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Original Research

Self-perceived digital competence, tool use and knowledge among preservice early childhood and primary teachers

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Abstract: Everyday familiarity with digital applications is often taken as evidence of pedagogically meaningful teacher digital competence, yet the two are not equivalent. The study's original contribution is a direct, within-sample comparison of how self-reported tool use and knowledge relate to self-perceived digital competence among preservice early childhood and primary education teachers. A cross-sectional, non-experimental survey was completed by 903 students at a public university in southern Spain during 2022–2023, before the widespread incorporation of generative artificial intelligence into teacher education. The instrument combined the validated Digital Competence Questionnaire for Pre-service Teachers (20 items across five dimensions) with an inventory covering use and knowledge of 26 digital tools. Internal consistency of the global self-perceived competence scale was high (α = .93). As expected, self-perceived digital competence was positively associated with global tool knowledge (r = .41, 95% confidence interval (CI) [.35, .46]) and global tool use (r = .33, 95% CI [.27, .39]), both $p < .001$. The knowledge association was reliably but only modestly stronger, Williams' $t(900) = 4.36$, $p < .001$, difference = .076, bootstrap 95% CI [.043, .108]. Among category-specific indices, the association was weakest for social-platform use (r = .24) and strongest for non-social tool knowledge (r = .39). Gender, age, timetable, university entrance grade and socioeconomic status showed no meaningful associations, whereas current academic achievement showed a small positive association (r = .11). The findings indicate that everyday technology use and reported tool knowledge are related but non-interchangeable indicators of self-perceived teacher digital competence and support assessment and training approaches that foreground pedagogical judgement rather than frequency of application use.

Keywords: Digital competence, Initial teacher education, Preservice teachers, Educational technology, Digital tools, Higher education

1. Introduction

Teacher digital competence is increasingly understood as a professional construct that extends beyond operating digital applications. Frameworks such as the European Framework for the Digital Competence of Educators (DigCompEdu) distinguish instrumental proficiency from the capacity to select, adapt, evaluate and use digital technologies for pedagogical, professional and ethical purposes (Redecker, 2017). Recent reviews of preservice teacher education likewise show that basic digital familiarity is often stronger than pedagogical integration, critical judgement and ethical use, indicating that frequent technology use should not be treated as a direct proxy

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for readiness to teach with technology (Zeng et al., 2025; Zhang et al., 2025).

This distinction is especially consequential in early childhood and primary education. Future teachers in these stages work with learners who are developing their first relationships with digital media, so technology use must be developmentally appropriate, accessible, safe and instructionally justified. The central issue for initial teacher education is therefore not simply whether students use digital tools, but how everyday familiarity relates to their perceived capacity to make pedagogically meaningful decisions about technology.

1.1 From everyday technology use to self-perceived teacher digital competence

Research in initial teacher education has repeatedly shown that familiarity with digital resources does not automatically translate into pedagogical integration. Studies of preservice teachers have linked digital competence with technology-integration knowledge, while also showing that training is most valuable when it connects technical operation to instructional design and professional judgement (Çebi et al., 2022; Tondeur et al., 2025). In Spain, self-perception studies similarly emphasise the need to move beyond instrumental mastery toward methodological and pedagogical uses of technology (Marimon-Martí et al., 2023).

Self-perceived digital competence is nevertheless a perception measure rather than a direct demonstration of performance. Self-assessments can provide useful information about confidence and perceived capability, but they may diverge from performance-based evidence (Seifert & Lindmeier, 2024). In the present study, self-perceived competence is therefore interpreted as a distinct outcome in its own right, not as an objective measure of what participants can do in authentic teaching situations. This distinction is particularly important because tool use and tool knowledge were also self-reported, making common-method variance a plausible contributor to the observed associations.

1.2 Distinguishing tool use from tool knowledge

Within this study, tool use refers to the reported extent to which participants used a set of digital applications and platforms, whereas tool knowledge refers to their reported familiarity or knowledge of those same tools. The latter is not an objective knowledge test. The two indicators are expected to overlap, because repeated use normally increases familiarity, but they are not conceptually identical: a student may know about the affordances of a tool without using it frequently, while frequent use of a familiar social platform says little by itself about the ability to select or justify it for teaching. This makes a direct comparison of the two associations with self-perceived teacher digital competence informative even when the indicators are highly correlated.

