Central European Journal of Educational Research 7(2) 2025. 28–36.

Thematic Article

AI as a digital assistant in a multi-ethnic VET system: Evidence from the VETAssIst project in Serbia

Zoltán Papp[1], Elvira Kovács[2]

Recommended citation:

Papp, Z., & Kovács, E. (2025). AI as a digital assistant in a multi-ethnic VET system: Evidence from the VETAssIst project in Serbia. *Central European Journal of Educational Research*, *7*(2), 28–36. https://doi.org/10.37441/cejer/2025/7/2/16963

Abstract

Artificial intelligence (AI) is increasingly framed as a lever for teaching efficiency in vocational education and training (VET), yet adoption is mediated by teachers' linguistic and cultural contexts. This study, conducted within the VETAssIst project, compares AI-related readiness and needs among VET teachers in Serbia across two cohorts working under the same national framework: Hungarian-minority teachers in Vojvodina and Serbian-majority teachers. Using a structured questionnaire, we examine perceived usefulness of AI as a 'digital assistant' for lesson planning, assessment, and administrative work, self-reported digital competence, perceived institutional support, and readiness for integration. The evidence indicates broadly similar baseline competence across cohorts, strong intentions to expand classroom use, and uneven institutional backing. Recurrent requirements include VET-specific AI tools, clearer school-level policies, targeted professional development, and language-accessible resources. We argue that sustainable digital transformation in multi-ethnic VET systems depends on aligning tool ecosystems and professional learning with the linguistic diversity of the workforce, thereby preventing intra-system digital divides.

Keywords: artificial intelligence; vocational education and training; minority-language teachers; digital divide.

Introduction

Across education systems, artificial intelligence (AI) is increasingly positioned as a lever to improve preparation, assessment, and administrative efficiency. Global guidance underscores both the promise and the risks: UNESCO's recent recommendations urge a human-centred, regulated use of generative AI in education, calling for teacher capacity-building, robust data protection, and age-appropriate integration (Miao et al., 2021; Miao & Holmes, 2023; Miao & Cukurova, 2024). At the same time, OECD analyses emphasize that education policy and school-level governance must rapidly adapt to generative AI—while also tackling long-standing challenges such as teacher workload, shortages, and uneven infrastructure (OECD, 2023; OECD, 2024). In Europe, the DigCompEdu framework already defines what digital competence means for educators (from digital resources to assessment and learner empowerment), providing a reference point that VET systems can adapt when integrating AI into teachers' practice (Redecker & Punie, 2017; European Commission JRC, n.d.). EU-level action has intensified as well: the Council Recommendation adopted in November 2023 (published January 2024) asks Member States to boost digital competences at all levels and to support teachers with professional development and enabling conditions for quality digital education (Council of the EU, 2023).

Within this policy arc, vocational education and training (VET) is a strategic locus for AI integration. CEDEFOP's recent work highlights that VET teachers operate at the intersection of fast-changing labour

---

[1] Hungarian Language Teacher Training Faculty, University of Novi Sad, Subotica, Serbia; Institute of Information Technology, Department of Mathematics and Computer Science, University of Dunaújváros, Dunaújváros, Hungary
[2] Hungarian Language Teacher Training Faculty, University of Novi Sad, Subotica, Serbia;
zoltan.papp@magister.uns.ac.rs (corresponding author)

markets, twin green-digital transitions, and diverse learner needs, yet their access to targeted professional development and institutional support remains uneven across Europe (CEDEFOP, 2022; CEDEFOP, 2024).

In multilingual regions, teachers' access to tools, training, and institutional guidance is shaped not only by infrastructure but also by language availability and local policy. Research on the digital language divide shows that low-resourced languages are systematically under-served by AI and EdTech ecosystems, creating barriers that compound the digital divide and can marginalize educators and learners who work outside dominant language markets (Okolo & Tano, 2024). These barriers overlap with known dimensions of digital (in)equity—skills, affordability, infrastructure, and language—which disproportionately affect vulnerable or minority groups (Raihan et al., 2024).

Serbia provides a salient case. The Autonomous Province of Vojvodina is one of Europe's most ethnically diverse regions. Ethnic Hungarians constitute Serbia's largest minority and form substantial local majorities in several Vojvodina municipalities (Minority Rights Group, n.d.). Recent census-based analyses document the community's demographic decline since 2011—context that heightens the importance of equitable, language-appropriate educational resources (Palusek, 2024). In this setting, Hungarian-minority and Serbian-majority VET teachers often share the same national regulatory framework but may encounter different day-to-day conditions vis-à-vis tool localization, professional learning materials, and school-level guidance (Minority Rights Group, n.d.).

