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Artificial Intelligence in Spanish Secondary Education: Reported Uses and Pedagogical Practices

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Abstract

Evidence on everyday uses of artificial intelligence (AI) in secondary education remains limited. This cross-sectional study examined teacher and student AI functions reported by 504 preservice teachers during school placements in Spain in 2025–2026. Each questionnaire summarized an entire placement and could cover multiple class groups. Within the categories assessed, instructional planning was the most frequently reported teacher function, while student functions centered on information management and content or task creation. Association analyses were restricted to 243 Year 4 compulsory secondary education reports (Educación Secundaria Obligatoria, ESO), where both AI items included an explicit "none of the above" option. Teacher and student AI functions were strongly associated within placement-stage reports, without establishing use in the same class or session. Teacher AI reporting was associated with digital content creation and publication resources, although the categories could overlap. No individual active methodology remained statistically significant after adjustment for multiple comparisons. The number of teacher AI functions showed a modest positive association with the number of methodologies reported in more than 25% of sessions. These findings describe contemporaneous associations between reported practices. They establish neither temporal order nor causality and do not demonstrate pedagogical transformation or improvements in student autonomy or learning.

Keywords: artificial intelligence in education; secondary education; preservice teachers; reported AI use; classroom pedagogy; digital resources; active methodologies

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1. Introduction

Artificial intelligence (AI), particularly generative artificial intelligence (GenAI), has expanded the tools available to teachers and students. Large language models and conversational systems can generate explanations, summaries, instructional materials, feedback, code, and audiovisual content. These capabilities create opportunities for educational support but also raise questions about accuracy, cognitive dependence, privacy, and human oversight (Kasneci et al., 2023; Tlili et al., 2023). Their growing accessibility has prompted schools to reconsider instructional practices, assessment, teacher preparation, and governance (Mantalia et al., 2026; Miao & Holmes, 2023).

Research on AI in school education encompasses two related but distinct areas: teaching about AI and teaching with AI. Teaching about AI concerns the development of knowledge about AI concepts, systems, and their social implications. Liu and Zhong (2024) review this area within K-12 education. Teaching with AI concerns the use of AI technologies to

support instruction, educational tasks, and learning. Reviews by Alfarwan (2025) and Marzano (2026) examine this second area, which is the focus of the present study. Keeping these strands separate helps distinguish evidence about AI literacy education from evidence about AI-supported teaching practices.

School-level research documents applications across different subjects and educational purposes. Jauhiainen and Garagorry Guerra (2024), for example, investigate the personalization of pupils' learning materials with ChatGPT. At the review level, Alfarwan (2025) identifies a need for evidence on how GenAI is implemented across school contexts. Mantalia et al. (2026) examine pedagogical uses, evaluation, and governance in secondary education across Southern Europe and the Balkans. Together, these studies support further investigation of the functions for which AI is used and the educational contexts in which those uses occur.

Evidence from higher education provides additional perspectives, although its applicability to secondary education requires qualification. Abedin et al. (2026) review responsible GenAI use in university teaching, while Liakopoulos and Liapakis (2026) examine AI and immersive technologies in higher education. Sevryugina et al. (2026) address AI literacy in university chemistry education. These contributions inform questions about instructional design, verification, and responsible engagement. However, they do not establish equivalent outcomes among secondary students. Their relevance to schools depends on adaptation to curricular objectives, learners' developmental needs, teacher supervision, and age-appropriate safeguards (Miao & Holmes, 2023).

A central conceptual distinction is between adopting AI and changing pedagogy. AI may support planning, material preparation, assessment, or task completion without changing how teaching and learning are organized. Ouyang and Jiao (2021) distinguish AI-directed, AI-supported, and AI-empowered learning according to the roles of learners and technology. From a disciplinary perspective, Merchán-Sánchez-Jara et al. (2026) discuss AI in relation to understanding, meaning-making, and creative and cognitive growth in music education. These perspectives motivate attention to the purposes and pedagogical context of AI use. They do not imply that the presence of an AI tool, or a larger number of reported functions, demonstrates pedagogical transformation.

The opportunities associated with GenAI must also be considered alongside its risks. Creely (2026) examines ethical concerns including misinformation, dependency, learner agency, and data privacy. UNESCO's competency frameworks for teachers and students emphasize human-centered approaches, ethical understanding, and informed engagement with AI (Miao & Cukurova, 2024; Miao et al., 2024). European guidance likewise addresses the ethical use of AI and data in teaching and learning (European Commission, 2026). These contributions establish a conceptual and policy context for studying educational uses of AI, although AI competence, learner autonomy, and learning quality are not measured in the present study.

Teacher engagement offers another relevant perspective. Kong et al. (2024) examine factors associated with primary and secondary teachers' intentions to use GenAI, while Yuan et al. (2026) review teacher motivation and engagement in K-12 schools. Such research helps explain willingness to adopt AI and the conditions surrounding its use. However, acceptance, intentions, and accounts of practices encountered during school placements represent different sources of evidence. Reports from preservice teachers can complement this literature by describing activities encountered across subject areas and educational settings. Their interpretation must nevertheless account for respondents' familiarity with AI and their ability to recognize its use.

AI practices also need to be examined alongside other digital resources and pedagogical approaches. In Spain, the Plan de Digitalización y Competencias Digitales del Sistema Educativo provides a policy context for investment in educational technologies and digital competence (Ministerio de Educación y Formación Profesional, 2021). Research on European multilingual education further discusses the relationship between digital environments, pedagogical design, and institutional support (Vavouras et al., 2026). These contexts motivate examining AI and digital resources together. They do not establish that digital practices preceded AI use in the settings included in this study.

Against this background, a specific question concerns how reported teacher and student AI functions relate to digital resources and active methodologies in Spanish secondary education. Examining these dimensions together provides a more detailed account than documenting tool presence alone. It allows assessment of whether teacher AI use is associated with communication, content-creation, and information-management resources, and with a wider range of active methodologies. School-placement questionnaires offer a complementary source of information for identifying such associations across subjects and contexts. They cannot establish nationally representative prevalence or determine whether AI has changed teaching or learning.

The present study analyzes questionnaires completed by 504 preservice secondary teachers during their 2025–2026 school placements in Spain. Each questionnaire summarizes a participant's placement experience and may cover multiple class groups within an educational stage. The study describes reported teacher and student AI functions and examines associations with digital resources and six active methodologies: cooperative learning, gamification, flipped classroom, problem-based learning, project-based learning, and service learning. Teacher and student items contain different sets of functions, so their distributions are interpreted within the categories assessed. Analyses of overall AI presence and its associations with digital resources and methodologies focus on 243 reports concerning Year 4 of compulsory secondary education (Educación Secundaria Obligatoria, ESO), where both AI items include an explicit "none of the above" option.

Figure 1 summarizes the analytical domains considered in the study. It organizes contextual descriptors, reported digital resources, teacher and student AI functions, and active methodologies without proposing causal pathways or a temporal sequence.

Accordingly, the study addresses three research questions:

RQ1. Which teacher and student AI functions are reported within each educational stage, and what patterns emerge within the categories assessed?

RQ2. How is reported teacher AI use associated with reported digital-resource categories in Year 4 ESO?

RQ3. How is reported teacher AI use associated with the presence and number of active methodologies reported in Year 4 ESO?

The study contributes a descriptive and associative account of AI-related practices reported during school placements. Its contribution lies in examining educational functions alongside digital resources and pedagogical practices. The analyses concern contemporaneous associations and do not establish temporal order, causal relationships, or pedagogical transformation.