Spanish and international research has often examined adjacent parts of this problem separately. Studies have described self-perceived teacher digital competence (Marimon-Martí et al., 2023), the use of digital resources in early childhood teacher education (Martínez-Serrano et al., 2021), and preservice teachers' use of general social-networking platforms (Calderón-Garrido & Gil-Fernández, 2023). Recent systematic reviews also identify persistent weaknesses in pedagogical integration despite widespread basic digital familiarity (Alastor et al., 2025; Zeng et al., 2025; Zhang et al., 2025). What is less commonly tested within the same sample is whether reported breadth of tool knowledge and reported tool use relate differently to self-perceived teacher digital competence when both are measured over the same set of applications. The present comparison is intended to refine, rather than overturn, the established distinction between everyday technology engagement and professional digital competence.

1.3 Present study, temporal scope and expectations

The study uses data collected during the 2022–2023 academic year. The 26-tool inventory should therefore be read as a historically situated snapshot of the digital ecosystem immediately before generative artificial intelligence (AI) became a routine consideration in teacher education. AI literacy has since become an important component of teachers' professional knowledge, and recent work has called for updated preparation strategies that address AI, digital identity and technology-specific instructional design (Sperling et al., 2024; Tondeur et al., 2025; Ares-Ferreirós et al., 2026). The contemporary relevance of the present data lies less in the enduring centrality of every named application than in the broader question of whether everyday use and reported tool familiarity can stand in for pedagogically framed self-perceived competence.

The present manuscript also addresses questions that differ from those examined in an earlier publication based on 897 responses from the same data collection (Alastor et al., 2024). That article described overall self-perceived competence and compared degree programme and academic year. It did not analyse the 26-tool inventory or the associations between tool use, tool knowledge and self-perceived competence examined here. The present study therefore focuses on the relation between these constructs and deliberately does not repeat programme- or year-level comparisons.

On theoretical grounds, greater exposure to and familiarity with digital tools should be positively related to self-perceived teacher digital competence, but the cross-sectional design does not allow either indicator to

be interpreted as a cause or component of competence. Moreover, because prior literature does not establish a sufficiently strong basis for predicting whether reported use or reported knowledge should show the stronger association when both are measured over the same tools, their relative magnitude is treated as exploratory.

*H*1. Global tool use and global tool knowledge will each be positively associated with self-perceived digital competence.

RQ1. Does the strength of the association with self-perceived digital competence differ between global tool use and global tool knowledge?

RQ2. Are there significant differences or associations in self-perceived digital competence by gender, age, current academic achievement, university entrance grade, timetable and socioeconomic status?

RQ3. How are social-platform and non-social tool use and knowledge related to the different dimensions of self-perceived digital competence?

Accordingly, the study tests one directional hypothesis and addresses three research questions: it examines whether global use and knowledge are positively associated with self-perceived competence, compares the strength of those two associations, describes selected sociodemographic and academic relationships, and examines category-level associations with the five competence dimensions.

2. Materials and methods

2.1 Design

A quantitative, non-experimental, cross-sectional, ex post facto survey design was used. This design allows variables to be described and associations between them to be analysed, but it does not support causal claims or the estimation of effects derived from the use of digital tools. Reporting follows the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations for cross-sectional observational studies (von Elm et al., 2007).

Table 1. Sample characteristics ($N = 903$)

Variable	Category	*n*	%
Gender	Female	707	78.3
	Male	196	21.7
Degree programme	Primary education	600	66.4
	Early childhood education	303	33.6
Academic year	First	356	39.4
	Second	169	18.7
	Third	201	22.3
	Fourth	177	19.6
Timetable	Morning	477	52.8
	Afternoon	426	47.2
Socioeconomic status	Low	18	2.0
	Lower-middle	177	19.6
	Middle	562	62.2
	Upper-middle	136	15.1
	High	10	1.1

Note. Percentages are computed on the valid total for each variable. No data were missing for any variable in this table.

2.2 Participants and curricular context

The sample comprised 903 students enrolled in the Early Childhood Education and Primary Education

degree programmes at the Faculty of Education of a public university in southern Spain. Age ranged from 18 to 56 years (mean [M] = 20.84, standard deviation [SD] = 3.30). Participants were recruited through intentional non-probability sampling. Data collection was organised classroom by classroom across the four academic years and was not tied to the subject being taught on the day of administration; all students present in participating groups were invited, with enrolment in one of the two degree programmes as the only inclusion criterion. Table 1 shows the distribution of participants.

Part of this dataset has been reported previously. Alastor et al. (2024) analysed 897 responses from the same data collection to describe the overall level of self-perceived digital competence and compare degree programme and academic year. The present dataset includes six additional responses received before the form was closed. The earlier article did not analyse the 26-tool inventory or the associations between tool use, tool knowledge and self-perceived digital competence. To avoid redundant reporting, degree-programme and academic-year comparisons are not repeated here.