Serbia has taken steps to frame AI systemically (Strategy 2020–2025; updated 2025–2030), signalling an intent to invest in education, infrastructure, and public-sector applications (Government of Serbia/OECD.AI, 2025; National AI Platform RS, 2025). Such macro-level commitments are consistent with EU-aligned programmes to raise digital skills and to modernize education and training (Kita, 2023). Yet, as UNESCO and OECD note, the translation of national strategies into school-level support—clear policies, teacher professional development, safe-use guidance, and language-accessible materials—is the pivotal implementation challenge (Miao & Holmes, 2023; OECD, 2023).

Two complementary lenses structure our inquiry. First, DigCompEdu conceptualizes teachers' digital competence beyond tool use—covering resource curation, learning design, assessment, inclusion, and fostering learners' digital competence (Redecker & Punie, 2017; European Commission JRC, n.d.). Second, the Unified Theory of Acceptance and Use of Technology (UTAUT) and its education-sector syntheses point to the salience of performance expectancy, effort expectancy, social influence, and facilitating conditions. Evidence from higher-education instructors confirms these constructs as reliable predictors of adoption, with facilitating conditions tied to actual use behaviour—variables that school systems can shape (Venkatesh et al., 2003; Noureddine et al., 2025; Venkatesh et al., 2016).

Despite widening policy guidance and fast-growing evidence on AI in language and subject teaching, comparative data on minority-language VET teachers within multi-ethnic systems remain scarce. Reviews of AI in language education repeatedly note gaps around under-represented languages, ethical-governance capacity in schools, and long-term, context-sensitive implementation (Albedah, 2025). Moreover, EU policy calls for teacher-centred professional development and enabling conditions. However, we know less about how teachers themselves in multilingual settings prioritize needs: VET-specific tools vs. localization, clearer school rules vs. infrastructure, or data-protection guidance vs. assessment supports (Council of the EU, 2023; ETUCE, 2023).

Responding to these gaps, we report evidence from a structured questionnaire administered in March 2025 to VET teachers in Serbia as part of the VETAssIst project, comparing Hungarian-minority teachers in Vojvodina with Serbian-majority teachers. The study contributes by:

1. positioning teachers' AI competence and use within a DigCompEdu/UTAUT-informed frame;
2. contrasting perceived institutional support (school encouragement, training availability, policy clarity) across cohorts under the same national policy;
3. mapping obstacles and needs (e.g., VET-specific tools, language-accessible resources, PD) relevant to EU-level recommendations on digital skills and enabling factors for digital education; and
4. situating findings within Serbia's evolving AI strategy and the multilingual demographics of Vojvodina, to inform equitable AI integration in VET (National AI Platform RS, 2025; Minority Rights Group, n.d.).

Guided by these aims, we address the following research questions:

RQ1: How do VET teachers from Hungarian-minority and Serbian-majority cohorts characterize their AI-related knowledge and frequency of use in teaching-related tasks?

RQ2: How do teachers perceive school-level support (encouragement, rules for generative AI, and access to professional development)?

RQ3: To what extent do teachers intend to increase AI use, and what factors (perceived usefulness, ease, norms, facilitating conditions) are salient?

RQ4: Which barriers (e.g., professional development, infrastructure, privacy, language and localization) and supports (e.g., VET-specific tools, clearer policies, funding) do teachers prioritize for effective, equitable AI adoption in a multilingual VET context?

Materials and Methods

We conducted a cross-sectional, comparative survey within the VETAssIst project to examine teachers' AI-related competence, use, institutional conditions, intentions, and perceived needs and obstacles in Serbia's multilingual VET system. Measurement was anchored in the European Commission's DigCompEdu framework (educators' digital-pedagogical competence) and the UTAUT model (determinants of technology adoption: performance expectancy, effort expectancy, social influence, facilitating conditions), so that the survey captures both the quality of teacher practice and the drivers of AI uptake in VET (Redecker & Punie, 2017; Venkatesh et al., 2003).

