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Knowledge and skills dominate stakeholder conceptions of professional training in Transport Technologies

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Abstract

Background. The 2017–2024 reform of Ukrainian higher technical education obliges bachelor programmes in specialty 275 "Transport Technologies" to express learning outcomes through the five-dimension descriptor set of the European and National Qualifications Frameworks (EQF/NQF): *knowledge – skills – communication – responsibility – autonomy*. Whether the stakeholders who enact these programmes share that multidimensional understanding is unknown. **Purpose.** To describe and compare how students, teachers, and employers conceptualise the core constructs of professional training in Transport Technologies, to quantify the gap between these conceptions and the EQF/NQF descriptor set, and to explore – not confirm – whether pedagogical and digital orientations are associated with conceptual breadth. **Methods.** Convergent mixed-methods design. Parallel semi-structured questionnaires were completed by 31 students, 16 teachers, and 7 employers ($\boldsymbol{N = 54}$) at five Ukrainian higher education institutions and cooperating logistics enterprises. Open and closed responses were coded against the EQF/NQF descriptors using a transparent dual-rubric codebook (inter-rubric Krippendorff's $\boldsymbol{\alpha_{\text{ordinal}} = 0.66}$). Analyses combined qualitative content analysis, non-parametric group comparisons with effect sizes, a descriptor-coverage gap analysis, and an explicitly exploratory partial-least-squares structural-equation model (PLS-SEM). **Results.** Stakeholders converge on a reduced "knowledge + skills" core. Within the framing offered to them, 100 % of students invoked knowledge and 96.8 % skills, but 0 % invoked communication, responsibility, or autonomy. This pattern is partly an artefact of knowledge/skills-framed response options and so bounds, rather than measures, student cognition. Coded conceptual breadth differed across groups (Kruskal–Wallis $\boldsymbol{H = 10.9}$, $\boldsymbol{p = .004}$, $\boldsymbol{\varepsilon^2 = .17}$), but because the three instruments offered different options this difference is treated as descriptive, not as evidence of differing cognition; attitudinal valuations did not differ. Employers judged graduate preparedness far more critically than students judged their own programme. The exploratory PLS-SEM explained little variance ($\boldsymbol{R^2_{\text{breadth}} = .085}$) and no structural path's bootstrap interval excluded zero, confirming that confirmatory modelling is not warranted with these data. **Conclusions.** The reduction of professional competence to "knowledge+skills" is empirically robust and cuts across stakeholder groups; communication, responsibility, and autonomy are systematically under-represented. We recommend instrument and curriculum redesign that makes the transversal EQF/NQF descriptors explicit, and we report the study's small convenience sample from one national context as a clear limitation.

Keywords: vocational education and training, professional competence, qualifications frameworks, engineering pedagogy, transport technologies, mixed methods, PLS-SEM

1 Introduction

The professional training of bachelors in the field of transport technologies is being reshaped by three simultaneous pressures: the digital transformation of the educational process, rising employer expectations for work-readiness, and the alignment of national degrees with supranational qualifications frameworks (OECD, 2023; Rashkevych &

Semigina, 2025; UNESCO, 2024). In Ukraine, the Law on Education (Verkhovna Rada of Ukraine, 2017), the National Qualifications Framework (Cabinet of Ministers of Ukraine, 2011), and the 2018 higher-education standard for specialty 275 "Transport Technologies (by modes of transport)" (Ministry of Education and Science of Ukraine, 2018) jointly require that programme outcomes be articulated through the learning-outcome descriptors that the European Qualifications Framework (Council of the European Union, 2017) organises along five dimensions: *knowledge, skills, communication, responsibility,* and *autonomy.*

A framework, however, governs documents, not minds. The descriptors become operative only if the people who design, deliver, and recruit from these programmes – teachers, students, and employers – actually understand professional training in those multidimensional terms. A companion conceptual study of the same specialty (Lebid, 2025) mapped the *terminological field* of professional training and argued, on documentary and lexicographic grounds, that stakeholders tend to reduce competence to a "knowledge+skills" core, leaving communication, responsibility, and autonomy underarticulated. That claim was advanced theoretically. It has not been tested against stakeholders' own responses, nor quantified, nor compared across groups.

