



**Teachers' Readiness for Artificial Intelligence in Digital Education:
Evidence from TALIS 2024 and Implications for a Competence-Based
Methodology**

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Abstract

Purpose. To identify which factors most strongly limit Teachers' use of artificial intelligence (AI) in digital education and to derive methodological implications for teacher training. **Methods.** Secondary analysis of published results of the OECD Teaching and Learning International Survey (TALIS) 2024, which covered about 280,000 educators in 55 education systems, supplemented by descriptive statistics and rank and linear correlation analysis for ten systems ($n = 10$). **Results.** On average across OECD systems, 36% of teachers reported using AI in their work, with national values ranging from 14% (France) to 75% (Singapore). Among teachers who had not used AI, 75% cited insufficient knowledge and skills, whereas 37% cited insufficient school infrastructure. Skills for using AI were the most frequently reported area of high professional learning need (29%), while 38% of teachers had taken part in AI-related professional learning. In nine of ten analysed systems, lack of knowledge was a more frequent barrier than lack of infrastructure. The association between AI use and the knowledge barrier was negative but not statistically significant (Pearson $r = -0.42$, $p = 0.23$; Spearman $\rho = -0.55$, $p = 0.10$). **Conclusions.** Teachers' competence, rather than technology access, is the primary bottleneck. A competence-based methodology of digital education is therefore proposed, built on diagnostics, pedagogy-first training, institutional enablement and ethical evaluation.

Keywords





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artificial intelligence; digital education; teacher digital competence; professional learning; TALIS 2024; educational methodology; competence-based approach.

Artificial intelligence has moved from an experimental technology to an everyday tool in education. Generative language models, adaptive platforms and analytics systems now support lesson planning, feedback, differentiation and administration. Education systems have responded unevenly: some have trained most of their teachers to use AI, while others still report that the majority of teachers have not used it at all.

In Uzbekistan, the development of AI and digital education is a declared policy priority. Presidential Resolution No. PQ-4996 of 17 February 2021 set out measures for the accelerated introduction of AI technologies [13], and the “Digital Uzbekistan – 2030” strategy, approved by Presidential Decree No. PF-158 of 11 September 2023, treats the digitalisation of education as a strategic direction [14]. Yet infrastructure and regulation do not by themselves determine classroom practice. The decisive question for the theory and methodology of digital education is what prevents teachers from using AI purposefully, and which methodological solutions follow from the answer.

Until recently, international evidence on this question was fragmentary. TALIS 2024 changed this: it is the fourth TALIS cycle and the first large-scale international survey to ask teachers how they use AI, why they do not, and what training they receive [4]. This makes it possible to ground a methodology of AI-supported teaching in representative data rather than in assumptions.

The study addresses three research questions:

- How widely do teachers use AI, and how much does this vary between education systems?
- Which barrier is cited more often by teachers who do not use AI: lack of knowledge and skills or lack of infrastructure?
- What methodological implications follow for the training of teachers in digital education?





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Three strands of research frame the problem.

Competence frameworks. The European DigCompEdu framework describes educators' digital competence in six areas, from professional engagement to facilitating learners' digital competence [6]. UNESCO's AI Competency Framework for Teachers extends this logic to AI, emphasising a human-centred mindset, ethics, AI pedagogy and professional learning [7]. The TPACK model argues that technology knowledge is effective only when integrated with pedagogical and content knowledge [8].

AI in education research. A systematic review of AI applications in higher education found that educators' perspectives were weakly represented and that pedagogical theory was seldom explicit [9]. Subsequent work on large language models describes opportunities for lesson preparation and differentiation but also stresses errors, bias and the risk of over-reliance [10]. Holmes and colleagues emphasise that AI raises ethical questions that cannot be left to technology developers [11], and Selwyn argues that AI should strengthen rather than replace Teachers' professional role [12].

Large-scale survey evidence. Before 2024, comparable cross-national data on Teachers' AI use did not exist. TALIS 2024 provides indicators on use, purposes, barriers, beliefs and professional learning [1–3]. However, the published reports present these indicators mainly country by country. The relationship between the barriers teachers report and the level of AI use has received little analysis, and the implications for the methodology of digital education have not been systematically drawn. This article addresses that gap.

