double Blind Peer Review

Citation
De Vivo, B., De Padova, V., Dipace, A. & Tinterri, A. (2026). *Investigating the digital competence of in-service teachers through the DigCompEdu framework. Italian Journal of Health Education, Sports and Inclusive Didactics, 10*(3).

Doi: https://doi.org/10.32043/gsd.v1i3.1759

Copyright notice:
© 2023 this is an open access, peer-reviewed article published by Open Journal System and distributed under the terms of the Creative Commons Attribution 4.0 International, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

gsdjournal.it
ISSN: 3103-5744

ABSTRACT
This study investigates the self-perceived digital competences of 829 teachers enrolled in the 30-CFU initial qualification pathways at Pegaso Telematic University, using a self-assessment questionnaire based on the DigCompEdu framework and operationalised through the SELFIE for Teachers instrument. Data were collected at the outset of the programme, before any instructional intervention, capturing a diagnostic baseline across three subscales: Professional Engagement, Teaching and Learning, and Facilitating Learners' Digital Competence. Results reveal a globally low level of self-perceived digital competence (Overall M = 38.0% of maximum), with the Facilitating Learners' Digital Competence subscale registering the lowest mean (M = 34.4%). A Kruskal-Wallis test identified statistically significant differences across experience groups ($H = 66.9$, $df = 3$, $p < .001$). Findings confirm the DigCompEdu framework as a diagnostically valid and policy-relevant instrument for initial teacher education and underscore the need for structured digital competence training within qualification programmes.

KEYWORDS
DigCompEdu; SELFIE for teachers; digital competences; teacher education; initial teacher training.

Received 2026-06-30
Accepted 2026-10-26
Published 2026-10-30

[1] Paragraphs 4 and 5: Results

[2] Paragraphs 2 and 3: Theoretical Framework and Methodology

[3] Paragraph 6: Discussion

[4] Paragraphs 1 and 7: Introduction and Conclusions

1. Introduction: Digital Competence as a Structural Challenge in Initial Teacher Education

The relationship between technology and pedagogy has undergone a profound transformation over the past decade. Digital tools are no longer optional enhancements to teaching practice but a core component of professional competence, with implications for teacher education, evaluation, and support.

Despite this shift, initial teacher education programmes often fail to ensure the systematic development and assessment of digital competence. As a result, a gap persists between emerging professional standards and the actual preparedness of novice teachers, with potential consequences for instructional quality and educational equity. Systematic diagnostic assessment at entry into qualification pathways is therefore needed to identify competence levels and inform programme design. At the European level, this need is addressed through the DigCompEdu framework (Redecker, 2017), which defines 22 competences across six areas and extends the broader DigComp framework (Carretero et al., 2017; Vuorikari et al., 2022). DigCompEdu emphasises not only technical proficiency but also pedagogical integration, critical evaluation, and learner-centred deployment of digital tools. Its operationalisation through the SELFIE for Teachers instrument (European Commission, 2021) enables structured self-assessment for diagnostic and developmental purposes.

In Italy, the DPCM of 4 August 2023 has made digital competence a statutory requirement within the new 30-CFU teacher qualification pathways. Annex A specifies competencies related to digital literacy, critical selection of resources, inclusive and personalised teaching, and the promotion of responsible digital engagement, thereby transforming digital competence into a formal professional standard. This study investigates the self-perceived digital competence of teachers

enrolled in the 30-CFU qualification pathways at Pegaso Telematic University. Using an adapted SELFIE for Teachers instrument covering Professional Engagement, Teaching and Learning, and Facilitating Learners' Digital Competence, data were collected via CAWI from 829 participants at the start of the programme, prior to any training intervention. The dataset provides a baseline mapping of incoming teacher candidates under the new regulatory framework.

The article is structured as follows: Section 2 outlines the theoretical framework; Section 3 describes the methodology; Sections 4 and 5 present the empirical results; Section 6 discusses implications for teacher education policy and programme design.

2. Theoretical Framework: DigCompEdu, SELFIE for Teachers, and the Epistemology of Digital Competence Assessment

2.1. The DigCompEdu Framework: Structure, Rationale, and Theoretical Foundations

The DigCompEdu framework (Redecker, 2017), developed by the European Commission's Joint Research Centre, is the reference model for defining and assessing educators' digital competences. It conceptualises digital competence as inherently professional and context-dependent, embedded within pedagogical, relational, and institutional settings rather than reducible to generic ICT skills (Mishra & Koehler, 2006). The framework organises 22 competences into six areas (Professional Engagement, Digital Resources, Teaching and Learning, Assessment, Empowering Learners, and Facilitating Learners' Digital Competence) and is structured as a six-level progression (A1–C2), allowing both diagnostic and developmental interpretation.