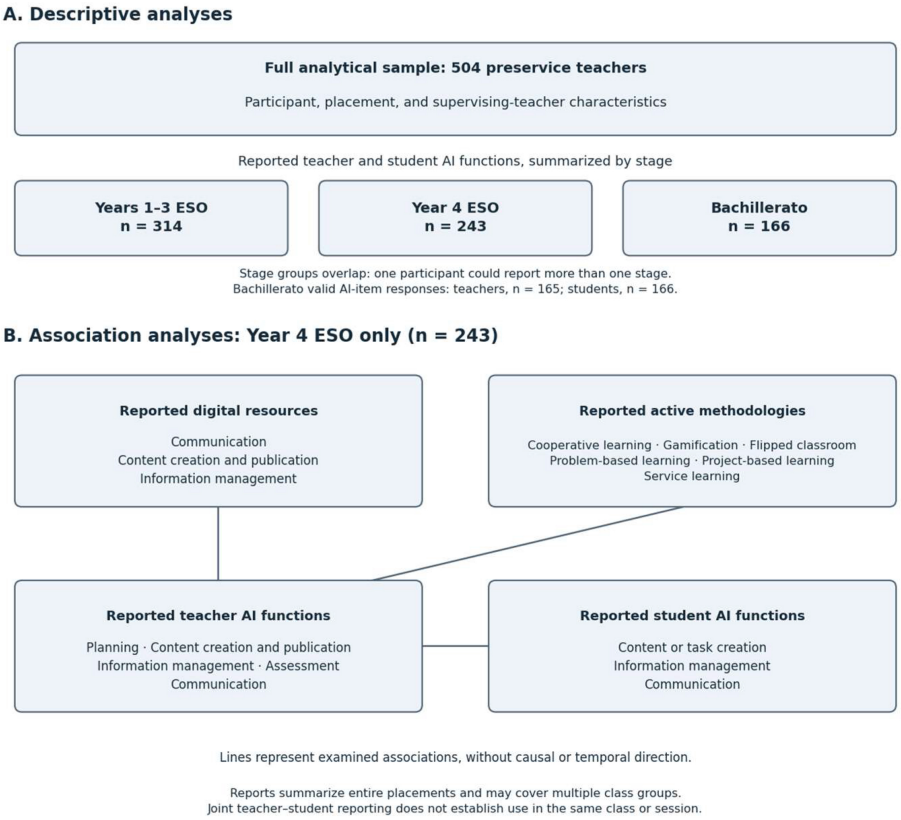

Figure 1. Overview of the descriptive and association analyses. (**A**) Participant and placement characteristics were described for the full analytical sample ($n = 504$), and teacher and student AI functions were summarized separately by educational stage. Stage groups overlap; the Bachillerato teacher AI item had 165 valid responses. (**B**) Associations were examined in the Year 4 ESO subsample ($n = 243$). Lines represent examined associations without implying causality or temporal order. Joint reporting of teacher and student AI functions does not establish use in the same class or session.

2. Materials and Methods

2.1. Research Design

A quantitative, non-experimental, cross-sectional observational study examined reported artificial intelligence (AI) use, digital resources, and pedagogical practices during secondary-teaching placements in the 2025–2026 academic year. Data were obtained from an institutional questionnaire completed by preservice teachers at the end of their placements.

Each questionnaire summarized the respondent's entire placement rather than a single lesson. Within an educational-stage block, responses could combine experiences involving the supervising teacher and students from several class groups. The unit of analysis was therefore the respondent's report for the corresponding stage, rather than an independently identified classroom or teaching session.

Descriptive analyses summarized reported teacher and student AI functions separately by educational stage. Association analyses examined relationships between teacher AI use, student AI use, digital resources, and active methodologies in Year 4 of compulsory secondary education (Educación Secundaria Obligatoria, ESO). These analyses addressed contemporaneous associations and could not establish causality, temporal order, or pedagogical transformation.

2.2. Participants and Educational Context

The study used a non-probability sample of preservice secondary teachers who completed an institutional questionnaire during the 2025–2026 academic year and authorized the use of their responses for research. The source database contained 661 submitted questionnaires, of which 507 included affirmative research consent. Because the questionnaire was intended to be completed once at the end of the placement, repeated submissions were identified using email addresses after removing surrounding whitespace and converting them to lowercase. Two email addresses each had two submissions with consent. The latest submission was retained for each address, removing two additional records. One further report concerned a placement outside Spain and was excluded to maintain the study's geographical scope. The final analytical dataset comprised 504 reports.

The number of individuals invited to complete the questionnaire was not available in the database; consequently, a response rate could not be calculated.

Respondents represented ten teaching-specialization categories: Mathematics ($n = 123$), English as a Foreign Language ($n = 70$), Geography and History ($n = 53$), Biology and Geology ($n = 50$), Technology and Computer Science ($n = 47$), Economics and Business Administration ($n = 45$), Vocational Guidance and Training ($n = 42$), Spanish Language and Literature ($n = 32$), Physical Education ($n = 24$), and General Pedagogical Training without a specific subject specialization ($n = 18$).

The sample included 293 women (58.1%) and 211 men (41.9%). Of the respondents, 58 (11.5%) were under 25 years old, 346 (68.7%) were aged 25–40 years, and 100 (19.8%) were over 40.

Placements were reported across all 17 Spanish autonomous communities. The largest groups were in Andalusia ($n = 114$), the Community of Madrid ($n = 98$), Galicia ($n = 43$), Catalonia ($n = 35$), the Valencian Community ($n = 33$), Castilla-La Mancha ($n = 28$), the Canary Islands ($n = 25$), and the Basque Country ($n = 24$). Regarding school ownership, 255 reports (50.6%) concerned publicly funded private schools, 174 (34.5%) public schools, and 75 (14.9%) private schools. Most placements were reported in urban settings ($n = 455$; 90.3%), compared with rural settings ($n = 49$; 9.7%). Respondents most frequently classified the socioeconomic context as middle ($n = 207$), upper-middle ($n = 152$), or lower-middle ($n = 115$).

Respondents could report experiences from more than one educational stage. The final dataset included 314 reports for Years 1–3 ESO, 243 for Year 4 ESO, 166 for upper secondary education (Bachillerato), and 144 for other educational levels. These groups overlap and their frequencies were not summed to estimate the number of independent reports. Analyses were conducted separately by stage.

The database did not provide identifiers for schools, supervising teachers, or class groups. Their distinct numbers could therefore not be established, and potential clustering of reports within schools or supervising teachers could not be assessed. Separate stage analyses address overlap across stage blocks but do not resolve this potential dependence.

Figure 2 summarizes the selection process and the overlapping stage-specific reporting groups.