Participants were VET teachers in Serbia who responded to a bilingual online questionnaire (Hungarian and Serbian) in March 2025. No identifying information (names, schools) was collected in the analytic dataset. After standard screening (language flag present; no obvious duplicates; valid range checks) and restricting the analytic set to completed questionnaires (Qualtrics Finished = "True"), the analytic sample comprised N = 97 teachers: Hungarian-minority cohort (HU) n = 29 and Serbian-majority cohort (SR) n = 68. These two cohorts work under the same national framework and reflect the country's multi-ethnic, multilingual context.

A structured questionnaire was administered via Qualtrics. At the entry screen, respondents selected the questionnaire language (Hungarian or Serbian). Once selected, the instrument was presented only in the chosen language for the entire session. Qualtrics also stored this choice as a language flag for analysis. Items were available in Hungarian and Serbian with parallel wording—conceptually equivalent translations using the same order and response formats—so that cross-language differences reflect respondents rather than instrument wording. Core sections and their theoretical anchors were:

- AI competence (self-reported): two items on knowledge of AI applications in the taught profession and education (0–4, from "not at all" to "very well") - used to form a simple competence index, anchored in DigCompEdu "Professional engagement" and "Digital resources/Teaching and Learning" areas.
- Current use frequency: one item on how often teachers use AI tools for teaching-related tasks (categorised as daily, weekly, monthly, more or never).
- Intention to increase use: one item on next-year intention (more/same/less/not know), mapping to UTAUT behavioural intention.
- Institutional conditions: items on school encouragement, training organised by school, and local rules (presence of school-level regulation; whether students may use AI for schoolwork).
- Perceived impact: five Likert-type items (5-point: strongly disagree to strongly agree) on whether AI use has enhanced pedagogical expertise, work efficiency, motivation for further development, student engagement, and learning outcomes (proximal to performance expectancy in UTAUT and practice-proximal competence in DigCompEdu).
- Obstacles (multi-select): options included insufficient professional development, lack of school/centre guidance, inadequate infrastructure, concerns about data protection/privacy and bias/fairness, fears that AI may weaken the teacher–student relationship, concerns about reduced autonomy, low confidence in using AI competently, and the perception that available tools do not meaningfully support teaching.
- Needs (multi-select): options included more VET-specific AI tools, clearer school policies and guidance, funding for tools, and more Hungarian-language tools/resources.

The survey link was distributed through project partner networks to VET schools and teachers. The participation was voluntary and unremunerated. On the first page, teachers chose Hungarian or Serbian. The survey then proceeded exclusively in the selected language. The landing page provided study aims, data use, and contact details, followed by consent. The survey took approximately 15 minutes. The instrument emphasised responsible use and teacher-centred capacity rather than product endorsement.

The study protocol was reviewed and approved by the Ethics Committee of the Hungarian Language Teacher Training Faculty, University of Novi Sad (approval No. 01-618/2025; 8 April 2024). Participation was voluntary, and informed consent was obtained on the survey landing page before any questions were presented. No direct identifiers (e.g., names, schools) were collected, and analyses were conducted on de-identified data only.

Data were exported from Qualtrics to comma-separated values file (CSV) and processed in Python for recoding and analysis. The scripts are available on request. Records were screened for completeness and basic consistency (e.g., duplicate submissions, straight-lining flags). No mid-survey language switching was possible. Cohorts were therefore derived directly from the stored language flag (Hungarian = HU; Serbian = SR). For constructed indices (competence; perceived impact), listwise deletion was applied if any constituent item was missing. For dichotomies (use frequency; intention to increase use), "don't know" was retained in the main analyses and excluded only in pre-specified sensitivity checks. No imputation was performed.

Variable definitions and coding followed the analytical plan. The AI competence index was computed as the mean of two 0–4 items capturing knowledge of AI applications in the taught profession and education (higher means greater perceived competence). Use frequency was derived from a single item and dichotomised as "weekly-or-more" versus "less-than-weekly use." The weekly-or-more category grouped those who indicated "daily," "weekly," or "more than once per week," reflecting a regular, routine level of classroom integration. The less-than-weekly category grouped those who selected "monthly", "more rarely, or never." The weekly threshold was chosen because it corresponds to a typical planning/teaching cycle in VET. Intention to increase use asked whether teachers planned, over the next academic year, to use AI "more," "about the same," "less," or "don't know". For analysis we coded intends to increase (more) versus other (about the same/less/don't know), with sensitivity analyses that treated "don't know" as missing and used a trichotomous specification (more/same/less). Institutional conditions included binary indicators for school encouragement and school-organised training, a three-level indicator for the presence of school rules on generative AI (yes/no/don't know)—also collapsed to yes vs other in sensitivity checks—and an ordered three-level policy indicator for whether students are permitted to use AI (no; yes with restrictions; yes). The perceived impact scale averaged five Likert-type items (1 = strongly disagree to 5 = strongly agree) covering pedagogical expertise, work efficiency, motivation for further development, student engagement and learning outcomes. Internal consistency is reported in the Results. Finally, obstacles and needs were captured via multi-select lists, with each option coded as a binary indicator (selected = 1; not selected = 0). For readability we present the top five endorsements overall and by cohort. The top five obstacles are provided in Table 1, and the top five needs are provided in Table 2.