The present study supplies that empirical test. Using parallel questionnaires administered to students, teachers, and employers connected to transport-technologies bachelor programmes at five Ukrainian higher education institutions, we ask:

RQ1: How do the three stakeholder groups conceptualise the core constructs of professional training (professional training, professional competence, engineering pedagogy, the methodical system / educational process, technical education, and digitalisation)?

RQ2: How large is the gap between these conceptions and the five EQF/NQF descriptor dimensions, and is the "knowledge + skills" reduction observable in the data?

RQ3: Do conceptions and valuations differ across stakeholder groups and respondent characteristics?

RQ4: *(Exploratory.)* Are pedagogical and digital orientations associated with the breadth of stakeholders' conceptions?

Our contribution is threefold. Substantively, we provide the first quantified, cross-stakeholder evidence on the "knowledge + skills" reduction in transport-technologies bachelor education and locate precisely which descriptors are missing and for whom. Methodologically, we demonstrate a transparent, reproducible procedure for coding closed and open survey responses against qualifications-framework descriptors, with an inter-rubric reliability check. Reflexively, we treat the limits of a small convenience sample from one national context seriously: we report an exploratory structural model honestly, including its failure to reach significance, rather than over-claiming.

2 Theoretical background

Within competence-based vocational and professional education, professional training is understood not as the transmission of subject knowledge but as the orchestrated development of an integrated capacity to act (Billett, 2011; Mulder, 2017). This outcome-based, integrative view is the international common denominator of modern qualifications systems, from the European Qualifications Framework to national VET reforms that re-express curricula as learning outcomes rather than input syllabi (Council of the European Union, 2017; Rashkevych & Semigina, 2025). Baartman and de Bruijn (2011) characterise vocational competence precisely as the *integration* of knowledge, skills, and attitudes, warning against curricula that decompose competence into separately taught fragments – a caution echoed across the international VET literature, where the recurrent failure mode is exactly the narrowing of competence to its most assessable parts. The EQF/NQF formalises this integration for the bachelor's (sixth) level as the ability to manage complex activities and make decisions in unpredictable contexts, articulated across knowledge, skills, communication, responsibility, and autonomy (Cabinet of Ministers of Ukraine, 2011; Council of the European Union, 2017). Read against Baartman and de Bruijn's argument, the last three descriptors – communication, responsibility, autonomy – are the transversal dimensions most easily lost when competence is operationalised as "what students should know and be able to do". The present study tests whether that internationally documented narrowing is observable in the conceptions of stakeholders in specialty 275 bachelor programmes.

In the Ukrainian pedagogical tradition, the *methodical system* is the construct that translates intended outcomes into a managed educational process – goals, content, methods, and tools rendered coherent for a specialty (S.O. Semerikov et al., 2021). *Engineering pedagogy* – internationally associated with the IGIP (International Society for Engineering Pedagogy) tradition that professionalises the teaching competence of engineering educators – is the sub-discipline that adapts this system to technical disciplines, foregrounding the link between engineering content and the methods that make it learnable (Ivanushko, 2022; Tkachuk, Semerikov, Yechkalo, Khotskina, & Soloviev, 2020). Both constructs matter here because they are the levers through which the transversal descriptors could, in principle, be cultivated: a methodical system that values only content delivery has no place to develop autonomy or professional communication.

Underlying professional training is the psychological construct of *readiness* – a multidimensional formation combining motivational, cognitive, activity-related, value, and reflective components that together enable effective professional functioning (Kremen et al., 2026; S. Semerikov, Nechypurenko, Vakaliuk, Mintii, & Fadieieva, 2026). This componential view frames professional training as the cultivation of readiness rather than the accumulation of knowledge, and it predicts that stakeholders who hold a richer (more multidimensional) conception of training will also value the pedagogical and reflective processes that develop the non-cognitive components. RQ4 puts a deliberately modest version of this prediction to an exploratory test.

The companion study (Lebid, 2025) synthesised these constructs into a structured terminological field with "professional training" at its core and proposed harmonised definitions aligned to the EQF/NQF. It identified – but did not measure – a gap

between framework requirements and stakeholders' reduced conceptions. The present study operationalises that gap empirically and asks whether it is uniform across the groups who together constitute the specialty's community of practice.

3 Methods

3.1 Design

We used a convergent mixed-methods design (Creswell & Plano Clark, 2018): qualitative content analysis and quantitative analysis were conducted on the same responses and integrated at interpretation. The qualitative strand is primary; the quantitative strand (including the exploratory model) supports and disciplines it. The study extends the conceptual companion paper (Lebid, 2025) with the "live" stakeholder data the companion paper called for.