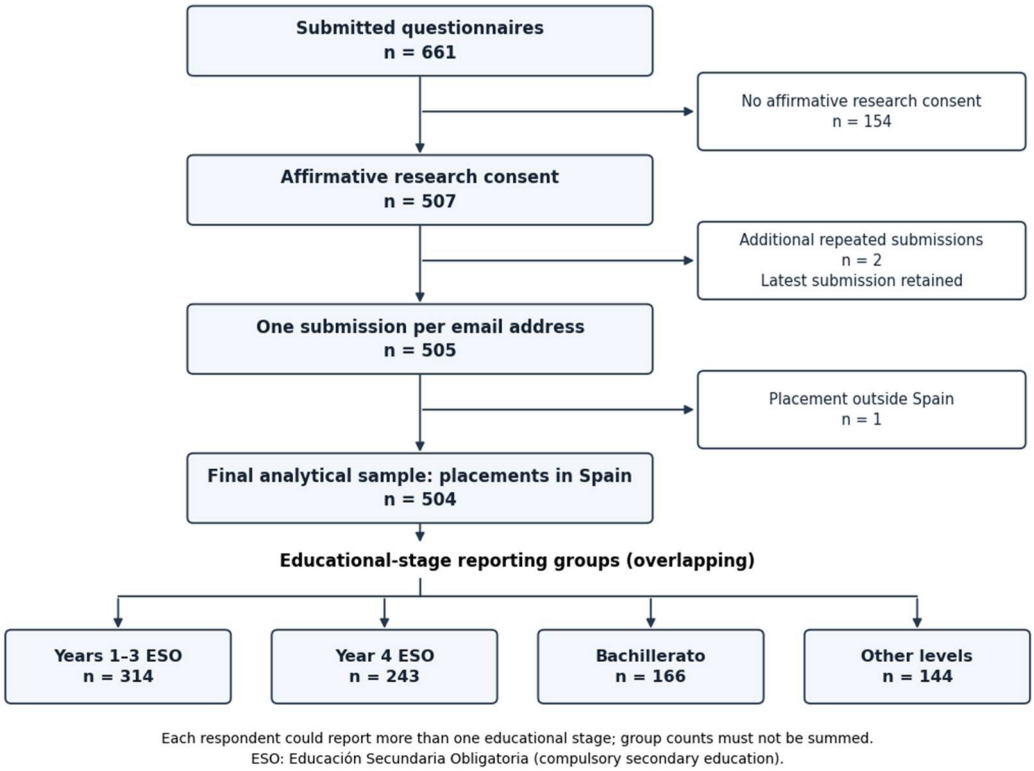

Figure 2. Selection of the revised analytical sample and educational-stage reporting groups. Of 661 submitted questionnaires, 507 included affirmative research consent. Retaining the latest submission per email address removed two additional records, and excluding one placement outside Spain yielded 504 reports. Educational-stage groups overlap because respondents could report experiences from more than one stage; their counts must not be summed.

2.3. Instrument and Study Variables

The study forms part of the Observatory of Educational Innovation's research program at Universidad a Distancia de Madrid (UDIMA). Data were collected using the 2025–2026 version of its institutional questionnaire on educational innovation during school placements. Previous questionnaire-based research within this program examined technological resources reported by preservice secondary teachers following their placements (Jiménez Ortega et al., 2025).

The development and preliminary psychometric evaluation of the Educational Innovation Observatory Questionnaire (COIE) were described by Brenlla et al. (2025). That study examined methodology, organization, resources, and assessment dimensions. It included content evaluation by six experts and psychometric analyses using responses from 764 preservice secondary teachers. The authors reported content-validity evidence and an internal-consistency coefficient of $\alpha = 0.75$ for the innovative-methodologies dimension. These findings provide background evidence for the earlier instrument; they do not establish the validity of the subsequently added AI-function items or of the breadth counts constructed for the present study.

The questionnaire used here covered respondent characteristics, school context, supervising-teacher characteristics, educational stages, teaching methodologies, educational resources, AI functions, learning spaces, assessment, and perceived student learning experiences. It included stage-specific blocks, which respondents completed according to their placement experience. The complete Spanish-language questionnaire, including introductory instructions, item wording, response options, and examples, is provided in Supplementary Materials S1.

The questionnaire provided descriptions and examples of the six active methodologies examined: cooperative learning, gamification, flipped classroom, problem-based learning, project-based learning, and service-learning. Their response categories distinguished non-observation, related practices that did not meet the stated characteristics, occasional implementation (<25% of sessions), implementation in a substantial proportion of sessions (>25% and <75%), and implementation in most sessions (>75%). These categories represented respondents' estimates rather than percentages calculated from session logs.

For the primary analyses, a methodology was coded as present only when either of the two categories indicating implementation in more than 25% of sessions was selected. All other answered categories were coded as zero. Pedagogical breadth was the sum of these six indicators and represented the diversity of reported practices, not teaching quality. A sensitivity analysis used a broader definition that also included occasional implementation while continuing to exclude related practices that did not meet the questionnaire's stated characteristics.

AI items asked respondents to select frequently observed functions. Teacher options covered planning, content creation and publication, information management, assessment, and communication. Student options covered content or task creation, information management, and communication. The items included examples of educational tasks but did not establish operational criteria for distinguishing AI from other digital technologies. Their introductory wording also assumed that AI had transformed teaching and learning; this statement was part of the instrument and was not treated as an empirical finding.

Selected functions were coded as one. An unselected function within an answered item was coded as zero, meaning that the function was not reported. Entirely missing items were treated as missing, and stage blocks that did not apply to a respondent were excluded from that stage's denominator. Selecting "none of the above" without any function was coded as zero reported functions, rather than confirmed absence of actual AI use. Because these were multiple-response items, contradictory selections of "none" and a function were screened. No such contradictions or missing responses occurred in the Year 4 ESO AI-function or digital-resource items. One Bachillerato teacher AI response selected both "none of the above" and a specific AI function. This response was excluded only from analyses of that item; the participant's other responses were retained. The valid denominator was therefore 165 for Bachillerato teacher AI functions and 166 for student AI functions.

Response options were not equivalent across stages. The Years 1–3 ESO teacher and student AI items lacked an explicit "none of the above" option, whereas both Year 4 ESO items included it. In Bachillerato, this option was available for teachers but not students. Function-specific results were therefore reported separately by stage, and overall teacher–student reporting patterns were examined in Year 4 ESO. The available documentation did not explain why five teacher functions and three student functions were offered. These unequal category sets precluded direct comparisons of functional breadth between roles. Results therefore describe reporting patterns within the categories assessed for each role.

Digital-resource indicators covered communication, content creation and publication, and information management. A separate educational-resource item explicitly listed AI tools, including ChatGPT, Gemini, Grok, and Claude. This checkbox indicated selection of the AI-tool category, not identification of the particular system used. The broader digital-resource categories did not exclude AI-enabled tools. Consequently, an exclusively non-AI resource measure could not be reconstructed, and associations involving these indicators may partly reflect overlapping definitions.

AI-function and methodology counts were descriptive indices rather than psychometric scales. Beyond the preliminary evidence reported for the earlier COIE, no separate validation of the AI-function items, study-specific pilot, or inter-rater reliability assessment

was documented for the present study. Table 1 summarizes the operationalization of the selected variables.

Table 1. Study variables and coding rules.

Domain	Variable	Operationalization
Teacher AI functions	Planning; content creation/publication; information management; assessment; communication	Separate indicators: 1 = function selected; 0 = function not selected within an answered item.
Student AI functions	Content/task creation; information management; communication	Separate indicators using the same selection-based coding.
Overall reported AI use	Teacher and student indicators	In Year 4 ESO: 1 = at least one function selected; 0 = "none of the above" selected without a function.
AI breadth	Teacher and student function counts	Sum of selected functions: 0–5 for teachers and 0–3 for students. Counts are not directly comparable across roles.
Explicit AI-tool category	Selection in the educational-resource item	1 = AI-tool category selected; 0 = category not selected within an answered item.
Digital resources	Communication; content creation/publication; information management	Separate selection-based binary indicators. Categories may include AI-enabled tools.
Active methodologies	Six methodology indicators	1 = either response category indicating implementation in >25% of sessions; 0 = any other answered category.
Pedagogical breadth	Methodology count	Sum of the six primary methodology indicators, ranging from 0 to 6.
Sensitivity measure	Broader methodology count	Includes occasional implementation (<25%) and both higher-frequency categories; excludes non-observation and related practices not meeting the stated characteristics.
Contextual descriptors	Specialization, school ownership, setting, socioeconomic context, supervising-teacher age and experience	Categories recorded in the questionnaire; school-context and supervising-teacher descriptors reflect respondents' reports.

Note. Zero indicates a category not reported under the relevant coding rule, rather than independently verified absence. Entirely missing items are not assigned zero. Percentages use valid responses within the applicable educational-stage block.