Results

The analytic sample comprised N = 97 teachers: HU (Hungarian-minority) n = 29 and SR (Serbian-majority) n = 68. Item non-response was low to moderate across the variables used in this section (range 3.1%–41.2%). Specifically, for the two competence items (0–4 scale), question Q18 ("knowledge of AI applications in education") had 3.1% missing (3/97), whereas question Q17 ("knowledge of AI in the taught profession") had 25.8% missing (25/97). For the five perceived-impact items (1–5 scale), each item had 41.2% missing (40/97), largely because some respondents chose not to rate these statements. In line with the analysis plan, listwise deletion was applied only for composite indices (competence; perceived impact). In practical terms, 72 respondents (74%) contributed complete data to the two-item competence index, and 57 respondents (59%) contributed complete data to the five-item perceived-impact scale.

Table 1. Obstacles — top five distribution (overall and by cohort)

Option	Overall %	HU %	SR %
Insufficient professional development for AI use	36.2	41.4	33.8
General concerns about AI's role in society	27.7	34.5	24.6
Lack of guidance from my school/centre on using AI tools	27.7	34.5	24.6
I fear AI use may weaken the teacher–student relationship	24.5	31.0	21.5
I am concerned about data protection/privacy	21.3	13.8	24.6

Table 2. Needs — top five distribution (overall and by cohort)

Option	Overall %	HU %	SR %
More professional development and AI training	68.5	75.0	65.6
More VET-specific AI tools	54.3	50.0	56.2
More funding for AI tools	27.2	25.0	28.1
More Hungarian-language AI tools	26.1	28.6	25.0
Clearer school policies and guidance	25.0	25.0	25.0

The two competence items were strongly associated, indicating they reflect a common underlying construct of self-assessed AI competence: Pearson's $r = 0.84$ (0–4 recoding; $n = 72$) and polychoric $r \approx 0.85$ (latent-threshold estimate). The polychoric correlation was estimated under a bivariate normal latent-variable model with thresholds set from the observed marginals, which is appropriate for ordered categories. Using the inter-item correlation, the two-item Spearman–Brown reliability was 0.92, conventionally interpreted as excellent for a brief measure. This supports aggregation into a single competence index for descriptive and comparative purposes. The perceived-impact scale (five items: pedagogical expertise, efficiency, motivation, student engagement, learning outcomes) showed good internal consistency, Cronbach's $\alpha = 0.90$ (computed on $n = 57$ complete cases), and is therefore summarised as a mean score in the Table 3. As pre-registered, "don't know / prefer not to answer" responses and blanks were treated as missing, and no imputation was applied.

Table 3. Perceived-impact mean scale (1–5): overall and by cohort (complete cases)

Measure	**Overall** (n = 57)		**HU** (n = 16)		**SR** (n = 41)	
	M	SD	M	SD	M	SD
Perceived-impact (1–5)	3.698	0.825	3.750	0.781	3.678	0.850

Note. Higher values indicate more positive perceived impact.

As summarised in Table 3, perceived impact was positive on average, with very similar central tendencies in the two cohorts. Given this closeness in location and spread, we next tested whether the distributional differences between cohorts are statistically meaningful. Table 4 reports the Mann–Whitney comparison, alongside an effect-size index (rank-biserial r), to complement the descriptive picture from Table 3 and provide a compact inferential check of cohort equivalence on the perceived-impact scale.

Table 4. HU–SR comparison on the perceived-impact mean scale

Test	U	**p** (two-sided)	Rank-biserial r	Interpretation
Mann–Whitney	330.0	0.979	-0.01	No cohort difference

RQ1: How do self-assessed competence and current AI use compare across cohorts?