3.2 Participants and instruments

Three parallel questionnaires were administered through Google Forms to stakeholders of transport-technologies bachelor education at five Ukrainian higher education institutions and cooperating logistics enterprises: students ($n = 31$), teachers of professionally oriented disciplines ($n = 16$), and employer representatives in the transport and logistics sector ($n = 7$); total $N = 54$. Students came from three institutions: the National Transport University ($n = 12$), the State Biotechnological University ($n = 13$), and Lviv Polytechnic National University ($n = 6$). Twenty-nine were enrolled in specialty 275 "Transport Technologies (by modes of transport)", which corresponds internationally to ISCED-F 1041 (Transport services), and two in the related specialty J8 "Automobile Transport" of Ukraine's updated 2024 classifier of specialties; 30 reported bachelor-level enrolment (24 in the fourth year, one of whom also marked the master's level) and one reported first-year master's enrolment. Teachers came from five institutions: the National Transport University ($n = 6$), the State Biotechnological University ($n = 5$), the Ukrainian State University of Science and Technologies ($n = 3$), Volodymyr Dahl East Ukrainian National University ($n = 1$), and Lviv Polytechnic National University ($n = 1$). Employer representatives worked in freight road transport, freight forwarding, and warehousing enterprises. Table 1 summarises the sample. The three group-specific questionnaires were distributed electronically in October 2025 (2025/2026 academic year) through the programmes' existing channels – student group mailing lists, departmental teaching staff, and standing employer partners. Respondents were therefore a convenience sample reached through the authors' professional networks rather than a probability sample; the population frames across the participating departments and partner enterprises could not be enumerated, so a meaningful response rate cannot be computed and is not claimed. Participation was voluntary and anonymous, and no names or contact details were collected. The introduction to each questionnaire explained the purpose of the study, the voluntary and anonymous nature of participation, and the intended publication of aggregated results, and informed consent was obtained from all participants before they responded (see Declarations).

Table 1 Sample composition and mean EQF/NQF alignment index by stakeholder group. The alignment index (0–10) is the sum of professional-training and professional-competence descriptor-completeness scores. The index inherits the instrument confound discussed for RQ3 (Section 4) – the larger teacher and employer values partly reflect their access to an explicit "all components" option – and should be read descriptively, not as a clean trait measure; the employer value rests on only $n = 7$.

Group	n	**Female / Male**	**EQF/NQF index,** M **(SD)**
Students	31	19 / 11	3.74 (0.51)
Teachers	16	6 / 9	5.88 (1.78)
Employers	7	5 / 2	5.86 (3.58)

The three instruments were *parallel but not identical*: each posed conceptually matched questions about six shared constructs – professional training, professional competence, engineering pedagogy, the methodical system / educational process, technical education, and digitalisation of education – using wording and answer options adapted to each group's vantage point. The verbatim shared-construct items and their answer options for each group are reproduced in the Supplementary Information (Section S1). This design choice mirrors the stakeholders' differing relationships to their programmes, but it also constrains cross-group comparison, as we discuss in Section 6.

3.3 Reflexivity and positionality

All authors are insiders to the field studied: the second author teaches professionally oriented disciplines within specialty 275 at one of the participating universities (the National Transport University), and the rest of authors researches pedagogical education nationally. Insider access made the parallel three-stakeholder elicitation feasible but also risks confirmation of the authors' prior (companion-paper) hypothesis. We mitigated this in three ways: coding rules were fixed in advance and applied mechanically from verbatim categories (Section 3.4); a conservative second rubric was applied to test the sensitivity of conclusions to coder generosity; and we report the disconfirming exploratory result (RQ4) in full rather than omitting it. The second author was not involved in coding her own institution's responses differently from others, as coding operated on de-identified response categories.

3.4 Coding and codebook

Each response to the professional-training and professional-competence items was coded for the subset of the five EQF/NQF descriptors it invoked, yielding a *completeness* score (0–5) per construct and an EQF/NQF *alignment index* (0–10) per respondent. Valuation items were coded on ordinal scales: engineering-pedagogy valuation (decisive = 2, secondary = 1, none = 0), digitalisation orientation (positive/neutral/negative), educational-process conception (process-oriented = 2, form-oriented = 1), and perceived adequacy of preparation (meets = 2, needs

Table 2 Inter-rubric agreement for EQF/NQF completeness coding (lenient vs. conservative rubric; $n = 108$ codings).