2.4. Procedure

The questionnaire was administered electronically to preservice teachers at the end of their school placements. Reports retained in the revised analytical sample were submitted between 20 October 2025 and 25 August 2026. The latter date corresponds to the latest consented submission included in the analysis, rather than a specified questionnaire closure date. Submission dates indicate when questionnaires were completed, not the dates of individual teaching sessions.

The 2025–2026 placement requirements specified at least 180 h of attendance at the educational center, encompassing different teaching-related activities. A further 45 h were allocated to final written work and university tutorials. Neither requirement represented a prescribed number of classroom-observation sessions. Placement schedules varied, and

actual observation hours, session counts, and the number of class groups contributing to each report were not recorded.

Respondents received the questionnaire's introductory instructions and the explanations embedded in its items. No additional observer training was provided. They summarized their experience within each applicable educational-stage block. The instrument did not prescribe how to combine observations across class groups or maintain session-level records.

The questionnaire did not distinguish whether reported AI use had been witnessed directly, communicated by the supervising teacher, or inferred from materials or other evidence. This limitation also applied to activities potentially undertaken outside lessons, such as planning, assessment preparation, and family communication. Results are therefore described as AI uses reported by preservice teachers, without assuming that each use was directly observed. Reporting teacher and student AI functions in the same stage block did not establish their occurrence in the same class or session.

The introductory information identified the Observatory of Educational Innovation at Universidad a Distancia de Madrid (UDIMA), explained the research purpose and potential academic dissemination, and described confidentiality and voluntary research participation. Respondents were informed that authorizing or declining research use would not affect their academic assessment and that they could leave the questionnaire before submission.

An explicit research-consent item appeared near the end of the questionnaire. Only submissions with affirmative consent were eligible for analysis. The source database contained respondent email addresses, which were used to identify repeated submissions. These addresses were excluded from the statistical variables and reported outputs. The structured items did not request names or identifiers of supervising teachers, school students, or schools. Free-text responses were not included in the present quantitative analyses. Access to the source data was restricted and password-protected, and findings were reported in aggregate.

Details of the original ethical opinion, the Committee's extension dated 19 October 2026 (reference NR20261019), and the data-handling procedures are provided in the Institutional Review Board Statement.

2.5. Statistical Analysis

Descriptive analyses summarized categorical variables using frequencies and percentages. AI functions were examined separately by role and educational stage, using valid responses within each applicable block. Percentages from multiple-response items were not expected to sum to 100%. Counts of AI functions and active methodologies were summarized using their frequency distributions, medians, and interquartile ranges.

Association analyses used the Year 4 ESO reporting block ($n = 243$). Teacher AI reporting was compared with student AI reporting, the three digital-resource indicators, any reported digital resource, and the six primary methodology indicators. A separate contingency table compared teacher AI-function reporting with selection of the explicit AI-tool category.

Pearson's chi-square test was used when all expected cell counts were at least five. Otherwise, a two-sided Fisher's exact test was used. Pearson tests were calculated without Yates's continuity correction. Cramér's V was derived from the uncorrected Pearson statistic. Odds ratios and 95% confidence intervals were calculated for binary comparisons using the log-Wald method, with standard error $\sqrt{(1/a + 1/b + 1/c + 1/d)}$ for the four cell counts. No cell-count correction was required because the analyzed tables contained no zero cells. Cell counts and group denominators were retained for reporting.

The association between teacher AI breadth and pedagogical breadth was examined using Spearman's rank correlation. Its 95% confidence interval was estimated us-

ing 10,000 report-level bootstrap resamples and the percentile method, with random seed 20261001. Pedagogical breadth was compared between reports with and without a selected teacher AI function using a two-sided Mann–Whitney U test with an asymptotic, tie-adjusted calculation and continuity correction. The corresponding effect size was the rank-biserial correlation, oriented so that positive values indicated greater breadth among reports with teacher AI functions.

An exploratory adjusted analysis used ordinary least squares regression with pedagogical breadth as the outcome, teacher AI breadth as the main predictor, and HC3 heteroskedasticity-robust standard errors. Adjustment included subject area, school ownership, and elapsed questionnaire-submission time in months. Subject specializations were grouped into STEM (Mathematics, Biology and Geology, and Technology and Computer Science), languages (English and Spanish Language and Literature), Geography and History, Economics and Vocational Guidance, and Physical Education. This grouping limited model complexity and avoided a separate category containing a single report. The model estimated an adjusted association rather than a causal effect.

Sensitivity analyses examined the breadth association using the broader methodology definition described in Section 2.3. Observation duration, observer familiarity, and school or supervising-teacher identifiers were unavailable and could not be controlled. Submission time was a proxy for collection timing, not observation duration. Stage blocks were analyzed separately, but this did not address potential dependence between reports from the same school or supervising teacher. Inferential calculations and report-level bootstrap intervals therefore relied on an independence assumption that could not be fully verified.

The breadth and adjusted analyses were treated as exploratory. Tests were two-sided, with $p < 0.05$ as the nominal significance threshold. Benjamini–Hochberg adjustment was applied separately to the three resource-specific comparisons and the six methodology-specific comparisons. Adjusted values are reported as q values and were calculated from unrounded p values. Analyses were implemented in Python 3.13.18 using pandas 2.2.3, NumPy 2.4.6, and SciPy 1.16.3.

The analysis code and variable codebook are provided in Supplementary Materials S2 and S3, respectively. They document sample selection, item coding, statistical analyses, and figure generation.

3. Results

3.1. Sample and Educational Contexts

The revised analytical sample comprised 504 reports from preservice teachers undertaking placements in Spain. Educational-stage groups overlapped: 314 respondents reported experiences in Years 1–3 ESO, 243 in Year 4 ESO, 166 in Bachillerato, and 144 in other educational levels. Stage-specific analyses were conducted separately.

Joint teacher–student AI reporting and associations with digital resources and active methodologies were examined in Year 4 ESO, where both role-specific AI items included "none of the above." This response indicated that no listed function was reported, rather than independently verified absence of AI use. Comparisons across the three secondary-stage blocks focused on individual functions and were interpreted descriptively because response options differed.

3.2. Reported AI Functions Among Teachers and Students

Instructional planning was the most frequently selected teacher AI function across the three educational-stage blocks, followed by content creation and publication (Table 2). Planning was reported in 48.1% of Years 1–3 ESO reports, 40.3% of Year 4 ESO reports, and 38.8% of Bachillerato reports.

Table 2. Reported AI functions by role and educational stage.

AI Function	Years 1–3 ESO (n = 314)	Year 4 ESO (n = 243)	Upper Secondary (n = 166)
Teacher functions	**n = 314**	**n = 243**	**n = 165**
Instructional planning	151 (48.1%)	98 (40.3%)	64 (38.8%)
Content creation/publication	121 (38.5%)	85 (35.0%)	57 (34.5%)
Information management	86 (27.4%)	76 (31.3%)	56 (33.9%)
Assessment	95 (30.3%)	64 (26.3%)	46 (27.9%)
Communication	80 (25.5%)	51 (21.0%)	43 (26.1%)
Student functions	**n = 314**	**n = 243**	**n = 166**
Content/task creation	174 (55.4%)	118 (48.6%)	93 (56.0%)
Information management	189 (60.2%)	127 (52.3%)	107 (64.5%)
Communication	53 (16.9%)	38 (15.6%)	43 (25.9%)

Note. Values are n (%), calculated using the stage-specific denominators shown in the headings. Items allowed multiple selections, so percentages do not sum to 100%. Stage groups overlap. Differences in available response options preclude interpreting these percentages as directly comparable estimates of overall AI use. Bold text identifies the teacher and student section headings and their corresponding valid sample sizes.