For this study, three areas were selected: Professional Engagement, Teaching and Learning, and Facilitating Learners' Digital Competence. These were chosen because they capture the core dimensions of digitally mediated instructional practice. Professional Engagement concerns collaboration, communication, and reflective practice; Teaching and Learning addresses the design and management of technology-enhanced instruction; Facilitating Learners' Digital Competence focuses on the teacher's deliberate efforts to develop students' own digital competence, including information and data literacy, communication, content creation, responsible use, and problem solving. Together, they provide a focused measure of teachers' self-perceived digital competence as it is enacted in everyday educational practice.

2.2. The SELFIE for Teachers Instrument: Psychometrics, Validity, and Methodological Considerations

The SELFIE for Teachers (SFT) instrument (European Commission, 2021) is the official self-assessment operationalisation of the DigCompEdu framework. It comprises 32 items distributed across six competence areas, rated on a six-point scale from 1 (very limited competence) to 6 (highly advanced competence). The instrument is available in multiple languages, including Italian, and has shown satisfactory psychometric properties in terms of reliability, factorial validity, and cross-national comparability (Lucas et al., 2021; Scherer et al., 2019).

This study employs three SFT subscales, Professional Engagement (PE), Teaching and Learning (TL), and Facilitating Learners' Digital Competence (FLDC), selected on theoretical and normative grounds. Together, they capture the core dimensions of digitally mediated teaching practice most directly aligned with the DPCM professional standards: teachers' professional digital activity (PE), the pedagogical

integration of technology (TL), and the promotion of students' digital competence (ESDC). Self-report measures entail well-known limitations, particularly the risk of systematic bias and miscalibration between perceived and actual competence (Kruger & Dunning, 1999). However, they remain methodologically appropriate in this context because they capture perceived self-efficacy, a construct that is itself a strong predictor of professional behaviour. As shown by Bandura (1997), perceived capability influences teachers' willingness to integrate digital tools, engage in professional development, and experiment with pedagogical innovation, often independently of actual skill levels. It should be noted that self-perceived digital competence and digital self-efficacy, although conceptually related, are not equivalent constructs: the former refers to an individual's assessment of their own level of competence, while the latter denotes a generalized belief in one's ability to successfully perform specific actions (Bandura, 1997). The SFT instrument used here operationalizes self-perceived competence; when the term "self-efficacy" is used in this manuscript, it is conceived as a proximal indicator of perceived readiness rather than as a direct measure of Bandura's construct. For this reason, self-reported digital competence is interpreted here primarily as a measure of perceived readiness to engage in digital teaching practice.

2.3. Teaching Experience, Self-perceived digital competence, and the Professional Development Literature

A substantial body of research has examined the relationship between teaching experience and digital competence, with findings that challenge a simple linear model of progression. Early adoption theories (Rogers, 2003; Ertmer, 2005) assumed a positive relationship between experience and digital competence, based on the idea that more experienced teachers would have greater exposure to professional development and classroom technologies. However, more recent

empirical studies have produced more complex and often non-linear results. Large-scale investigations (Scherer et al., 2019; Tondeur et al., 2016; Starkey, 2019) suggest that mid-career teachers tend to report higher levels of digital competence and integration than both novice and highly experienced teachers, indicating a curvilinear rather than linear relationship. This pattern can be interpreted through complementary theoretical perspectives. Huberman's (1989) model of teacher career cycles describes a mid-career phase characterised by consolidation and experimentation, in which teachers are more open to pedagogical innovation and thus more likely to engage with digital tools. By contrast, more experienced teachers may face stronger first-order barriers, including entrenched pedagogical beliefs, stabilised instructional routines, and reduced exposure to institutional incentives for technological change (Ertmer, 2005; Prestridge, 2012). These factors can limit the adoption and perceived relevance of digital innovation, even in the presence of adequate technical infrastructure.

The Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006; Koehler et al., 2013) further refines this interpretation by emphasising that effective digital integration depends on the interaction between technological, pedagogical, and content knowledge. This intersection may be particularly salient for mid-career teachers, who have accumulated sufficient pedagogical and content expertise to meaningfully integrate technology, whereas novice teachers may lack pedagogical consolidation and highly experienced teachers may rely on routinised practices that reduce experimentation with digital tools. Against this background, the present study empirically examines the relationship between teaching experience and self-perceived digital competence. Participants are grouped into four categories: no experience, up to 2 years, 3–10 years, and more than 10 years of teaching experience. Differences across groups

are analysed using a non-parametric inferential approach appropriate to the distributional characteristics of the data.

The results, presented in Section 5, provide one of the largest Italian datasets on the experience–digital competence relationship within initial teacher qualification pathways. They allow for a more fine-grained understanding of how professional experience relates to perceived digital readiness and offer evidence to inform the design of differentiated training strategies within 30-CFU programmes.