Agreement metric	Value
Exact percent agreement	85.2 %
Cohen's weighted κ (linear)	0.467
Cohen's weighted κ (quadratic)	0.389
Krippendorff's α (ordinal)	0.663

improvement = 1, does not meet = 0). "Hard to answer" responses were coded missing. The full mapping from every verbatim response category to its code is given in the reproducible codebook accompanying the analysis scripts.

3.5 Reliability

Because coding was performed by the authors, we guard against coder latitude with a dual-rubric procedure rather than a single rubric. Two rubrics were applied independently to all $54 \times 2 = 108$ conception statements: a *lenient* rubric, which credits holistic options ("all of the listed components") with the full descriptor set they imply, and a *conservative* rubric, which credits a descriptor only when it is lexically explicit and assigns holistic options the "knowledge + skills" core only. Agreement between the rubrics on the ordinal completeness score indexes the sensitivity of our conclusions to coding generosity (Table 2). We emphasise that this is an intra-author robustness check, not independent double coding by separate researchers – a limitation noted in Section 6.

3.6 Analytic procedures

For RQ1 we used qualitative content analysis of the response categories (Braun & Clarke, 2006; Krippendorff, 2018). For RQ2 we computed, per group, the proportion of respondents whose conception invoked each descriptor (the gap analysis). For RQ3 we used Kruskal–Wallis tests with ε^2 effect sizes (Tomczak & Tomczak, 2014) for ordinal outcomes and Fisher–Freeman–Halton exact tests with Cramér's V for contingency tables, chosen because of small and uneven cell counts (employers $n = 7$); ε^2 is read against the conventional bands .01/.06/.14 for small/medium/large effects, and weighted κ against the bands of Landis and Koch (1977) (.41–.60 "moderate"). For RQ4 we estimated an exploratory PLS-SEM (Hair, Hult, Ringle, & Sarstedt, 2022; Hair, Risher, Sarstedt, & Ringle, 2019) on the pooled sample, with discriminant validity assessed by the heterotrait–monotrait ratio (Henseler, Ringle, & Sarstedt, 2015) and structural paths evaluated with 1,000-resample bootstrap percentile intervals; we also report the inter-construct correlation matrix and the inverse-square-root minimum-sample-size benchmark (Kock & Hadaya, 2018), and we re-estimate the model on complete cases to check the median imputation. All analyses are reproducible from the accompanying Python scripts and coded dataset (S.O. Semerikov, Petrenko, & Lebid, 2026): the exploratory PLS-SEM was estimated with the `plspm`

package and its bootstrap used 1,000 resamples under a fixed random seed. Statistical tests are interpreted as exploratory throughout.

4 Results

4.1 RQ1: How stakeholders conceptualise the core constructs

Across all three groups the modal conception of *professional training* fused theory and practice: students described it as "a combination of theoretical knowledge and practical skills needed for the future profession" (27 of 31), and all 16 teachers selected "the formation of the knowledge and skills necessary for professional activity". *Professional competence* was understood as the capacity to apply knowledge and skills in professional activity. Notably, the holistic "all of the listed components" option for competence was chosen by 11 of 16 teachers but by only a minority of employers, whose free-text answers instead named single dimensions ("technical knowledge"; "practical skills"; "communicative and organisational abilities").

Valuations of *engineering pedagogy* were mixed and, tellingly, did not differ across groups (see RQ3): teachers split between "decisive" (9/16) and "secondary – content matters more" (5/16); two of seven employers did not recognise the term at all. *Digitalisation* was viewed positively by a large majority in every group, with a small but articulate minority of employers warning that unrestricted digital resources can "reduce critical thinking and learning almost to zero". Conceptions of the *methodical system* and *educational process* divided between an outcome-oriented reading (interaction directed at forming competences) and a form-oriented reading (lectures, practicals, laboratory work).