Among the three student functions measured, information management was most frequently selected, followed by content or task creation. Communication was less frequently reported. These patterns describe the categories available in the questionnaire; the five teacher categories and three student categories do not support a direct comparison of functional breadth between roles.

In Year 4 ESO, at least one teacher AI function was reported in 192 of 243 reports (79.0%); 51 (21.0%) selected none of the listed functions. At least one student AI function was reported in 190 reports (78.2%), while 53 (21.8%) selected none. Figure 3 presents the function-specific distributions.

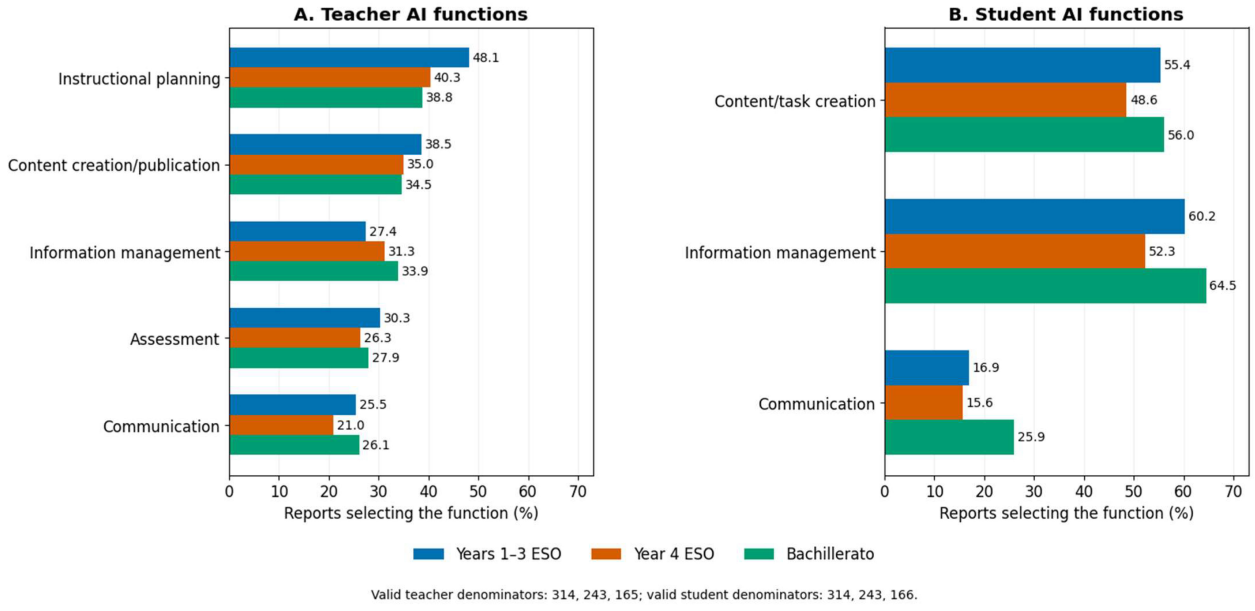

Figure 3. Reported AI functions among teachers (**A**) and students (**B**) by educational stage. Percentages use the role- and stage-specific valid denominators shown below the figure. Multiple functions could be selected. Stage groups overlap, and teacher and student function counts are not directly comparable.

3.3. Joint Reporting of Teacher and Student AI Functions

Of the 243 Year 4 ESO reports, 173 (71.2%) included AI functions for both teachers and students. Nineteen reports (7.8%) included teacher functions only, 17 (7.0%) student functions only, and 34 (14.0%) neither.

Teacher and student AI-function reporting were strongly associated, $\chi^2(1) = 76.16$, $p < 0.001$, Cramér's V = 0.560, OR = 18.21, 95% CI [8.60, 38.57]. These results concern joint reporting within the same placement and educational-stage block, not necessarily AI use in the same class or session. Figure 4 displays the four cell counts and their percentages.

3.4. Reported AI Functions and Digital Resources

In Year 4 ESO, digital communication resources were reported in 182 of 243 reports (74.9%), content-creation and publication resources in 150 (61.7%), and information-management resources in 43 (17.7%). Fifteen reports (6.2%) selected none of these categories.

Teacher AI-function reporting was associated with digital content-creation and publication resources, $\chi^2(1) = 11.54$, $p < 0.001$, q = 0.002, OR = 2.93, 95% CI [1.55, 5.51]. The information-management association did not remain significant after adjustment ($p = 0.038$, q = 0.057), and communication resources were not significantly associated with teacher AI reporting ($p = 0.127$, q = 0.127).

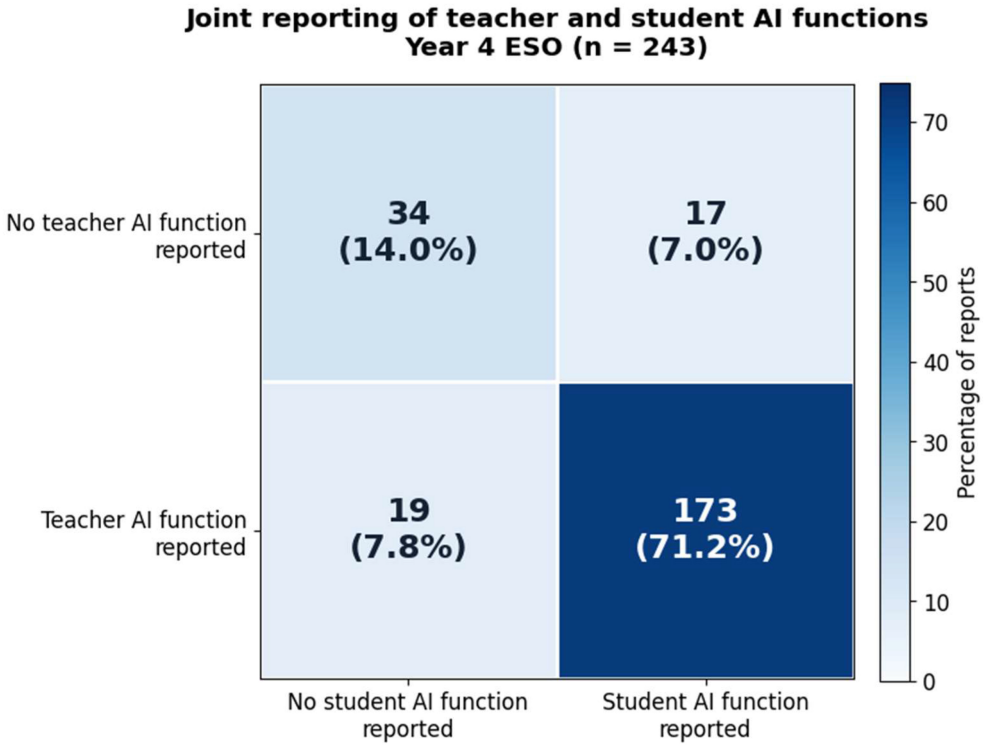

Figure 4. Joint reporting of teacher and student AI functions in Year 4 ESO ($n = 243$). Cells show counts and percentages of all reports. Joint reporting within a placement and stage block does not establish use in the same class or session.

The comparison of any digital-resource category with none included an expected cell count of 3.15 and was therefore evaluated using Fisher's exact test. The association remained significant (two-sided $p < 0.001$), with OR = 12.93, 95% CI [3.92, 42.66]. The wide interval reflects the small group selecting no digital-resource category.

The separate educational-resource item's explicit AI-tool category was selected in 68 reports (28.0%). Of these, 64 also included a teacher AI function and four did not. Among the 175 reports not selecting the AI-tool category, 128 included a teacher AI function

and 47 did not. The association between these indicators was significant, $\chi^2(1) = 12.99$, $p < 0.001$, OR = 5.88, 95% CI [2.03, 17.03].