The two programmes also differed in their formal curricular exposure to information and communication technologies (ICT) in education. In the curriculum in force during data collection, Primary Education included a first-year, second-semester course worth six credits under the European Credit Transfer and Accumulation System (ECTS), entitled 'Tecnologías de la Comunicación y la Información Aplicadas a la Educación' (Information and Communication Technologies Applied to Education), whereas Early Childhood Education did not include a stand-alone compulsory ICT course; this institutional difference was also noted in the previous publication from this sample (Alastor et al., 2024). Digital technologies could nevertheless be encountered transversally in other subjects and placements. The present study did not conduct a systematic curriculum audit, analyse course documents, or measure each participant's individual exposure to technology-related teaching. These features are therefore provided only to contextualise the setting and cannot be used to explain the observed tool-use or competence patterns.

2.3 Instrument

Data were gathered through a questionnaire administered via Google Forms and supplemented with demographic and academic questions. The opening information described the academic purpose of the study, the approximate completion time, voluntary participation and the anonymous and confidential treatment of responses.

2.3.1 Self-perceived digital competence

Self-perceived digital competence was measured with the Digital Competence Questionnaire for Pre-service Teachers validated by Cabero-Almenara et al. (2020). Its 20 items cover five dimensions: technological literacy (4 items), communication and collaboration (3), information search and processing (4), digital citizenship (3), and creativity and innovation (6). Each item was answered on an 11-point scale from 0 ('I do not know how to do this') to 10 ('I can do this fully'). The instrument has reported evidence of reliability and construct validity; internal consistency in the present sample is reported in Section 3.1. Scores are interpreted throughout as self-perceptions rather than performance measures.

2.3.2 Digital-tool use and knowledge inventory

The tool inventory assessed self-reported use and knowledge of 26 applications and platforms on a 0–4 scale, where 0 indicated no use or knowledge and 4 a high level. The inventory was assembled by the research team before data collection as a pragmatic, breadth-oriented list rather than by adapting a single validated taxonomy or scale. It was intended to cover both high-visibility social platforms and a range of general-purpose and education-oriented tools that were salient in university and teacher-education contexts at the time. This breadth is consistent with research available before or around the time of data collection documenting intensive social-network use among university and preservice-teacher populations (Calderón-Garrido & Gil-Fernández, 2023; Guerra-Santana et al., 2021), the use of digital resources in Early Childhood teacher education (Martínez-Serrano et al., 2021), and preservice-teacher experience with tools such as Kahoot (Mdlalose et al., 2022). Because the original inventory-development process did not include a formal expert panel or item-level source mapping, the instrument should be treated as a historically situated descriptive inventory rather than a validated measure of contemporary tool repertoires. Six unweighted mean indices were calculated: global tool use and global tool knowledge (all 26 items); social-platform use and social-platform knowledge (Instagram, YouTube, Facebook, TikTok, Twitter/X and Twitch); and non-social tool use and non-social tool knowledge (the remaining 20 items). Operationally, the social-platform category comprised services whose primary design centres on user profiles or channels, following/subscription networks, distribution of user-generated content and social interaction; all remaining applications were coded as non-social. This partition is descriptive, not a validated taxonomy. Individual-tool scores were retained and are reported in Section 3.5.

2.4 Procedure and ethical considerations

Data were collected during the second semester of the 2022–2023 academic year. Before each classroom visit, the teaching staff responsible for the participating

group were informed in advance of the study purpose, the anonymous and voluntary nature of participation, and the planned data-collection procedure. This advance notification facilitated classroom access and scheduling but did not constitute institutional ethics review or exemption. A member of the research team then explained the study to students and answered questions. Participation was voluntary, no incentives were offered, course teaching staff did not monitor who responded, responses were not linked to assessment, and non-participation carried no academic consequence. The form itself reiterated the academic purpose of the study and the anonymous and confidential treatment of data. The analysed database contains no names, email addresses or direct personal identifiers. Completion and submission of the questionnaire constituted consent.

2.5 Data preparation and missing data

The dataset was screened for out-of-range values and duplicate submissions; none were identified. All 903 records were retained. Missing data were minimal and confined to two academic variables: current grade point average (4 cases, 0.4%) and university entrance grade (2 cases, 0.2%). No item of the self-perceived digital competence scale or the tool inventory had missing values. Analyses involving these two variables used pairwise deletion, and the effective sample size is reported alongside each corresponding coefficient. Given the negligible proportion of missing values, no imputation was performed and no sensitivity analysis was considered necessary.