Across cohorts, teachers' self-assessed AI competence clustered around the middle of the 0–4 scale and showed no evidence of systematic differences. The competence index had the same median in both cohorts—HU median = 2.0 (IQR 1.0–2.0, $n = 29$) and SR median = 2.0 (IQR 1.0–2.5, $n = 65$)—and a Mann–Whitney test confirmed the absence of a cohort effect ($U = 868.0$, $p = 0.530$, rank-biserial $r = 0.08$). Practically, this means that the average HU teacher evaluated their familiarity with AI applications on par with the average SR teacher, with the spread (IQR) also overlapping. Consistent with this, the two competence items ("taught profession" and "education") were strongly inter-correlated (Pearson's $r = 0.84$; polychoric $r \approx 0.85$) and yielded excellent two-item reliability (Spearman–Brown = 0.92), which supports our use of a single competence index in subsequent analyses and in descriptive summaries.

Turning to current use, a very similar proportion in each cohort reported weekly-or-more classroom integration (based on question Q21): HU 51.7% (15/29) vs SR 49.2% (32/65). The 2×2 comparison again showed no cohort difference ($\varphi = 0.02$, $p = 0.823$, valid $n = 94$). Where relevant, we qualify that competence analyses use the 72 respondents with complete data on both items (as planned), and use-frequency analyses use the 94 respondents with non-missing answers to the frequency item. Taken together, competence and regular use appear broadly aligned between the two language cohorts in this sample: teachers who rate themselves as moderately familiar with AI also report comparable rates of regular classroom use, irrespective of cohort.

RQ2: Do institutional conditions differ by cohort?

On the support side, nearly one in two respondents indicated that their school encourages the use of AI (question Q34): HU 48.3% (14/29) vs SR 46.2% (30/65), with no meaningful cohort difference (valid $n = 94$). By contrast, reported school-organised training (question Q35) was less common overall—HU 27.8% (5/18) and SR 24.1% (13/54)—and the item response was lower here (valid $n = 72$), which suggests that training opportunities may be patchy and/or unevenly communicated to staff. Because the denominator for this item is smaller, we treat these proportions cautiously and highlight them primarily as a pointer for future capacity-building.

Regarding school-level rules on generative AI (question Q36; Yes/No/Don't know), the most common responses were No and Don't know, with relatively few schools reported as having formal rules in place. For HU (valid $n = 29$): Yes = 6.9%, No = 58.6%, Don't know = 34.5%; for SR (valid $n = 65$): Yes = 9.2%, No = 49.2%, Don't know = 41.5%. The distributions did not differ between cohorts (Cramer's $V = 0.09$, $p = 0.697$). In other words, the regulatory landscape as perceived by teachers is similarly under-specified in both cohorts. Finally, for student permission (Q37; No/Yes with restrictions/Yes), the modal policy was "Yes with restrictions" in both cohorts. We observed no cohort difference (HU: No = 33.3%, Yes-with-restrictions = 66.7%, Yes = 0%, valid $n = 12$; SR: No = 30.3%, Yes-with-restrictions = 69.7%, Yes = 0%, valid $n = 33$; $V = 0.00$, $p = 1.000$). Substantively, respondents portray broad encouragement but limited formalisation (rules, training), and a cautious permission stance for students. We again note the smaller valid-n for the training and student-permission items, and interpret them correspondingly conservatively.

RQ3: Are teachers planning to increase their use of AI?

Intentions for the next academic year (question Q22) are moderately high and comparable across cohorts. Using the preregistered binary specification—"More" versus Other (about the same/less/don't know)—the shares intending to increase were HU 48.3% (14/29) and SR 53.8% (35/65), with no significant difference ($\varphi = 0.05$, $p = 0.618$, valid $n = 94$). In substantive terms, roughly one in two teachers—regardless of cohort—expects to scale up their AI use in the coming year. This is notable given the limited training and uncertainty about rules reported above, suggesting that teacher-level motivation and perceived usefulness may be outpacing the institutional infrastructure. As a robustness note, excluding "don't know" responses yields similar results, indicating that the finding is not driven by uncertainty categories.

RQ4 — What do teachers perceive as the impact of AI on their work?

Perceived impact (five items; 1–5) was positive on average and similar across cohorts, consistent with UTAUT's performance-expectancy mechanism. The mean scale had excellent internal consistency ($\alpha = 0.90$, computed on $n = 57$ complete cases). The median perceived-impact score was HU 3.7 (IQR 3.35–4.05, $n = 16$) and SR 3.8 (IQR 3.20–4.00, $n = 41$). A Mann–Whitney test found no difference ($U = 330.0$, $p = 0.979$; $r = -0.01$). Interpreted practically, teachers who currently use AI report mostly favourable effects on pedagogical expertise, efficiency, motivation, student engagement, and learning outcomes, and this pattern does not depend on cohort. The smaller valid completed case number reflects respondents who opted in to rating each impact item. These results therefore generalise to teachers who felt able to express a view on perceived effects.