Nevertheless, the indicators were not interchangeable: 128 reports attributed at least one teacher function to AI without selecting the explicit AI-tool category. The questionnaire did not establish which systems supported those functions or explain the discrepancy. Furthermore, the broader digital-resource categories could include AI-enabled tools, so their associations with reported AI functions may partly reflect overlapping definitions. Table 3 presents the contingency counts and statistical results.

Table 3. Associations between teacher AI use and the digital classroom environment in Year 4 ESO.

Digital Indicator	Selected/Not Selected: Teacher AI Function Reported ($n = 192$)	Selected/Not Selected: No Teacher AI Function Reported ($n = 51$)	Test	*p*	q	V
Content creation/publication	129/63	21/30	$\chi^2 = 11.54$	<0.001	0.002	0.218
Information management	39/153	4/47	$\chi^2 = 4.30$	0.038	0.057	0.133
Communication	148/44	34/17	$\chi^2 = 2.33$	0.127	0.127	0.098
Any digital-resource category	188/4	40/11	Fisher's exact	<0.001	—	0.330
Explicit AI-tool category	64/128	4/47	$\chi^2 = 12.99$	<0.001	—	0.231

Note. Each pair gives the selected and not-selected cell counts within the corresponding teacher-AI-reporting group. Pearson tests have one degree of freedom and use no continuity correction. Fisher's test is two-sided. V denotes Cramér's V calculated from the uncorrected Pearson statistic. OR confidence intervals use the log-Wald method without cell-count corrections. Benjamini–Hochberg q-values were calculated from unrounded *p*-values for the three resource-specific comparisons; the aggregate and explicit AI-tool contrasts were analyzed separately.

3.5. Reported AI Functions and Active Methodologies

The primary criterion included only responses describing implementation in "a substantial number of sessions (>25% and <75%)" or "most sessions (>75%)." Occasional implementation (<25%), related activities not meeting the defining characteristics of the methodology, and non-observation were coded as not meeting the criterion. The same mapping was applied to all six methodologies across educational-stage blocks.

Using this category mapping, as implemented in Supplementary Materials S2, cooperative learning was the most frequently reported methodology in each secondary-stage block: 113 of 314 Years 1–3 ESO reports (36.0%), 79 of 243 Year 4 ESO reports (32.5%), and 37 of 166 Bachillerato reports (22.3%). In Year 4 ESO, the corresponding counts for project-based learning, problem-based learning, gamification, flipped classroom, and service-learning were 55 (22.6%), 50 (20.6%), 35 (14.4%), 30 (12.3%), and 8 (3.3%), respectively.

All six methodologies were descriptively more frequent among Year 4 ESO reports selecting at least one teacher AI function. Project-based learning and flipped classroom showed unadjusted associations with teacher AI-function reporting, but none of the six comparisons remained statistically significant after Benjamini–Hochberg adjustment. Project-based learning had the lowest adjusted value (q = 0.083).

Table 4 presents the contingency counts and methodology-specific comparisons. Figure 5 displays the group percentages. The analysis code in Supplementary Materials S2 applies the category mapping consistently across stages and reproduces the methodology indicators used in Table 4.

Table 4. Associations between reported teacher AI functions and active methodologies in Year 4 ESO.

Methodology	Criterion Met/Not Met: Teacher AI Function Reported (n = 192)	Criterion Met/Not Met: No Teacher AI Function Reported (n = 51)	Test	p	q	V	OR [95% CI]
Cooperative learning	67/125	12/39	$\chi^2 = 2.37$	0.123	0.247	0.099	1.74 [0.85, 3.55]
Gamification	30/162	5/46	$\chi^2 = 1.11$	0.293	0.351	0.068	1.70 [0.63, 4.64]
Flipped classroom	28/164	2/49	$\chi^2 = 4.23$	0.040	0.119	0.132	4.18 [0.96, 18.19]
Problem-based learning	43/149	7/44	$\chi^2 = 1.85$	0.173	0.260	0.087	1.81 [0.76, 4.32]
Project-based learning	50/142	5/46	$\chi^2 = 6.07$	0.014	0.083	0.158	3.24 [1.22, 8.61]
Service learning	7/185	1/50	Fisher's exact	1.000	1.000	0.038	1.89 [0.23, 15.74]

Note. Criterion met comprises the response categories "a substantial number of sessions (>25% and <75%)" and "most sessions (>75%)." Criterion not met comprises occasional implementation (<25%), related activities not meeting the methodology's defining characteristics, and non-observation. Counts indicate criterion met/criterion not met within each teacher AI-function reporting group. Pearson tests have one degree of freedom and use no continuity correction; Fisher's exact test is two-sided. Benjamini–Hochberg adjustment used unrounded p values across all six comparisons. Cramér's V and odds-ratio confidence intervals were calculated as described in Table 3; log-Wald intervals should be interpreted cautiously for sparse tables.

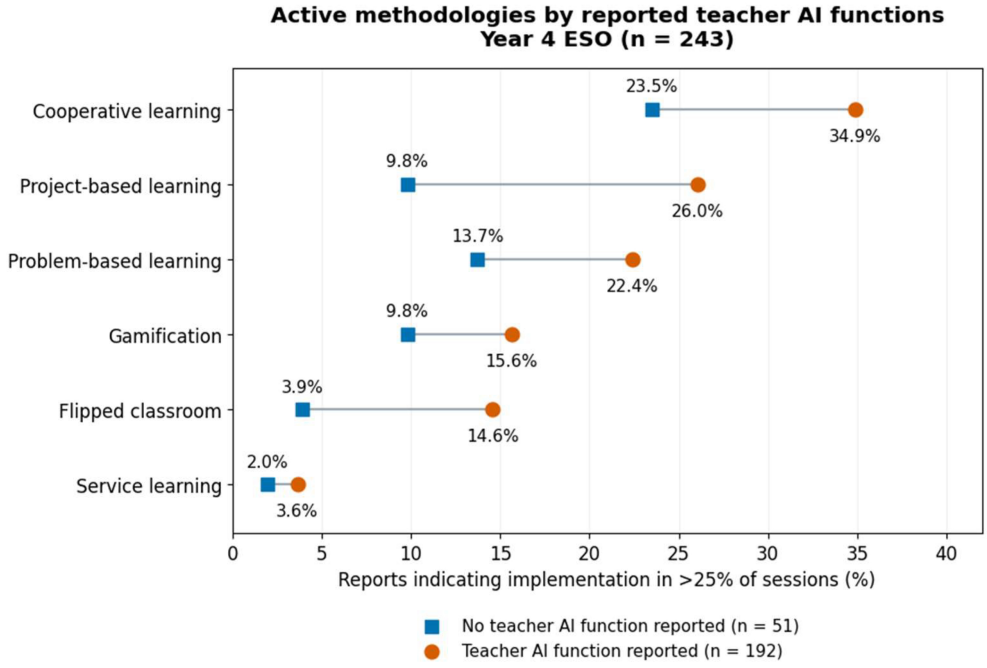

Figure 5. Active methodologies reported as implemented in more than 25% of sessions, according to teacher AI-function reporting in Year 4 ESO. Percentages use the group denominators shown in the legend. Connecting lines facilitate comparison and do not indicate temporal change. None of the six comparisons remained significant after Benjamini–Hochberg adjustment.

3.6. Breadth of Reported Teacher AI Functions and Active Methodologies

Exploratory analyses examined the association between the number of reported teacher AI functions and the number of active methodologies reported in more than 25% of sessions. Both counts were available for all 243 Year 4 ESO reports. Teacher AI breadth ranged from

0 to 5, with a median of 1 (Q1–Q3: 1–2). Pedagogical breadth ranged from 0 to 6, with a median of 0 (Q1–Q3: 0–2). Table 5 presents their frequency distributions.