2.6 Data analysis

Analyses were conducted in Python 3.10 using pandas (McKinney, 2010) for data management; NumPy (Harris et al., 2020) for array operations and bootstrap resampling; SciPy (Virtanen et al., 2020) for descriptive statistics, Pearson and Spearman correlations, Welch t tests, Kruskal–Wallis tests and probability distributions; and pingouin (Vallat, 2018) for Cronbach's alpha and effect sizes. Welch tests were used for two-group comparisons to avoid assuming equal variances, particularly given the imbalance in the gender groups.

Because the global and category indices share items by construction, they were not entered jointly as predictors. The relative strength of the two central associations—self-perceived digital competence with global use and with global knowledge—was compared using Williams' test for dependent correlations sharing a common variable (Williams, 1959). The statistic was calculated directly from the three sample correlations, and the two-sided p value was obtained from the t distribution with n – 3 degrees of freedom. A percentile bootstrap confidence interval was obtained by resampling participants with replacement 10,000 times and recomputing the difference between the two correlations on each resample; the NumPy random-number generator was initialised with a fixed seed of 0. The significance level was set at $p < .05$. Effect sizes and 95% confidence intervals accompany the principal comparisons. Where the labels "small", "moderate" or "large" are used, they follow the conventional benchmarks of Cohen (1988) as general reference points rather than field-specific thresholds.

*H*1 and RQ1/RQ3 constituted the primary analyses. The six comparisons reported for RQ2 formed a secondary descriptive family of tests; no formal multiplicity correction was applied, so individual p values are interpreted alongside effect sizes and confidence intervals. Given the cross-sectional design and the self-reported nature of the measures, all associations are interpreted as covariation rather than causal effects or objective competence.

3. Results

3.1 Descriptive statistics and reliability

The global self-perceived digital competence scale showed high internal consistency (α = .93) and a mean of 7.27 (*SD* = 1.39) on the 0–10 scale. In substantive terms, participants generally rated themselves toward the upper part of the response scale, although this should not be interpreted as demonstrated performance. Technological literacy (*M* = 7.74) and digital citizenship (*M* = 7.73) had the highest mean self-ratings, whereas creativity and innovation (*M* = 6.75) and communication and collaboration (*M* = 6.93) were lower. Dimension alphas ranged from .62 to .87; the α = .62 for communication and collaboration indicates greater measurement uncertainty for that dimension and warrants caution when comparing its associations with those of the more reliable dimensions. Table 2 presents the full descriptive statistics.

3.2 Global tool use and knowledge in relation to self-perceived digital competence

Pearson correlations were positive for all six use and knowledge indices. Consistent with *H*1, self-perceived digital competence was associated with both global tool use ($r = .33$) and global tool knowledge ($r = .41$). These coefficients indicate meaningful but far from complete overlap: squared correlations correspond to approximately 11% and 16% shared variance, respectively, leaving most variation in self-perceived competence unrelated to either single index. Among the category-specific indices, social-platform use showed the weakest association ($r = .24$) and non-social tool knowledge the strongest ($r = .39$). Spearman coefficients yielded the same overall ordering. Table 3 reports the coefficients and confidence intervals. Figure 1 illustrates the individual-level relationship

between global tool knowledge and self-perceived digital competence.

Table 2. Descriptive statistics and internal consistency by dimension ($N = 903$)

Dimension	*M*	*SD*	Skew.	Kurt.	α
Technological literacy	7.74	1.53	−.88	.78	.76
Communication and collaboration	6.93	1.73	−.43	−.20	.62
Information search and processing	7.49	1.57	−.83	.99	.83
Digital citizenship	7.73	1.63	−.79	.64	.83
Creativity and innovation	6.75	1.81	−.55	.18	.87
Total self-perceived digital competence	7.27	1.39	−.59	.45	.93

Note. M = mean; SD = standard deviation. Response scale ranged from 0 to 10.

Table 3. Pearson correlations between self-perceived digital competence and use or knowledge indices ($N = 903$)

Index	Pearson r	95% CI	Spearman ρ
Global tool use (26 items)	.33	[.27, .39]	.33
Global tool knowledge (26 items)	.41	[.35, .46]	.42
Social-platform use (6 items)	.24	[.18, .30]	.22
Social-platform knowledge (6 items)	.31	[.25, .37]	.30
Non-social tool use (20 items)	.31	[.25, .37]	.33
Non-social tool knowledge (20 items)	.39	[.33, .44]	.42

Note. CI = confidence interval; N = 903. All coefficients were significant at $p < .001$. Global indices contain all 26 items; category indices partition the same items into six social platforms and twenty non-social tools. They are reported descriptively and were not entered together in a joint model.