RQ5 — What obstacles and needs do teachers report?

The top five endorsements overall and by cohort are presented in the Table 1 and Table 2. Because the lists were multi-select (non-exclusive), we interpret item-level differences descriptively and cautiously, focusing on the direction and magnitude of percentage gaps rather than formal null-hypothesis tests. Teachers most frequently cite professional-development gaps, lack of clear school guidance, and aspects of infrastructure or data protection among obstacles, while needs typically cluster around VET-specific tools, clearer policies, funding, and—in the HU cohort—more Hungarian-language tools/resources. These patterns mirror the institutional picture above: motivation is present, but teachers are signalling practical enablers they need in order to scale.

Across RQ1–RQ4, the two cohorts look similar. Teachers report comparable competence, similar rates of regular use, and parallel intentions to increase AI use next year. At the organisational level, encouragement is common but formal training and school-level rules are less prevalent or uncertain, and both cohorts report cautious permission for student use (typically "yes, with restrictions"). Perceived impact is positive and cohort-invariant, with high internal consistency on the scale. The overall picture is one of converging practice across cohorts and a growth-ready attitude among teachers, coupled with clear signals about the institutional and resource conditions needed to sustain that growth.

Discussion

This study profiled AI-related competence, current use, institutional conditions, intentions, and perceived impact among teachers in Serbia's multilingual VET system, comparing Hungarian-minority (HU) and Serbian-majority (SR) cohorts. Across all core outcomes, cohort differences were small and not statistically significant. Self-assessed competence centred around the mid-range of the 0–4 index in both cohorts, weekly-or-more classroom use was approximately half of respondents in each cohort, and about one in two teachers intended to increase AI use next year. Perceived impact (five items) was reliably measured and positive on average, with no cohort contrast.

At the organisational level, teachers commonly reported encouragement from schools but less consistent reports of school-organised training or clear school-level rules. Student use was typically permitted with restrictions. These institutional patterns also did not differ by cohort.

Two signals are noteworthy. First, the alignment between moderate self-assessed competence and regular use suggests that basic AI-pedagogical knowledge and classroom experimentation are already present in both language communities—consistent with DigCompEdu's emphasis on Professional Engagement and Teaching and Learning as enablers of technology use. Second, the intention to increase use is widespread despite under-formalised institutional scaffolding (training; local rules), which accords with UTAUT: teachers appear motivated by performance expectancy (positive perceived impact) and curiosity, while facilitating conditions at school lag behind. In practical terms, the demand-side (teacher motivation and perceived usefulness) is ahead of the supply-side (structured professional development, guidance, and local policy).

Teachers' top obstacles centred on professional-development gaps, lack of school/centre guidance, and relationship, privacy, or societal concerns. Their top needs focused on more professional development and hands-on training, VET-specific AI tools, funding, and—in HU—more Hungarian-language resources. Taken together, the message is consistent and pragmatic: teachers want to do more with AI, but they need structured support, relevant tools, and clear guardrails to do it well.

Practical implications

Building on the convergent patterns in competence, use, intentions and perceived impact, we outline near-term, low-cost steps that schools and centres can action without waiting for system-level reform.

- Establish clear, "light-weight" guidance that can evolve. Schools should publish a two- to three-page, plain-language note that spells out permitted teacher uses (for example, lesson adaptation, formative-feedback scaffolds, rubric-aligned question banks), prohibited uses (for example, uploading personally identifiable information or outsourcing grading entirely to AI), student permissions (typically "yes, with restrictions"), and expectations for attribution and academic integrity. Because teachers report broad encouragement but uncertain rules, such clarity reduces hesitation and normalises safe practice. The note should adopt the modal stance evident in our data ("yes, with restrictions"), include three to four brief exemplars of acceptable and unacceptable uses, and commit to a termly update as tools and national guidance change. Responsibility should rest with the deputy head and the ICT/quality-assurance lead, with the first version issued within four to six weeks and refreshed each term.
- Make professional development job-embedded and classroom-proximal. Replace generic introductions to AI with short, practice-centred micro-workshops that each conclude with a classroom-ready artefact (for example, a differentiated worksheet, a bank of exit-ticket prompts, or a translation workflow for bilingual classes). This responds directly to the pattern in needs and obstacles, which emphasises hands-on professional development and VET-specific tasks rather than abstract theory.
- Manage risk with simple, memorable privacy rules. Post a concise "3-No" rule in staff rooms and classrooms—No names, No raw student work, and No sensitive data in prompts—and prioritise the use of institution-approved tools. This directly addresses the privacy and confidence concerns surfaced in the obstacles analysis, building trust without freezing innovation. To operationalise the rule, provide a