4.2 RQ2: The descriptor gap and the "knowledge + skills" reduction

Figure 1 and Table 3 report, per group, the percentage of respondents whose professional-training or professional-competence conception invoked each EQF/NQF descriptor. The reduction the companion paper predicted is starkly visible among students: within the framing their instrument offered, every student invoked knowledge (100 %) and almost all invoked skills (96.8 %), but *not one* invoked communication, responsibility, or autonomy (0 %). Teachers, offered an explicit "all components" option, recorded high coverage of the transversal descriptors (communication 75 %, responsibility 68.8 %, autonomy 87.5 %); employers, answering largely in free text, fell in between and fragmented across single dimensions.

This pattern is the central empirical finding. Read with appropriate caution about instrument framing (Section 6), it shows that the transversal descriptors – precisely those the EQF/NQF treats as defining bachelor-level autonomy and responsibility – are absent from the working vocabulary made available to and used by students, and are unevenly held even by teachers and employers when not explicitly prompted.

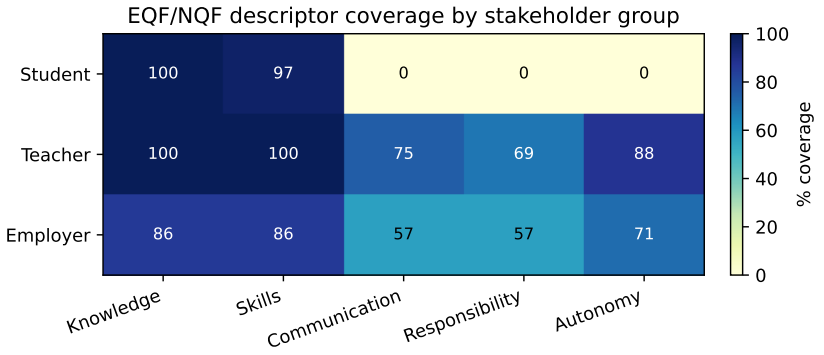


Fig. 1 EQF/NQF descriptor coverage by stakeholder group (percentage of group whose professional-training or competence conception invokes each dimension; lenient rubric). The student row is the empirical signature of the "knowledge + skills" reduction.

Table 3 EQF/NQF descriptor coverage (% of group). Note that the student instrument's closed options were themselves framed in knowledge/skills terms, so the student zeros reflect the offered response frame as well as respondents' conceptions (Section 6).

Group	Knowledge	Skills	Communication	Responsibility	Autonomy
Students	100.0	96.8	0.0	0.0	0.0
Teachers	100.0	100.0	75.0	68.8	87.5
Employers	85.7	85.7	57.1	57.1	71.4

4.3 RQ3: Group and respondent differences

Coded conceptual *breadth* – our shorthand for the summed descriptor-*completeness* scores defined in Section 3.4; the two terms denote the same quantity – differed across groups: the EQF/NQF alignment index (Kruskal–Wallis $H = 10.9$, $p = .004$, $\varepsilon^2 = .17$), professional-training completeness ($H = 13.4$, $p = .001$, $\varepsilon^2 = .22$), and professional-competence completeness ($H = 13.0$, $p = .002$, $\varepsilon^2 = .22$) all showed nominally medium-to-large group effects. *These comparisons must, however, be read as descriptive rather than cognitive.* Because the three instruments offered different answer options – in particular, teachers (but not students) could select an explicit "all components" response – the between-group difference in completeness is confounded with instrument design and very likely overstates any true difference in how the groups conceive competence. We therefore do not interpret the magnitude of these effects; the defensible cross-group result is the *qualitative pattern* of which descriptors are present or absent (RQ2), not the size of the completeness gap.

By contrast, *attitudinal* valuations did not differ across groups: engineering-pedagogy valuation ($H = 2.24$, $p = .33$; Fisher–Freeman–Halton $p = .38$, Cramér's $V = .21$), digitalisation orientation ($H = 0.95$, $p = .62$), and educational-process conception ($H = 0.40$, $p = .82$) were statistically indistinguishable. Within students, work experience was not associated with alignment ($\rho = .21$, $p = .26$).

The most consequential difference is in *perceived adequacy* of preparation. Of 7 employers, 3 judged graduate technical education "does not meet market requirements" and 3 "needs improvement" – only 1 found it adequate. Of 27 students who rated their own methodical system, 20 called it "clearly structured, modern, meeting labour-market requirements" and none rejected it outright. Producers and consumers of the qualification thus diverge sharply in their confidence about its results (Figure 2).