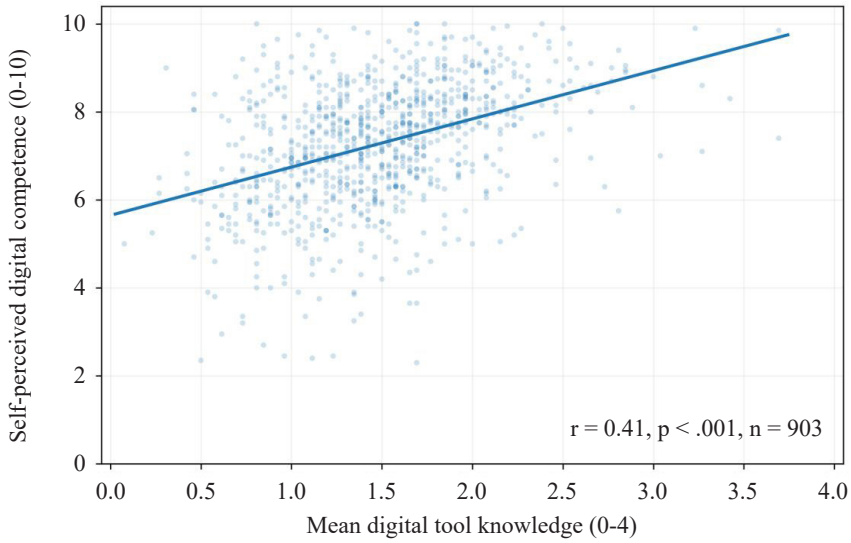

Figure 1. Relationship between mean digital tool knowledge and self-perceived digital competence
Note. Each point represents one participant (N = 903). The line represents the simple linear fit.

RQ1 asked whether the two central associations differed in strength. The correlation of self-perceived digital competence with global tool knowledge (r = .405) was significantly stronger than the correlation with global tool use (r = .329), Williams' $t(900) = 4.36$, $p < .001$, difference = .076, bootstrap 95% CI [.043, .108]. The confidence interval excludes zero, but the absolute difference is small. The substantive interpretation is therefore not that knowledge and use represent sharply different processes; rather, the two highly related indicators are not interchangeable, and reported breadth of knowledge shows a modestly closer association with self-perceived competence than reported frequency of use.

3.3 Sociodemographic and academic variables

RQ2 analyses showed little differentiation in self-perceived digital competence by the examined background variables. There was no statistically significant gender difference, Welch's $t(306.45) = 0.71$, $p = .478$, d = 0.06, 95% CI for the mean difference [−0.14, 0.30]. Women scored $M = 7.29$ ($SD = 1.38$, $n = 707$) and men $M = 7.21$ ($SD = 1.41$, $n = 196$), so the observed difference was both statistically non-significant and practically small.

No significant difference was found by timetable, Welch's $t(868.81) = -0.61$, $p = .540$, d = −0.04. The effect size was negligible.

Age was not significantly associated with self-perceived digital competence, $r = .03$, $p = .331$, $n = 903$. Current academic achievement showed a statistically significant but small positive association, $r = .11$, $p < .001$, 95% CI [.05, .18], $n = 899$, corresponding to only about 1% shared variance. University entrance grade was essentially unrelated to self-perceived competence, $r = -.02$, $p = .535$, $n = 901$, and socioeconomic status showed no significant differences, $H(4) = 4.23$, $p = .376$. Taken together, these analyses suggest that the measured background variables explain little of the between-student variation observed in this sample.

3.4 Self-perceived competence dimensions and tool categories

For RQ3, associations between the four category-specific indices and the five self-perceived competence dimensions were positive but variable in magnitude, ranging from $r = .12$ to $r = .37$. Non-social tool knowledge showed the most consistent associations across dimensions, whereas social-platform use showed the weakest. Within both operational categories, reported knowledge was generally more strongly associated with self-perceived competence than reported use. The pattern is descriptive rather than evidence of independent category effects because all indices were derived from the same inventory and share item content by construction. These correlations are illustrated in Figure 2.