3. Methodology

3.1. Study Design, Context, and Participants

The study adopts a cross-sectional survey design with an exploratory-descriptive and inferential orientation. It was conducted within the 30-CFU qualification pathways offered by Pegaso Telematic University, one of Italy's largest online universities, which delivers programmes across all 20 Italian regions. The qualification pathways, regulated by the DPCM of 4 August 2023, provide the pedagogical and didactic training required for eligibility to national secondary school teaching competitions. Data were collected on 12 October 2025 via a Computer-Assisted Web Interview (CAWI) platform, administered at the very beginning of the programme, prior to any instructional input. This timing ensures that the dataset captures a baseline measure of entering digital competence, unaffected by training exposure.

While the institutional reach of the programme spans all 20 Italian regions, the analytical sample used in this study is drawn from participants enrolled across 10 regions, reflecting the actual distribution of respondents who completed the survey. The initial dataset included 845 completed responses. Prior to analysis, all questionnaires were screened for completeness. Records with missing or

incomplete responses on any of the 19 SFT items were excluded from the analytic sample. Application of this criterion led to the exclusion of 16 records out of the 845 questionnaires initially collected, resulting in a final analytical sample of N = 829.

The sample was predominantly female: 577 respondents (69.6%) identified as female, 247 (29.8%) as male, and 5 (0.6%) preferred not to disclose gender. Participants were distributed across 44 subject competition classes spanning humanities, sciences, arts, technical, and vocational areas.

3.2. The Measurement Instrument

The measurement instrument was a self-assessment questionnaire constructed on the basis of three subscales of the SELFIE for Teachers (SFT) instrument (European Commission, 2021): (1) Professional Engagement (PE), comprising items assessing the frequency and quality of digital technology use for professional communication, collegial collaboration, participation in professional learning networks, and reflective professional development; (2) Teaching and Learning (TL), comprising items assessing the integration of digital tools in lesson planning, instructional delivery, classroom management, and the orchestration of collaborative and self-regulated learning activities; and (3) Facilitating Learners' Digital Competence (FLDC), comprising items assessing the teacher's deliberate and systematic efforts to develop students' digital literacy, including information literacy, safe and responsible online behaviour, digital content creation, and computational thinking.

Of the six competency domains of the SFT and its 32 initial items, this study selected three domains: Professional Engagement (9 items), Teaching and Learning (4 items), and Facilitating Learners' Digital Competency Developement (6 items). This selection is based on the theoretical foundations presented in Section 2.2. No items

were modified or merged; only the three subscales that did not comply with the DPCM's professional standards (Digital Resources, Assessment, and learner Empowerment) were excluded. The response format followed the original SFT format: for each item, respondents were asked to select the statement that best described their current practice from among seven behavioral descriptors, ranked from 0 ("I have not yet developed this competency") to 6 (the most advanced descriptor).

This response format is coded on a 0–6 ordinal scale, consistent with the original SFT instrument (European Commission, 2021), and avoids a neutral mid-point, ensuring adequate distributional variance for subsequent analyses.This response format, consistent with the original SFT instrument (European Commission, 2021), avoids the central tendency bias associated with mid-point neutral options and ensures adequate distributional variance for parametric and non-parametric statistical analysis. Composite subscale scores and the overall score were computed as the mean of item responses within each subscale and then rescaled to a 0–100 range (percentage of maximum possible score), more specifically, the score for each item was rescaled to (raw score / 6) × 100. The composite subscale scores were calculated as the unweighted average of the rescaled item scores within each subscale, and the overall score as the unweighted average of the 19 rescaled item scores.

The internal consistency of the instrument was evaluated through Cronbach's alpha coefficients, computed for each subscale on the final analytical sample (N = 829). All three subscales demonstrated excellent reliability: Professional Engagement, $\alpha = .909$; Teaching and Learning, $\alpha = .893$; Facilitating Learners' Digital Competence, $\alpha = .911$. These values easily exceed the conventionally accepted threshold for research instruments ($\alpha \geq .80$; Nunnally, 1978) and are consistent with the reliability estimates published for the SFT instrument in European validation studies

(Lucas et al., 2021; Scherer et al., 2019). It should be noted that Cronbach's alpha only documents internal consistency; it does not, on its own, establish the construct or criterion validity of the adapted instrument, which was not independently assessed in the present study (e.g., through confirmatory factor analysis). This is acknowledged as a limitation in Section 6.4.