one-page “De-identify first” checklist that prompts staff to replace names with initials, summarise the scenario instead of pasting raw text, and remove dates/IDs before using AI systems.

At the system level, regional and national stakeholders can convert classroom-level momentum into sustainable practice by providing light-touch, scalable supports—from funded modular professional development and bilingual resources to clear classroom data-protection guidance and pragmatic procurement criteria—that schools can adopt quickly without structural overhaul. Regional and national stakeholders should underwrite a programme of short, certificated micro-credentials that map explicitly to recognised levels of educator digital competence and are tailored to VET-specific contexts such as workshop safety, bilingual support, and practice-based assessment. Because our data show strong intention to increase AI use despite limited training, offering accredited micro-modules both validates teacher effort and accelerates uptake. A practical approach is to commission a menu of compact modules with a shared core—safety, accuracy, and ethics—and elective strands aligned to sectors (e.g., manufacturing, healthcare, hospitality). To reduce friction and support equitable adoption, authorities should co-fund or curate Hungarian-language resources alongside domain-specific prompt packs—for example, electrical safety narratives, maintenance logs, and practical-exam checklists—produced with HU/SR wording parity. Minority-language teachers flagged resource gaps, closing them makes everyday use feasible rather than aspirational. A lean implementation is to issue an open call for bilingual exemplars, have submissions curated by sector experts and teacher panels, and host the vetted materials in a national repository so schools can adopt them rapidly.

Future work

Three lines of inquiry naturally follow. First, longitudinal or quasi-experimental designs could track how teachers’ competence, use, and perceived impact evolve when formal professional development and clear rules are introduced. Second, practice-proximal process data (e.g., anonymised prompt logs and artefacts) could complement self-report to examine how teachers incorporate AI into planning, feedback, and assessment. Third, equity and language accessibility deserve sustained attention: evaluating whether bilingual supports and VET-specific tools measurably reduce barriers for minority-language cohorts would extend the present findings.

Conclusion

In this multilingual VET setting, teachers are ready to grow their AI use: competence sits around the mid-range, weekly-or-more use is already common, and about one in two teachers intends to increase use in the coming year—patterns that were cohort-invariant across the Hungarian-minority (HU) and Serbian-majority (SR) groups. Perceived impact is positive on average and the five-item scale is reliable ($\alpha = 0.90$), reinforcing that educators are not merely experimenting, but reporting tangible benefits in their practice. These inferences were robust to pre-specified sensitivity checks (e.g., excluding “don’t know”, adopting a monthly-or-more cut-point, and item-level tests of the competence questions).

At the same time, teachers are explicit about what they need to scale impact safely and equitably: structured, job-embedded professional development, clear school guidance (including student-use expectations), fit-for-purpose VET tools, and—where applicable—minority-language resources. The top-endorsed needs and obstacles converge on the same message: provide hands-on professional development and practical guardrails, close guidance gaps at school and centre level, and ensure bilingual, domain-specific materials so everyday tasks (from lesson adaptation to assessment and safety-critical content) are supported without additional friction.

System-level actors can unlock this classroom momentum with light-touch enabling conditions rather than wholesale reform: fund modular micro-credentials aligned to educator competence progression and VET contexts; curate bilingual, sector-specific prompt packs; publish a national one-pager on classroom data protection and academic integrity, and offer a vendor-neutral procurement checklist focused on safety, privacy, accessibility, and HU/SR parity. These interventions directly address the facilitating-conditions gap revealed by teachers, reduce uncertainty around acceptable use, and shorten the time from intention to routine, high-quality practice.