Data sources. The study is a secondary analysis of openly published TALIS 2024 results. TALIS is the OECD's survey of teachers and school leaders; in 2024 it collected data from about 280,000 educators in 55 education systems, mainly from lower secondary teachers, with optional primary and upper secondary samples [1]. System-level indicators were taken from the OECD report *Results from TALIS 2024* and from the OECD country notes [1–3]. The OECD averages used throughout are those stated in





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the country notes. (One secondary summary of the survey cites a figure of 41% for AI use across the OECD; this article uses the 36% reported in the OECD's own country notes.)

Three indicators were analysed for each system: (a) the share of teachers who reported having used AI in their work; (b) among teachers who had not used AI in the 12 months before the survey, the share reporting that they lack the knowledge and skills to teach using AI; (c) among the same group, the share reporting that their school lacks the infrastructure to use AI. For the OECD average, indicators on AI-related professional learning and professional learning needs were also used [1; 3].

Ten education systems were analysed: Singapore, Australia, Azerbaijan, Brazil, the United States, Saudi Arabia, Austria, Denmark, Cyprus and France. These are a convenience set of systems whose published country notes report all three indicators; they span the observed range of AI use (14–75%), several regions and different income levels, but they are not a random sample of the 55 systems.

Descriptive statistics (mean, standard deviation, median, range) were computed, and Pearson and Spearman correlation coefficients were calculated between the three indicators. Because system-level values are published as percentages without confidence intervals or survey weights, the correlations are exploratory and are not used for causal inference. Calculations were performed in Python (SciPy).

Across OECD education systems, 36% of teachers reported having used AI in their work [2]. National values differ by a factor of more than five. In Singapore, 75% of teachers reported using AI, compared with 66% in Australia, 59% in Azerbaijan, 56% in Brazil, 43% in the United States and Saudi Arabia, 39% in Austria, 36% in Denmark, 31% in Cyprus and 14% in France [2] (Table 1, Figure 1). The unweighted mean of the ten analysed systems is 46.2% (SD = 18.0), above the OECD average because the set includes several high-use systems.





Table 1. AI use and barriers among teachers who had not used AI, TALIS 2024 (% of teachers)

Education system	Teachers who used AI	Non-users: lack knowledge and skills	Non-users: lack infrastructure	Gap (knowledge – infrastructure), pp
Singapore	75	65	24	+41
Australia	66	75	25	+50
Azerbaijan	59	31	64	–33
Brazil	56	64	60	+4
United States	43	70	27	+43
Saudi Arabia	43	66	64	+2
Austria	39	69	23	+46
Denmark	36	82	20	+62
Cyprus	31	67	46	+21
France	14	79	50	+29
OECD average	36	75	37	+38

Source: OECD, TALIS 2024 country notes [2]; gap calculated by the author. Note: Wording of the "AI use" item follows the OECD country notes ("used AI in their work"). pp = percentage points.

4.2. Lack of knowledge is the dominant barrier (RQ2)

Among OECD teachers who had not used AI, 75% reported that they lack the knowledge and skills to teach using AI, whereas 37% reported that their school lacks the necessary infrastructure [2]. The same pattern appears at system level: in nine of the ten analysed systems the knowledge barrier was cited more often than the infrastructure barrier (Table 1, Figure 2). The gap was largest in Denmark (+62 pp), Australia (+50 pp) and Austria





(+46 pp). The exception is Azerbaijan, where 64% of non-users cited infrastructure and 31% cited knowledge. In Brazil (+4 pp) and Saudi Arabia (+2 pp) the two barriers were almost equally frequent, which suggests that in these systems infrastructure and competence constraints coexist.

Table 2. Descriptive statistics and correlations for the ten analysed systems (n = 10)

Indicator	Mean	SD	Median	Min	Max
AI use (%)	46.2	18.0	43.0	14	75
Lack of knowledge and skills (%)	66.8	14.0	68.0	31	82
Lack of infrastructure (%)	40.3	18.3	36.5	20	64

Pair of indicators	Pearson r (p)	Spearman ρ (p)
AI use – lack of knowledge	–0.42 (0.23)	–0.55 (0.10)
AI use – lack of infrastructure	–0.13 (0.73)	0.06 (0.86)
Lack of knowledge – lack of infrastructure	–0.56 (0.09)	not computed

Source: calculated by the author from Table 1. SD = sample standard deviation.