3.3. Data Analysis Strategy

Data were analysed using the jamovi statistical environment (v. 2.6; The jamovi Project, 2024), an open-source platform based on the R statistical computing environment. The analysis proceeded in three stages. In the first stage, descriptive statistics (means, standard deviations, medians, and frequency distributions) were computed for each subscale and for the overall score, both for the full sample and disaggregated by gender and teaching experience group, in order to characterise the baseline digital competence profile of the cohort. In the second stage, distributional assumptions were assessed using the Shapiro-Wilk test and visual inspection of Q-Q plots and histograms. Results indicated significant deviations from normality for all subscales (all $p < .001$), with positively skewed distributions, thereby precluding the use of parametric methods. In the third stage, non-parametric inferential analyses were conducted. Group differences across teaching experience categories were tested using the Kruskal–Wallis H test. Where significant omnibus effects were observed, post-hoc analyses were performed using the Dwass-Steel-Critchlow-Fligner (DSCF) procedure, which controls the familywise error rate under unequal group sizes.

To identify the specific experience-group contrasts driving the significant omnibus Kruskal-Wallis effects, post-hoc pairwise comparisons were conducted using the Dwass-Steel-Critchlow-Fligner (DSCF) procedure, a robust non-parametric multiple-comparison method that controls the familywise error rate without assuming equal

sample sizes (Hollander et al., 2013). Results for the overall score are reported in Table 4.

4. Results: Descriptive Statistics of Digital Competence Self-Perceptions

4.1. Overall and Subscale-Level Findings

Table 1 reports descriptive statistics for the nineteen item-level components, the three subscales, and the composite score for the full analytical sample (N = 829). Scores are expressed as percentages of the maximum possible value on a 0–100 rescaled metric, allowing comparison across items and subscales.

Table 1. Descriptive statistics for DigCompEdu subscales and item-level components (N = 829)

Subscale / Component	N	M (%)	SD	Mdn (%)	Min	Max
Professional Engagement	829	39.8	18.5	38.8	0.0	100.0
Organisational communication	829	52.9	24.6	66.7	0.0	100.0
Online learning environments	829	33.5	25.0	33.3	0.0	100.0
Prof. learning (through tech)	829	43.1	23.9	50.0	0.0	100.0
Computational thinking	829	29.7	23.9	16.7	0.0	100.0
Digital life (wellbeing)	829	42.3	25.3	50.0	0.0	100.0
Professional collaboration	829	42.0	23.3	50.0	0.0	100.0
Digital technologies & infrastructure	829	41.1	25.1	50.0	0.0	100.0
Reflective practice	829	37.0	25.3	33.3	0.0	100.0
Prof. learning (about tech)	829	37.0	22.5	33.3	0.0	100.0
Teaching & Learning	829	39.3	21.8	37.5	0.0	100.0
Teaching	829	41.7	24.3	33.3	0.0	100.0
Guidance & orientation	829	38.4	24.4	33.3	0.0	100.0
Collaborative learning	829	39.9	25.7	33.3	0.0	100.0
Self-regulated learning	829	37.5	26.0	33.3	0.0	100.0

Facilitating Learners' Digital Competence	829	34.3	20.5	33.3	0.0	100.0
Data & digital literacy	829	32.5	23.7	33.3	0.0	100.0
Communication & collaboration	829	35.3	24.5	33.3	0.0	100.0
Content creation	829	36.8	23.8	33.3	0.0	100.0
Safety & wellbeing	829	33.7	25.2	33.3	0.0	100.0
Responsible use	829	32.9	24.9	33.3	0.0	100.0
Problem solving	829	34.9	24.8	33.3	0.0	100.0
Overall	**829**	**38.0**	**18.3**	**35.9**	**0.0**	**100.0**

Notes. M = mean score (% of maximum). SD = standard deviation. Mdn = median. Items are grouped by subscale. All items scored on a 1–6 scale, rescaled to 0–100.

The overall composite score (M = 38.02, SD = 18.36, Mdn = 35.96) indicates that, at entry into the programme, participants self-assess their digital competence at approximately 38% of the maximum level. This places the cohort at the lower end of the B1 (Integrator) band (according to the conventional score-band mapping described in Section 4.3) in the DigCompEdu progression, with the median slightly below the B1 threshold, suggesting that more than half of participants fall within A2 (Explorer) or below. The relatively high standard deviation indicates substantial heterogeneity across the sample.

Across subscales, Professional Engagement (M = 39.84, SD = 18.52, Mdn = 38.89) shows the highest mean, closely followed by Teaching and Learning (M = 39.39, SD = 21.83, Mdn = 37.50). Facilitating Learners' Digital Competence (FLDC) records the lowest mean (M = 34.36, SD = 20.55, Mdn = 33.33), approximately five percentage points lower than the other two dimensions. Although differences are moderate, they are theoretically relevant, as FLDC is most directly aligned with the

pedagogical requirements specified in the DPCM (Article 3, paragraph j), suggesting a relative weakness in perceived capacity to foster students' digital competence.