Table 5. Distributions of teacher AI-function breadth and active-methodology breadth in Year 4 ESO ($n = 243$).

Number of Functions or Methodologies	Teacher AI Functions, *n* (%)	Active Methodologies, *n* (%)
0	51 (21.0)	123 (50.6)
1	90 (37.0)	43 (17.7)
2	53 (21.8)	38 (15.6)
3	24 (9.9)	26 (10.7)
4	19 (7.8)	7 (2.9)
5	6 (2.5)	4 (1.6)
6	Not applicable	2 (0.8)

Note. Teacher AI breadth counts selected functions from five available categories. Active-methodology breadth counts the six methodologies reported in more than 25% of sessions. These indices represent the diversity of reported functions and practices, rather than teaching quality. Percentages may not sum to 100% because of rounding.

In 123 reports (50.6%), none of the six methodologies met the primary frequency criterion. A zero count therefore indicates that no listed methodology was reported above the threshold, rather than the absence of all active pedagogical practices.

Teacher AI breadth showed a modest positive association with pedagogical breadth (Spearman's $\rho = 0.224$, 95% bootstrap CI [0.102, 0.341], $p < 0.001$). Reports with at least one teacher AI function ($n = 192$) had a median pedagogical breadth of 1 (Q1–Q3: 0–2), compared with 0 (Q1–Q3: 0–1) among reports selecting no listed teacher AI function ($n = 51$). The Mann–Whitney comparison yielded $U = 6102$, $p = 0.004$, with a rank-biserial correlation of 0.246.

In the exploratory regression adjusted for grouped subject area, school ownership, and questionnaire-submission time, the coefficient for teacher AI breadth was positive but modest and imprecisely estimated ($B = 0.161$, 95% CI [0.010, 0.312], $p = 0.036$; HC3 robust standard errors). It represents an estimated difference of approximately 0.16 reported methodologies per additional reported teacher AI function, conditional on the included covariates. The confidence interval extends from a value close to zero to approximately 0.31 methodologies.

Linear regression was used as an exploratory summary of additive differences in the methodology count. However, the outcome was bounded between 0 and 6 and concentrated at zero, so the model should be interpreted as an approximation rather than a model specifically designed for count data. HC3 standard errors address heteroskedasticity but do not resolve possible dependence between reports or confounding by unmeasured observation duration and observer familiarity. The adjusted result therefore provides tentative evidence of an association and requires confirmation in studies with more detailed observation and clustering information.

The sensitivity analysis also counted methodologies reported as occasionally implemented, while excluding related practices that did not meet the questionnaire's stated characteristics. The association remained similar (Spearman's $\rho = 0.229$, $p < 0.001$), suggesting that the unadjusted association was not confined to the primary frequency threshold. These analyses describe associations between reported counts and do not establish causal effects or improvements in teaching quality.

4. Discussion

This study examined AI functions reported by preservice teachers during school placements in Spanish secondary education. The findings describe differences between teacher and student functions, joint reporting of AI use within placement-stage blocks, and associations between teacher AI use, digital resources, and active methodologies. These results concern contemporaneous patterns of reported practice. They do not establish when AI use began or whether it changed teaching and learning.

4.1. Different Roles, Different Reported AI Functions

Across educational stages, instructional planning and content creation were frequently reported teacher AI functions. Student reports were concentrated in information management and content or task creation. These patterns describe the categories measured by the questionnaire. Because teachers had five response categories and students had three, they do not establish that teacher use was intrinsically broader or more diverse.

The findings are compatible with literature distinguishing professional support from learning-related applications of GenAI (Kasneci et al., 2023; Tlili et al., 2023). However, the questionnaire did not establish how particular functions were implemented. Reporting content creation, for example, does not reveal whether AI generated a complete product, supported revision, or provided material for critical evaluation.

Evidence from secondary English education illustrates why these distinctions matter. Riser (2025) examines GenAI use in relation to classroom practices, student authorship, and academic integrity. Such research provides a relevant secondary-school context for interpreting the reported functions, but the present study did not measure these processes or their consequences. Questions concerning verification, learner agency, and self-regulation therefore remain directions for further investigation, informed by guidance such as Miao and Holmes (2023).

4.2. Joint Reporting of Teacher and Student AI Use

In Year 4 of Educación Secundaria Obligatoria (ESO; compulsory secondary education), teacher and student AI functions were jointly reported in 173 of 243 reports (71.2%). Their association was strong (Cramér's V = 0.560; OR = 18.21, 95% CI [8.60, 38.57]).

The unit of reporting is essential to interpreting this finding. Each participant completed the questionnaire once after the placement and could report experiences involving several student groups. Joint reporting therefore indicates that teacher and student AI functions were reported within the same placement and educational-stage block. It does not establish their occurrence in the same class, activity, or session.

Shared access, institutional expectations, or respondents' familiarity with AI could contribute to this association. Teacher and student practices might also influence one another. These explanations were not tested, and the cross-sectional design cannot distinguish among them.

The ecological perspective proposed by Merchán-Sánchez-Jara et al. (2026) offers a conceptual lens for considering relationships among technologies, participants, and educational activities. Its contribution is theoretical and situated in music education; it should not be treated as empirical confirmation of the mechanisms underlying the present association.

4.3. Associations with Reported Digital Resources

Teacher AI use was associated with reported digital content creation and publication resources after adjustment for multiple comparisons. The association with information management resources did not remain statistically significant after adjustment, while communication resources showed no statistically significant association.

These findings indicate that the measured digital categories had different relationships with reported teacher AI functions. However, the digital-resource items did not exclude AI-enabled tools. The association with content creation and publication may therefore partly reflect overlapping measurement definitions, rather than an association between independent technological domains. The available responses did not permit a reliable separation of exclusively non-AI resources, so the study cannot establish whether the association would persist for resources explicitly excluding AI.

The comparison between any reported digital resource and none was also statistically significant using Fisher's exact test. Its interpretation requires caution because only 15 reports selected none of the analyzed digital categories, producing an imbalanced comparison and a wide odds-ratio confidence interval. Neither analysis establishes that digital practices preceded AI use. European policy-oriented research provides a broader context for discussing technology, pedagogy, and inclusion (Vavouras et al., 2026), but cannot resolve this temporal question.

A further measurement issue concerns the difference between the explicit AI-tool category and teacher AI functions. In Year 4 ESO, 68 reports (28.0%) selected the tool category containing examples such as ChatGPT, Gemini, Grok, and Claude, whereas 192 (79.0%) reported at least one teacher AI function. Of the latter, 128 did not select that tool category.

The items captured different aspects of reported practice and should not be treated as interchangeable measures. Differences in item interpretation, recognition of AI, or the contexts represented may contribute to the discrepancy. Embedded AI is another possible explanation, but it was not established by the questionnaire. Future instruments should connect each reported function to a specific application and identify whether the evidence came from direct observation, information supplied by the supervising teacher, or inference.

4.4. AI Functions and the Diversity of Active Methodologies

All six active methodologies were descriptively more frequent among reports containing teacher AI functions. None of the individual associations remained statistically significant after adjustment for multiple comparisons. The findings therefore do not provide sufficient evidence of an association with any particular methodology under the specified testing procedure.

The aggregate analysis identified a modest positive association between the number of teacher AI functions and the number of active methodologies reported above the primary implementation threshold (Spearman's $\rho = 0.224$, 95% bootstrap CI [0.102, 0.341]). Reports containing teacher AI functions also had higher methodology counts than those selecting none of the listed functions, with a limited effect size (rank-biserial correlation = 0.246). In 50.6% of reports, no listed methodology met the primary threshold; this does not establish the absence of occasional implementation or other active pedagogical practices.