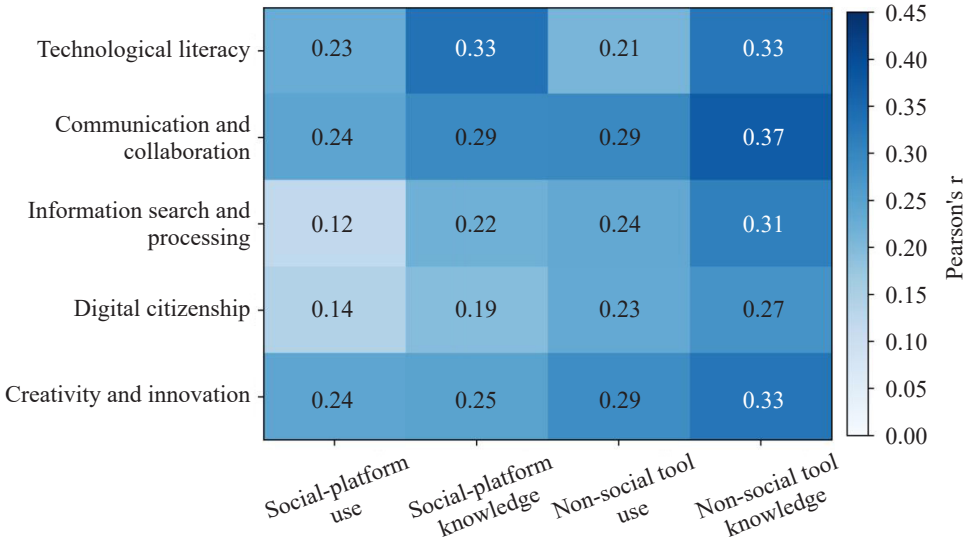

Figure 2. Correlations between tool categories and self-perceived digital competence dimensions
Note. Values are Pearson correlation coefficients (N = 903). All coefficients were significant at p < .001. Social-platform indices contain six tools; non-social indices contain the remaining twenty.

3.5 Use and knowledge of specific tools

The tools with the highest mean reported use were Instagram, Canva, YouTube, TikTok and Kahoot. By contrast, many non-social tools were rarely used: fourteen of the twenty scored below 1.00 on the 0–4 use scale, and nine scored below 0.30. Reported knowledge exceeded reported use for 25 of the 26 tools, with the largest gaps

for Facebook (2.55 vs. 1.48) and Google Classroom (2.89 vs. 2.05). Canva was the only tool whose mean use slightly exceeded mean knowledge (3.27 vs. 3.15). These descriptive patterns show an uneven repertoire centred on a small group of highly familiar platforms; they do not by themselves indicate whether low-use tools were required, taught or pedagogically relevant within participants' programmes. (see Table 4)

Table 4. Use and knowledge of specific digital tools ($N = 903$)

Tool	Use M	Use SD	Knowledge M	Knowledge SD
Instagram	3.38	0.87	3.41	0.81
Canva	3.27	0.86	3.15	0.89
YouTube	3.25	0.87	3.34	0.81
TikTok	3.00	1.27	3.14	1.09
Kahoot	2.72	1.13	3.15	0.96
Twitter/X	2.40	1.44	2.78	1.23
Google Classroom	2.05	1.47	2.89	1.14
Genially	2.01	1.27	2.38	1.18
Google Calendar	1.85	1.49	2.36	1.40
Google Sites	1.53	1.38	1.80	1.37
Facebook	1.48	1.47	2.55	1.29
Twitch	1.37	1.45	1.93	1.47
Padlet	0.87	1.12	1.15	1.28
Scratch	0.53	0.99	0.80	1.20
Powtoon	0.42	0.87	0.61	1.07
Mentimeter	0.35	0.82	0.48	1.00
Socrative	0.35	0.85	0.43	0.94
Evernote	0.24	0.73	0.33	0.85
Chess	0.23	0.72	0.30	0.82
MyHomework	0.23	0.69	0.31	0.80
CmapTools	0.23	0.70	0.27	0.77
Doodle	0.22	0.67	0.29	0.78
Xmind	0.15	0.53	0.19	0.67
Timetoast	0.12	0.50	0.16	0.60
Kodu Game Lab	0.12	0.48	0.14	0.53
Bubbl	0.11	0.45	0.14	0.53

Note. Scale from 0 to 4, ordered by mean use. The label Twitter/X is used to aid current identification of the platform; the questionnaire was administered during the 2022–2023 academic year.