4.2. Item-Level Analysis and Diagnostic Patterns

Item-level results show a consistent gradient across dimensions. Within Professional Engagement, Organisational communication records the highest mean (M = 52.9), indicating that digital tools are mainly used for administrative and communicative purposes. By contrast, Reflective practice and Professional learning about digital technologies show lower values (both M = 37.0), suggesting more limited engagement with development-oriented digital activities. Within Teaching and Learning, Teaching (M = 41.7) and Collaborative learning (M = 39.9) show the highest means, while Self-regulated learning (M = 37.5) and Guidance and orientation (M = 38.4) are slightly lower. Standard deviations remain high across items, indicating marked variability in perceived competence within the cohort. The FLDC subscale shows the lowest overall levels. Computational thinking records the lowest mean across all items (M = 29.7, SD = 23.9, Mdn = 16.7), with the median falling within the A1 (Newcomer) band, suggesting minimal self-perceived competence for a substantial share of respondents. Responsible use (M = 32.9) and Data and digital literacy (M = 32.5) also remain below the subscale mean, indicating weaker preparation in domains related to digital citizenship and critical engagement.

4.3. DigCompEdu Proficiency Level Distribution

The composite scores were mapped to the six DigCompEdu proficiency levels (A1–C2) by dividing the 0–100 re-100 metric into six bands of equal width, as an operational heuristic for descriptive purposes only. The DigCompEdu proficiency levels are not formally defined as equal intervals on a continuous scale, and the

SELFIE tool for teachers does not report official level thresholds; the resulting labels should therefore be interpreted as descriptive score-band categories rather than as formal proficiency classifications reported by the tool. This convention is applied consistently throughout the remainder of the manuscript.

Table 2. Distribution of participants across DigCompEdu proficiency levels (Overall score), by experience group

Group	A1	A2	B1	B2	C1	C2	Dominant level
Full sample	11.9%	29.4%	33.3%	19.2%	4.7%	1.4%	B1
G0 (None)	32%	32%	17%	12%	6%	2%	A1–A2
G1 (≤2y)	8%	32%	32%	21%	6%	1%	A2–B1
G2 (3–10y)	5%	25%	41%	22%	4%	2%	B1
G3 (>10y)	4%	33%	38%	20%	3%	1%	B1

(%)Notes. Levels: A1 = Newcomer; A2 = Explorer; B1 = Integrator; B2 = Expert; C1 = Leader; C2 = Pioneer. Dominant level = modal category.

To contextualise results within the DigCompEdu framework, To contextualise results within the DigCompEdu framework, composite scores were mapped onto the six proficiency levels (A1–C2) by partitioning the rescaled 0–100 metric into six equal-width bands. This procedure is adopted here as an operational heuristic for descriptive purposes only. It should be noted that the DigCompEdu proficiency levels are not formally defined as equal intervals on a continuous scale, and the SELFIE for Teachers instrument does not return official level cut-offs. The resulting distribution should therefore be read as an approximate descriptive mapping rather than a formal proficiency classification.

The modal level is B1 (Integrator), covering 33.3% of the sample. However, A1 and A2 together account for 41.3%, indicating that a substantial share of participants

remains at foundational or exploratory levels. At the upper end, C1 (Leader) and C2 (Pioneer) represent 4.7% and 1.4% respectively. Overall, only 6.1% of participants reach or exceed the C1 threshold, suggesting that advanced digital competence profiles are relatively limited within the cohort.

5. Results: The Effect of Teaching Experience on Digital Competence Self-Perceptions

5.1. Inferential Analysis: Kruskal-Wallis Tests

Prior to inferential testing, the distributional properties of composite scores were examined for each subscale. Shapiro-Wilk tests confirmed significant departures from normality for all four variables (Overall: $W = .988$, $p < .001$, skewness = .342; PE: $W = .993$, $p < .001$, skewness = .169; TL: $W = .967$, $p < .001$, skewness = .385; FCS: $W = .952$, $p < .001$, skewness = .696), justifying the adoption of non-parametric inferential procedures. Kruskal-Wallis H tests were therefore conducted to assess whether significant differences in digital competence self-perceptions existed across the four teaching experience groups (G0: no experience, n = 199; G1: up to 2 years, n = 154; G2: 3–10 years, n = 338; G3: more than 10 years, n = 138).