Systems with a higher share of AI users tended to report a lower knowledge barrier ($r = -0.42$; $\rho = -0.55$), while no relationship with the infrastructure barrier was found ($r = -0.13$). None of these coefficients reached the conventional 5% significance level, which is expected with ten observations; they should be read as the direction and





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approximate size of the associations, not as evidence of effects. The negative association between the two barriers ($r = -0.56$, $p = 0.09$) points to two distinct system profiles: systems in which competence is the main constraint (for example Denmark, Australia, Austria) and systems in which infrastructure constrains use at least as much as competence (Azerbaijan, Brazil, Saudi Arabia).

Skills for using AI for teaching and learning were the area in which the highest share of OECD teachers (29%) reported a high level of professional learning need, more than for any other content area surveyed; at the same time, 38% had taken part in professional learning on AI in the 12 months before the survey [3]. Singapore combines the highest use (75%) with the highest reported participation in AI-related professional learning (76%, against the OECD average of 38%) [4]. This coincidence is consistent with the view that systematic training supports adoption, although the data do not allow a causal conclusion.

Teachers who use AI mainly use it for low-risk, preparatory tasks on average, 69.4% of AI-using teachers in the eight systems below reported using it to learn about and summarise a topic and 68.5% to generate lesson plans or activities.

The results support a shift in how AI is treated in teacher education. If lack of knowledge and skills is the most frequent obstacle in most systems, then acquiring tools or platforms cannot be the first step of a methodology; it must start from Teachers' competence.

First, **diagnostics before intervention**. Because needs differ between systems and between novice and experienced teachers [3], a single standard course is unlikely to fit all. Second, **pedagogy before technology**: the most common uses (summarising and lesson planning) are valuable only if teachers can judge the accuracy and suitability of AI output, which is the TPACK argument applied to AI [8; 10]. Third, **context-specific enablement**: the contrast between Denmark (infrastructure barrier 20%) and Azerbaijan (64%) shows that infrastructure investment is a priority in some systems but secondary





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in others. Fourth, **ethical governance**: the very different shares of teachers using AI for assessment suggest the need for explicit professional standards.

For Uzbekistan, these findings should be treated as hypotheses rather than conclusions. The country notes consulted here do not provide national data for Uzbekistan, and the barrier profile of its teachers may differ. A methodology developed for Uzbekistan's education system therefore needs its own empirical base, which is the logical next stage of the research.

First, the analysis uses published aggregate indicators of ten systems and cannot take survey weights or standard errors into account. Second, the sample is a convenience set and the correlations are exploratory, with low statistical power. Third, the barrier indicators describe only teachers who had not used AI. Fourth, self-reported use and self-reported lack of skills may not match actual competence. Finally, TALIS focuses on lower secondary education, and the findings may not apply to higher education.

The analysis of TALIS 2024 shows that AI use among teachers is widespread in some systems and rare in others (14–75%), that insufficient knowledge and skills are cited by three quarters of non-users (75%) and are more frequent than infrastructure problems (37%), and that AI-related skills are the most frequently reported area of high professional learning need (29%). The statistical association between AI use and the knowledge barrier is negative but not significant in the analysed sample ($r = -0.42$, $p = 0.23$), which calls for confirmation on larger data.

These findings justify a competence-based methodology for AI in digital education, consisting of diagnostics, pedagogy-first training, context-specific institutional enablement and ethical evaluation.

Directions for further research.

1. Adapting TALIS-type instruments to measure Teachers' AI use, barriers and training needs in Uzbekistan.





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2. Validating a teacher AI-competence scale aligned with DigCompEdu and the UNESCO framework.
3. Experimentally testing the proposed methodology in teacher training (pre-test/post-test with a control group).
4. Extending the analysis to all 55 TALIS systems, using weighted microdata and multilevel models.

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