4. Discussion

4.1 What the knowledge–use distinction adds

The central contribution of this study is not that reported tool knowledge is dramatically more important than tool use. The difference between the two correlations with self-perceived digital competence was statistically reliable but small (.076). More importantly, the direct within-sample comparison shows that everyday use and reported knowledge, even when assessed over exactly the same 26 tools and strongly correlated with one another, are not interchangeable indicators of how prepared preservice teachers perceive themselves to be. Global knowledge showed the closer association (r = .41), but both coefficients were moderate and left most variation in self-perceived competence unexplained. This refines rather than contradicts prior work linking digital competence to technology-integration knowledge: technical exposure is relevant, but pedagogically framed competence cannot be reduced to how often applications are used (Çebi et al., 2022; Zeng et al., 2025).

The category-level findings sharpen this point. Social-platform use was the weakest correlate of self-perceived competence (r = .24), despite Instagram, YouTube and TikTok being among the most frequently used tools. In contrast, non-social tool knowledge showed a stronger association (r = .39). Similar Spanish research has documented the centrality of general social-networking sites in preservice teachers' everyday digital lives (Calderón-Garrido & Gil-Fernández, 2023), while studies of teacher education emphasise that instrumental familiarity must be connected to methodological and pedagogical judgement (Marimon-Martí et al., 2023). The present data therefore add a large-sample within-person comparison: extensive everyday platform use should not be read as equivalent to perceived professional digital capability.

This interpretation remains deliberately modest. Use and knowledge were self-reported for the same tools and correlated at r = .84, so part of their association with self-perceived competence may reflect common response tendencies. The study cannot establish that greater tool knowledge produces higher competence, nor that the knowledge index captures objective understanding. Its contribution is measurement-related and educational: when programmes diagnose students' digital preparation, frequency of use and reported knowledge provide overlapping but non-identical information, and neither substitutes for performance-based evidence.

4.2 Institutional and temporal context

The institutional context is important for interpreting the descriptive tool profile. Students were sampled across classroom groups irrespective of the subject being taught during data collection. The Primary Education programme included a dedicated first-year course on ICT applied to education, whereas the Early Childhood Education programme did not include a stand-alone compulsory ICT course (Alastor et al., 2024). However, digital technologies could also appear transversally in other coursework and school placements, and this study did not audit programme documents or measure individual exposure to specific digital-learning opportunities. Consequently, low use of a particular application cannot be interpreted as a curricular deficit: it may reflect local curricular choices, teacher preferences, individual experience, or the changing popularity of tools. This contextual uncertainty is one reason the present manuscript avoids repeating the programme comparisons already reported by Alastor et al. (2024).

The timing of data collection also defines what the inventory can and cannot represent. The 2022–2023 data precede the rapid incorporation of generative AI into education. AI literacy was still only a developing concern in teacher education, whereas current reviews place AI-related practical, epistemic and ethical knowledge among the issues that programmes must now address (Sperling et al., 2024). Updated evidence also shows that strategies for preparing preservice teachers have expanded toward digital identity, instructional design and technology-specific pedagogical approaches (Tondeur et al., 2025). The 26-tool inventory should therefore be interpreted as a pre-generative-AI snapshot rather than a current catalogue of essential tools. Its continuing relevance lies in the more durable finding that familiarity with named applications is an incomplete proxy for pedagogically meaningful self-perceived competence.

4.3 Implications for initial teacher education

Three practical implications follow directly from the observed pattern. First, because common social-platform use was high yet only weakly associated with self-perceived competence, teacher educators should avoid treating students' everyday digital activity as evidence of pedagogical readiness. Diagnostic activities are more informative when they require students to explain why a technology fits a learning goal, learner age, accessibility requirement or assessment purpose. Second, because global tool knowledge was modestly more closely associated with self-perceived competence than use and many non-social tools were little used, training can prioritise comparison, selection and justification of digital affordances rather than simply increasing the number or frequency of applications used. Such pedagogically embedded approaches are consistent with recent evidence on direct instruction, integrated practice and modelling in preservice teacher development (Momdjian et al., 2025; Tondeur et al., 2025).

Third, programme-level action should begin with local evidence rather than a universal list of tools. The present

study did not test the curriculum, so it cannot support a claim that either programme needs a particular new course or application. A more defensible use of these findings is as a diagnostic prompt: programme teams can map where students encounter digital pedagogy across coursework and school placements, compare those opportunities with performance-based evidence, and then target gaps that are demonstrated. This is important in a rapidly changing environment in which fixed application inventories become outdated quickly.