Results are reported in Table 3. Statistically significant omnibus effects were identified for all four variables: Overall ($H = 66.88$, $df = 3$, $p < .001$, $\varepsilon^2 = .077$), Professional Engagement ($H = 57.18$, $df = 3$, $p < .001$, $\varepsilon^2 = .066$), Teaching and Learning ($H = 63.01$, $df = 3$, $p < .001$, $\varepsilon^2 = .073$), and Facilitating Learners' Digital Competence ($H = 58.97$, $df = 3$, $p < .001$, $\varepsilon^2 = .068$). All effect sizes fall just above the lower bound of the medium range according to the benchmarks proposed by Tomczak and Tomczak (2014; $\varepsilon^2 \geq .06$ = medium; $\varepsilon^2 \geq .14$ = large). Teaching experience therefore accounts for a modest, statistically robust but quantitatively limited, share of the variance in digital competence self-perceptions. As the post-

hoc analysis indicates, this effect is driven almost entirely by the contrast between teachers with no classroom experience and those with any experience, rather than by a graded influence of experience across the cohort.

Table 3. Kruskal-Wallis H test results: teaching experience group means and inferential statistics by subscale

Subscale	G0 M	G1 M	G2 M	G3 M	H	df	p	ε^2	Effect size
Professional Engagement	31.62	41.34	43.63	40.75	57.18	3	< .001	.066	Medium
Teaching & Learning	30.19	40.53	44.03	40.04	63.01	3	< .001	.073	Medium
Facilitating Learners' Digital Competence	26.77	34.88	38.46	34.64	58.97	3	< .001	.068	Medium
Overall	**29.79**	**39.13**	**42.08**	**38.67**	**66.88**	**3**	**< .001**	**.077**	**Medium**

Notes. M = group mean score (% of maximum). H = Kruskal-Wallis test statistic. df = degrees of freedom. p = asymptotic significance (two-tailed). ε^2 = epsilon-squared effect size (Tomczak & Tomczak, 2014). Effect size benchmarks: small $\varepsilon^2 \geq .01$, medium $\varepsilon^2 \geq .06$, large $\varepsilon^2 \geq .14$. G0 = no experience; G1 = ≤2 years; G2 = 3–10 years; G3 = >10 years.

5.2. Post-Hoc Pairwise Comparisons

To identify the specific experience-group contrasts driving the significant omnibus Kruskal-Wallis effects, post-hoc pairwise comparisons were conducted using the Dwass-Steel-Critchlow-Fligner (DSCF) procedure, a robust non-parametric multiple-comparison method that controls the familywise error rate without assuming equal sample sizes (Hollander et al., 2013). Results for the overall score are reported in Table 4.

Table 4. Post-hoc pairwise comparisons (DSCF procedure) - Overall score

Comparison	W	p	Significance
G2 vs G0	−11.090	< .001	***
G1 vs G0	−7.293	< .001	***
G3 vs G0	−7.354	< .001	***
G2 vs G1	−2.870	.177	ns
G3 vs G2	2.869	.178	ns
G3 vs G1	−0.055	1.000	ns

*Note. W = Dwass-Steel-Critchlow-Fligner test statistic. p = associated significance value. ns = not significant; *** p < .001. G0 = no experience; G1 = ≤ 2 years; G2 = 3–10 years; G3 = > 10 years*

The post-hoc pattern is unambiguous: the group of teachers with no teaching experience (G0) differed significantly from all three groups with any classroom experience (G1, G2, G3; all p < .001), whereas none of the pairwise comparisons among the experienced groups (G1 vs G2, G1 vs G3, G2 vs G3) reached significance. The largest contrast in absolute terms was G2 vs G0 (W = −11.090), indicating that teachers with 3–10 years of experience, who also recorded the highest overall self-perceived digital competence (M = 42.08), represent the group most sharply differentiated from those with no experience. This finding is theoretically consequential: the primary axis of differentiation is not the gradient of experience per se, but the categorical distinction between having any classroom experience and having none at all. Once teachers have accumulated even minimal experience (G1: ≤ 2 years), their self-perceived digital competence is no longer significantly different from that of more experienced colleagues. The post-hoc model indicates

that self-perceived digital competence differs significantly between teachers with no classroom experience and those with any classroom experience, whereas no significant differences are observed among the experienced groups (G1, G2, G3). Given the cross-sectional design, this model should be interpreted as a difference between groups observed at a single point in time, rather than as evidence of a developmental process, transition, or trajectory.

5.3. Level Distribution by Experience Group

The proficiency level distributions reported in Table 2 provide a complementary perspective on the experience effect. In terms of the conventional score-band mapping introduced in Section 4.3, among teachers with no teaching experience (G0), 64% self-assessed at A1 or A2 level, compared to 40% in G1, 30% in G2, and 37% in G3. The proportion of G0 participants at A1 level (32%) is substantially higher than in any other group (G1: 8%; G2: 5%; G3: 4%), confirming that inexperienced teachers are disproportionately concentrated at the lowest proficiency tier. Conversely, the proportion of participants reaching or exceeding B1 level, the integrator threshold, at which teachers begin to systematically apply digital tools across their professional practice, is substantially lower in G0 (36%) than in G1 (60%), G2 (69%), or G3 (62%). The modal proficiency level for G0 is distributed between A1 and A2 (32% each), whereas for G1, G2, and G3 it is B1. This pattern is consistent with the inferential results and suggests a marked discontinuity between teachers with no experience and those with any teaching experience.