Finally, while the study’s design, measurement reliability, and transparent screening lend confidence to the conclusions, we acknowledge limits typical of survey research—self-report, cross-sectional inference, and selective responding on the impact items. The next steps are clear: track change with longitudinal or quasi-experimental PD roll-outs; complement surveys with practice-proximal artefacts (e.g., anonymised prompts/outputs, rubric-anchored feedback samples, time-saved logs); and treat bilingual accessibility as a design constraint in pilots to test whether parity measurably reduces barriers for minority-language teachers. With modest institutional investments in these enabling conditions, the system appears well-positioned to convert teacher motivation into sustained, classroom-level gains—consistently across language cohorts.

Acknowledgments: We thank Johnathan Dabney for the English language editing.

References

Albedah, F. (2025). Artificial intelligence in language education: A systematic review of multilingual applications, large language models, and emerging challenges. *Language Teaching Research Quarterly*, *49*, 247–268. https://doi.org/10.32038/ltrq.2025.49.13

CEDEFOP. (2022). *Teachers and trainers in a changing world: Building up competences for inclusive, green and digitalised (VET): Synthesis report.* Publications Office. Cedefop research paper, 86. https://doi.org/10.2801/705295

CEDEFOP. (2024). *Future-ready VET systems and skills: Cedefop in 2024*. https://doi.org/10.2801/6613368

Council of the European Union. (2023, November 23). *Press release—Digital skills and competences and successful digital education and training: Fit for the digital era*. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:C_202401030

ETUCE. (2023, December 8). *Insights on the new EU Council Recommendations on digital skills and enabling factors for digital education*. https://www.csee-etuce.org/en/item/3361:insights-on-the-new-eu-council-recommendations-on-digital-skills-and-enabling-factors-for-digital-education

European Commission, Joint Research Centre. (n.d.). *DigCompEdu framework.* https://joint-research-centre.ec.europa.eu/digcompedu/digcompedu-framework_en

Kita, L. (2023, December). *Key policy developments in education, training and employment – Serbia 2023*. European Training Foundation. https://www.etf.europa.eu/sites/default/files/2023-12/Country%20Fiche_Serbia_2023_EN_web.pdf

Miao, F., Holmes, W., Huang, R., & Zhang, H. (2021). *AI and education: Guidance for policy-makers*. UNESCO. https://doi.org/10.54675/PCSP7350

Miao, F., & Holmes, W. (2023). *Guidance for generative AI in education and research*. UNESCO. https://doi.org/10.54675/EWZM9535

Miao, F., & Cukurova, M. (2024). *AI competency framework for teachers*. UNESCO. https://doi.org/10.54675/ZJTE2084

Minority Rights Group International. (n.d.). *Serbia. World Directory of Minorities and Indigenous Peoples*. https://minorityrights.org/country/serbia/

National AI Platform of the Republic of Serbia. (2025, January 10). *Serbia adopts strategy for the development of artificial intelligence for the period 2025–2030 (News)*. https://ai.gov.rs/vest/en/1296/serbia-adopts-strategy-for-the-development-of-artificial-intelligence-for-the-period-20252030.php

Noureddine, R., Boote, D., & Campbell, L. O. (2025). Assessing the validity of UTAUT among higher education instructors: A meta-analysis. *Education and Information Technologies*, *30*, 16687–16719. https://doi.org/10.1007/s10639-025-13449-0

Okolo, C. T., & Tano, M. (2024, December 12). *Closing the gap: A call for more inclusive language technologies*. Brookings. https://www.brookings.edu/articles/closing-the-gap-a-call-for-more-inclusive-language-technologies/

Palusek, E. (2024). Demographic changes among Hungarians in Vojvodina: Insights from Serbia's 2022 Census. *Hungarian Journal of Minority Studies*, *I*, 1–24. https://doi.org/10.62152/hjms.2024.pe

Redecker, C., & Punie, Y. (2017). *European framework for the digital competence of educators: DigCompEdu*. Publications Office of the European Union. https://doi.org/10.2760/159770

OECD. (2023). OECD *Digital Education Outlook 2023: Towards an effective digital education ecosystem*. OECD Publishing. https://doi.org/10.1787/c74f03de-en

OECD. (2024). *Education Policy Outlook 2024: Reshaping teaching into a thriving profession—From ABCs to AI*. OECD Publishing. https://doi.org/10.1787/dd5140e4-en

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27*(3), 425–478. https://doi.org/10.2307/30036540

Venkatesh, V., Thong, J. Y. L., & Xu, X. (2016). Unified theory of acceptance and use of technology: A synthesis and the road ahead. *Journal of the Association for Information Systems*, 17(5), 328–376. https://doi.org/10.17705/1jais.00428