4.4 Limitations and future research

Several limitations qualify the findings. First, the non-probability sample came from a single university, limiting generalisation across institutions and national contexts. Second, the cross-sectional design establishes neither directionality nor change over time. Third, both self-perceived digital competence and tool familiarity were self-reported, so the observed associations may be inflated by common-method variance and cannot be interpreted as relationships with demonstrated performance. Performance-based assessments provide an important complement to self-report; recent work illustrates how such tasks can be designed to measure preservice teachers' ability to work with digital tools in authentic disciplinary contexts (Seifert & Lindmeier, 2024). Fourth, the communication and collaboration dimension had relatively low internal consistency (α = .62). Measurement error of this kind generally attenuates observed associations and makes coefficients less stable, so small differences between correlations involving this dimension and those involving more reliable dimensions should not be overinterpreted.

Fifth, global use and knowledge were based on the same 26 tools, and the global and category indices overlap by construction. The Williams comparison therefore distinguishes closely related self-report indicators rather than independent constructs. Sixth, the inventory itself was pragmatic and historically situated: it was not developed through expert validation, and the social/non-social partition is an operational classification rather than a taxonomy. Seventh, the study did not conduct a systematic curriculum audit or measure individual exposure to educational-technology coursework, so programme features cannot be linked causally to the observed tool profile. Eighth, the secondary sociodemographic analyses were not adjusted for multiplicity. Finally, the 2022–2023 inventory predates widespread generative-AI use and does not capture contemporary AI-supported teaching practices.

Future research should combine self-perception with objective or performance-based tasks, follow students longitudinally across teacher education, sample multiple institutions, and record individual exposure to digital-pedagogy learning opportunities. Updated inventories should be developed through expert review and psychometric evaluation, distinguish enduring functional categories from transient product names, and include the pedagogical and ethical use of generative AI. These designs would test whether the knowledge–use distinction observed here persists when competence is demonstrated rather than self-reported.

5. Conclusions

In this large sample of preservice early childhood and primary teachers, self-perceived digital competence was positively associated with both reported tool use and reported tool knowledge. Knowledge showed the stronger association, but the difference was small; the more defensible conclusion is therefore that use and knowledge are related but non-interchangeable indicators, not that one dominates the other. High everyday use of common social platforms was a particularly weak proxy for perceived professional capability, and the examined sociodemographic and academic variables contributed little additional differentiation.

The study is best understood as a historically situated, pre-generative-AI examination of how tool familiarity relates to self-perceived teacher digital competence. It does not identify a universal list of applications that teacher education programmes should teach, nor does it demonstrate objective competence. Its practical contribution is narrower and more transferable: digital preparation should be diagnosed through pedagogically meaningful judgement and performance as well as through self-report, and programme teams should not infer teaching readiness from frequent everyday technology use alone. Replication with current tool ecosystems, explicit curricular-exposure measures and performance-based assessment is needed to determine how this pattern has changed in the generative-AI era.

Declaration of generative AI use

The authors declare that generative artificial intelligence (AI) tools or AI-assisted technologies were used during the preparation of this manuscript.

AI tools were limited to the following purposes: language improvement and translation. All AI-assisted outputs were critically reviewed, verified, and revised by the authors.

Generative AI tools were not used to replace the authors' scientific judgment, generate unsupported scientific claims, interpret results independently, or assume responsibility for any part of the research. The authors remain fully responsible for the originality, accuracy, integrity, and ethical compliance of the manuscript.

Author contributions

All three authors contributed equally to this work. Conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, writing—original draft preparation, writing—review and editing, visualization, supervision and project administration were shared equally among the three authors. All authors have read and agreed to the submitted version of the manuscript.

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Institutional review board statement

Formal review by an institutional review board or ethics committee was not sought, and no formal institutional ethics exemption was issued. Before data collection, teaching staff responsible for the participating class groups were informed in advance of the study purpose, procedures, voluntary participation and anonymity and of the planned classroom data collection. This advance notification did not constitute ethics committee review or institutional exemption. The study was an anonymous, voluntary and non-interventional survey of adult university students and collected no names, email addresses, direct identifiers, special-category personal data, health or biometric information, or information about identifiable third parties. Participants were informed of the academic purpose of the study, the anonymous and confidential treatment of their responses and their right not to participate without academic consequence. Completion and submission of the questionnaire constituted consent. The research was conducted in accordance with the principles of the Declaration of Helsinki and the applicable data-protection framework.

Informed consent statement

Informed consent was obtained from all participants through the completion and submission of the questionnaire. The questionnaire was administered during class sessions, with a member of the research team present, and its opening text informed participants of the academic purpose of the study, of the approximate completion time and of the anonymous and confidential treatment of their responses. Participation was voluntary and no incentives were offered.

Data availability

The de-identified data supporting the findings of this study are available from the corresponding author upon reasonable request.

Conflict of interest

The authors declare no conflict of interest.

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