6. Discussion

6.1. Interpreting the Baseline Digital Competence Profile

The descriptive profile indicates that teachers entering the 30-CFU qualification pathways self-assess their digital competences at relatively low-to-moderate levels within the DigCompEdu continuum. The average score (38% of the maximum) positions the cohort at the lower end of the B1 (Integrator) band (according to the conventional score-band mapping described in Section 4.3), while the median suggests that a substantial proportion of participants remain at A2 (Explorer) or below. These findings are broadly consistent with prior European studies based on the SELFIE for Teachers instrument (Lucas et al., 2021) and extend this literature by providing evidence from a large Italian pre-service qualification cohort under the new DPCM regulatory framework. Across subscales, results indicate a relatively stronger profile in Professional Engagement and Teaching and Learning, while Facilitating Learners' Digital Competence emerges as the weakest dimension. This pattern suggests a partial asymmetry between teachers' operational use of digital tools and their perceived capacity to foster students' digital competence. Within this latter dimension, item-level results highlight particularly low scores in Computational Thinking, Data Literacy, and Responsible Use. Rather than indicating isolated deficiencies, these results point to a more general difficulty in translating digital tool use into explicitly pedagogical and student-facing competence development.

6.2. The Experience Effect and Programme Design Implications

The inferential analysis indicates a statistically significant association between teaching experience and self-perceived digital competence, but the pattern is not linear. Findings suggest that the main difference is observed between participants with no teaching experience and those with at least minimal classroom experience.

Beyond this initial transition, additional years of experience do not appear to be associated with substantial increases in self-perceived digital competence. This model of group differences is consistent with previous research on teachers' professional development (Huberman, 1989), which links the early stages of their careers to greater openness to pedagogical innovation. However, given the cross-sectional nature of the study, these results describe a difference between the groups observed at a single point in time and do not allow for inferences about individual development trajectories, transitions, or change over time.

From a theoretical perspective, these findings are consistent with interpretations offered by the TPACK framework (Mishra & Koehler, 2006), which emphasises that digital integration depends on the interaction between technological, pedagogical, and content knowledge rather than on accumulated experience per se. These results, observed cross-sectionally, are consistent with, though not a direct test of, the idea that initial gains associated with entry into teaching practice are not accompanied by further significant differences among more experienced groups; longitudinal data would be needed to establish whether this reflects an actual plateau in competence development.

6.3. Implications for 30-CFU Programme Design and Institutional Policy

The findings suggest that initial teacher education programmes should not assume a homogeneous baseline of digital competence among participants. The observed heterogeneity indicates the need for differentiated instructional strategies, particularly in cohorts characterised by wide variability in prior experience and self-assessed competence levels.

Rather than being treated as a separate module, digital competence development appears to benefit from integration across disciplinary and pedagogical training components. This aligns with prior work on situated digital competence

development in teacher education (Koehler et al., 2013), which emphasises contextualised and practice-based learning environments.

In addition, the relatively weaker profile observed in Facilitating Learners' Digital Competence suggests that particular attention should be given to the pedagogical dimension of digital competence, especially those aspects related to student agency, digital citizenship, and critical engagement.

6.4. Limitations and Future Research Directions

The reliance on self-report data implies that findings should be interpreted in terms of perceived rather than objectively measured competence. While self-assessments are informative for understanding self-efficacy and behavioural intention, they may not fully correspond to actual performance levels. Furthermore, although the internal consistency of the three adapted subscales was confirmed by Cronbach's alpha, this does not constitute evidence of construct validity. Future research should formally evaluate the factor structure of the adapted instrument.

The cross-sectional design also limits causal interpretation. While experience is associated with differences in self-perception, the direction and mechanisms of this relationship cannot be fully established. Future longitudinal designs would be needed to track changes in digital competence across the qualification pathway and into early career teaching.

Finally, the single-institution sample, although large and geographically diverse, limits generalisability. Comparative studies across different Italian and European teacher education contexts would strengthen external validity.

A further limitation concerns the mapping of composite scores onto the six DigCompEdu proficiency levels. In the absence of official cut-off values for the

SELFIE for Teachers instrument, levels were assigned by partitioning the rescaled 0–100 metric into equal-width bands. This is an operational approximation rather than a validated classification, and the level distribution reported in Table 2 should be interpreted with corresponding caution.