The exploratory linear model adjusted for grouped subject area, school ownership, and questionnaire-submission time yielded a small positive coefficient with considerable uncertainty ($B = 0.161$, 95% CI [0.010, 0.312], $p = 0.036$). The interval includes values close to zero, warranting a cautious interpretation of the magnitude of the association. Given the bounded count outcome and its concentration at zero, the linear model provides an approximate summary of additive differences. HC3 robust standard errors do not address possible clustering or unmeasured confounding.

The sensitivity analysis including occasional implementation produced a similar correlation ($\rho = 0.229$), suggesting that the unadjusted association was not confined to the primary threshold. However, longer observation periods or greater familiarity with a placement could increase both counts. Neither factor was measured, and dependence within

schools or supervising teachers could not be modeled. These findings remain exploratory and require confirmation. The counts represent the diversity of reported functions and practices, rather than teaching quality, implementation depth, or educational effectiveness.

4.5. AI Use and Pedagogical Transformation

The presence of AI functions does not establish pedagogical transformation. The questionnaire did not measure changes in task design, classroom interaction, student autonomy, cognitive engagement, or learning outcomes. Consequently, the findings cannot determine whether AI supported existing routines, accompanied changes in teaching, or altered students' learning experiences.

The distinction between adoption and transformation is therefore a conceptual boundary for interpreting this study. Future research should examine changes in instructional processes and outcomes directly, rather than infer them from the presence or number of reported AI functions.

4.6. Implications for Teacher Education and AI Literacy

The contribution of this study to teacher education is descriptive: AI-related functions were reported across several dimensions of professional practice and were associated with selected digital resources and a more diverse repertoire of methodologies. The study did not evaluate training interventions or establish which preparation strategies are effective.

Recommendations for teacher preparation instead draw on the wider literature. Research addressing elementary and secondary teachers' AI literacy considers tool use, confidence, and professional-development needs (Traga Philippakos & Rocconi, 2025). Bilbao-Eraña and Arroyo-Sagasta (2025) reported improvements in preservice teachers' awareness and attitudes following an AI-literacy intervention; the increase in trust was not statistically significant. UNESCO's framework likewise connects AI knowledge with ethics, pedagogy, professional learning, and a human-centered approach (Miao & Cukurova, 2024).

Evidence from other educational settings requires explicit contextualization. Al-Abdullatif (2024) examines AI acceptance in higher education, while Saimon et al. (2024) investigate structured learning design with teachers undertaking master's-level study in East Africa. These studies inform questions about professional knowledge and preparation, but their findings cannot be transferred directly to Spanish secondary classrooms.

Teaching about AI should also be distinguished from teaching with AI. The former concerns understanding AI systems, limitations, and ethical implications; the latter concerns their use in educational activities. The present questionnaire primarily addressed reported uses of AI and did not assess AI literacy. Recommendations concerning verification, authorship, privacy, and preservation of learner agency are supported by the literature and guidance (Miao & Holmes, 2023), rather than demonstrated by the present results.

4.7. Limitations and Future Research

The data represent retrospective reports by preservice teachers, rather than systematic observations conducted by the research team. Participants received the questionnaire instructions but no additional observer training. The instrument did not distinguish direct observation from information supplied by supervising teachers or inference. Its introductory wording about AI transforming education may also have influenced respondents' interpretations. Unreported functions should therefore not be equated with verified non-use.

Reports covered entire placements and could combine experiences from several groups. Although the placement required at least 180 h at the school, these hours included different professional activities and cannot be interpreted as observation time. Session counts and actual observation duration were unavailable. Without school and supervising-teacher

identifiers, potential clustering could not be assessed; statistical precision may consequently be overstated.

Educational-stage groups overlapped and were analyzed separately. Response options also differed across stages and roles, limiting direct comparisons. One contradictory Bachillerato teacher response was excluded from that item's analysis. Explicit "none" responses supported the Year 4 ESO comparisons but did not verify the absence of AI use throughout a placement.

The measures captured broad reported categories rather than frequency, duration, guidance, or implementation quality. Potential overlap between AI and digital resource categories further limits interpretation. The breadth analyses were exploratory, and their covariate adjustment did not account for all relevant contextual or observation-related factors.

Finally, the cross-sectional design establishes neither causality nor temporal order. The placement-based sample was not a probability sample of Spanish secondary schools, so the percentages should not be interpreted as national prevalence estimates. The association analyses concerned the 243 Year 4 ESO reports, rather than all 504 participants.

Future studies should combine standardized questionnaires with session-level records, explicit evidence-source categories, and identifiers permitting analysis of clustering. Longitudinal and mixed-method designs could examine changes in teaching practices, disciplinary differences, student agency, and learning outcomes directly.

5. Conclusions

This study examined AI functions reported by 504 preservice teachers during school placements in Spanish secondary education in the 2025–2026 academic year. Teacher reports frequently included instructional planning and content creation, whereas student reports were concentrated in information management and content or task creation. These patterns describe the functions captured by the questionnaire; differences in the response categories available for each role limit direct comparisons of their breadth.

Association analyses were conducted in the subset of 243 Year 4 ESO reports. Teacher and student AI functions were strongly associated within the same placement and educational-stage block. This joint reporting does not establish that their use occurred in the same class or session.

Teacher AI-function reporting was associated with digital content creation and publication resources, although potential overlap between the AI and digital resource categories limits interpretation. No individual active methodology remained statistically significant after adjustment for multiple comparisons. The number of reported teacher AI functions showed a modest positive association with the diversity of reported active methodologies. These counts represent reported diversity, rather than teaching quality or educational effectiveness.

The findings describe contemporaneous associations within a placement-based sample. They establish neither causal relationships nor the temporal order of AI use and digital practices, and they should not be interpreted as national prevalence estimates. Pedagogical transformation, student autonomy, and learning outcomes were not measured. Future research should examine these dimensions directly through longitudinal designs, clearer identification of AI applications and evidence sources, and measures of instructional processes and learning outcomes.

Supplementary Materials: The following supporting information can be downloaded at https://www.mdpi.com/article/10.3390/educsci16111864/s1: S1: Original Spanish-language questionnaire, including introductory instructions, response options, and examples; S2: Python analysis code; S3: Variable codebook.

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Institutional Review Board Statement: The institutional project "Observación de la innovación educativa en centros de secundaria" received a favorable ethical opinion from the Ethics Committee for Research and Teaching of the Faculty of Health Sciences and Education at Universidad a Distancia de Madrid (UDIMA) on 28 July 2020. In a statement dated 19 October 2026 (reference NR20261019), the Committee extended the authorization to the 2025–2026 academic year and subsequent years, explicitly acknowledging the questionnaire's expansion to address AI use and prevent duplicate responses. The present study involved secondary analysis of institutional placement questionnaires from the 2025–2026 academic year. Only responses with explicit consent for research use were analyzed. Respondent email addresses were used to identify repeated submissions and retain the latest consented response per address. Access to the source database was restricted and password-protected; email addresses were excluded from the statistical variables and reported outputs. The structured questionnaire items did not request names or identifiers of supervising teachers, pupils, or schools. Free-text responses were excluded from the quantitative analyses, and findings were reported in aggregate. The study involved no direct intervention with pupils or changes to teaching activities.

Informed Consent Statement: Informed consent for participation and for the use of questionnaire responses for educational research was obtained from all participants included in the study.

Data Availability Statement: The data presented in this study are available from the corresponding author upon reasonable request. The dataset is not publicly available because it contains information collected in educational settings and its public dissemination was not covered by the consent provided by participants.

Conflicts of Interest: The authors declare no conflicts of interest.

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