7. Conclusions

This study provides an empirical mapping of digital competence self-perceptions among teachers entering secondary school qualification programmes in Italy under the DPCM of 4 August 2023. Using the DigCompEdu framework and the SELFIE for Teachers instrument, it offers a multi-dimensional baseline across professional, pedagogical, and student-facing dimensions of digital competence. Findings indicate that participants generally self-assess at low-to-moderate levels within the DigCompEdu continuum, with particularly low scores in computational thinking, data literacy, and responsible digital use. Among the three subscales, Facilitating Learners' Digital Competence emerges as the weakest dimension, suggesting a gap between teachers' perceived ability to use digital tools in instruction and their perceived capacity to foster students' digital competence.

A key finding of this study is the identification of a significant difference in self-assessed digital competence between teachers with no classroom experience and those with some classroom experience, with no other significant differences among groups with higher levels of experience. This pattern, observed from a cross-sectional perspective, is consistent with—though does not directly test—certain theoretical conceptions of professional development that distinguish the early stages of a career from later stages (Huberman, 1989); longitudinal studies would be needed to determine whether it indeed reflects a developmental process.

Finally, the study provides a large-scale baseline dataset for teachers enrolled in 30-CFU programmes, offering a reference point for future comparative and longitudinal research within initial teacher education in Italy.

References

Bandura, A. (1997). Self-efficacy: The exercise of control. Freeman.

Carretero, S., Vuorikari, R., & Punie, Y. (2017). DigComp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use (EUR 28558 EN). Publications Office of the European Union. https://doi.org/10.2760/38842.

Decreto del Presidente del Consiglio dei Ministri. (2023, August 4). Disciplina dei percorsi universitari e accademici abilitanti all'insegnamento nella scuola secondaria di primo e secondo grado (DPCM 4 agosto 2023). Gazzetta Ufficiale della Repubblica Italiana, n. 196.

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? Educational Technology Research and Development, 53(4), 25–39. https://doi.org/10.1007/BF02504683.

European Commission. (2021). SELFIE for Teachers. European Commission, Joint Research Centre. https://education.ec.europa.eu/selfie.

Hollander, M., Wolfe, D. A., & Chicken, E. (2013). Nonparametric statistical methods (3rd ed.). Wiley.

Huberman, M. (1989). The professional life cycle of teachers. Teachers College Record, 91(1), 31–57. https://doi.org/10.1177/016146818909100107.

ISTAT. (2023). Cittadini e ICT 2023. Istituto Nazionale di Statistica.

Koehler, M. J., Mishra, P., & Cain, W. (2013). What is technological pedagogical content knowledge (TPACK)? Journal of Education, 193(3), 13–19. https://doi.org/10.1177/002205741319300303.

Kruger, J., & Dunning, D. (1999). Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments. Journal of Personality and Social Psychology, 77(6), 1121–1134. https://doi.org/10.1037/0022-3514.77.6.1121.

Lucas, M., Bem-Haja, P., Siddiq, F., Moreira, A., & Redecker, C. (2021). The relation between in-service teachers' digital competence and personal and contextual factors: What matters most? Computers & Education, 160, 104052. https://doi.org/10.1016/j.compedu.2020.104052.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. Teachers College Record, 108(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x.

Nunnally, J. C. (1978). Psychometric theory (2nd ed.). McGraw-Hill.

Prestridge, S. (2012). The beliefs behind the teacher that influences their ICT practices. Computers & Education, 58(1), 449–458. https://doi.org/10.1016/j.compedu.2011.08.028.

Redecker, C. (2017). European Framework for the Digital Competence of Educators: DigCompEdu (EUR 28775 EN). Publications Office of the European Union. https://doi.org/10.2760/159770.

Rogers, E. M. (2003). Diffusion of innovations (5th ed.). Free Press.

Scherer, R., Siddiq, F., & Tondeur, J. (2019). The technology acceptance model (TAM): A meta-analytic structural equation modeling approach to explaining teachers' adoption of digital technology in education. Computers & Education, 128, 13–35. https://doi.org/10.1016/j.compedu.2018.09.009.

Starkey, L. (2019). A review of research exploring teacher preparation for the digital age. Cambridge Journal of Education, 50(1), 37–56. https://doi.org/10.1080/0305764X.2019.1625867.

The jamovi Project. (2024). Jamovi (Version 2.6) [Computer software]. https://www.jamovi.org.

Tomczak, M., & Tomczak, E. (2014). The need to report effect size estimates revisited. An overview of some recommended measures of effect size. Trends in Sport Sciences, 1(21), 19–25.

Tondeur, J., van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2016). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: A systematic review of qualitative evidence. Educational Technology Research and Development, 65(3), 555–575. https://doi.org/10.1007/s11423-016-9481-2.

Vuorikari, R., Kluzer, S., & Punie, Y. (2022). DigComp 2.2: The Digital Competence Framework for Citizens (EUR 31006 EN). Publications Office of the European Union. https://doi.org/10.2760/115376.