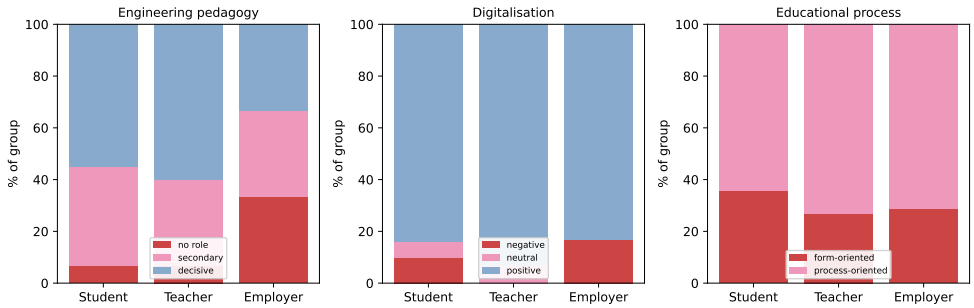


Fig. 2 Distribution of valuation responses by stakeholder group: engineering-pedagogy valuation, digitalisation orientation, and educational-process conception. Group differences on these attitudinal items were not statistically significant.

4.4 RQ4: Exploratory structural model

Before modelling, we note that the sample falls well short of the requirement for variance-based SEM. The inverse-square-root benchmark (Kock & Hadaya, 2018) implies a minimum of ≈99 cases to detect a path of $\beta = .25$ at 5% significance and 80% power (and ≈155 for $\beta = .20$); our $N = 54$ provides roughly half of this. The model below is therefore presented not as a relational model but as a transparent demonstration of *non*-modellability. The underlying relationships are weak to begin with: no Spearman correlation among the five coded indicators exceeds |.30| (Supplementary Information, Table S1).

We nonetheless specified a deliberately small exploratory PLS-SEM on the pooled sample ($N = 54$; complete cases $n = 47$, missing ordinal values imputed at the variable median): a *Pedagogical Valuation* construct (engineering-pedagogy valuation, educational-process conception) and a single-item *Digitalisation Orientation* construct were specified as predictors of *Conception Breadth* (professional-training and professional-competence completeness). Figure 3 reports the estimates.

The model is weak on every criterion, and we report it as such. Internal consistency was below conventional thresholds (Cronbach's $\alpha = 0.32$ for Pedagogical Valuation, 0.54 for Conception Breadth), driven by low loadings of the educational-process indicator ($\lambda = 0.35$) and the professional-training-completeness indicator ($\lambda = 0.35$); average variance extracted nonetheless exceeded 0.50 (Conception Breadth 0.56, Pedagogical Valuation 0.55), and discriminant validity was acceptable (HTMT = 0.58 < 0.85). The internal consistency of the single-item Digitalisation Orientation construct cannot be

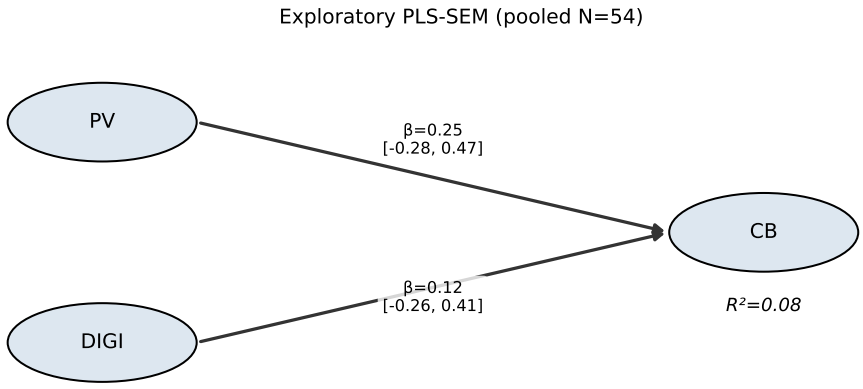


Fig. 3 Exploratory PLS-SEM (pooled $N = 54$). Path coefficients with 1,000-resample bootstrap 95% percentile intervals. Neither interval excludes zero; the model is reported as hypothesis-generating only.

assessed and its loading is fixed at unity, so no α is reported for it. Structurally, Pedagogical Valuation related to Conception Breadth in the hypothesised positive direction ($\beta = 0.25$, bootstrap 95% CI $[-0.28, 0.47]$, $t = 1.58$) and Digitalisation Orientation negligibly ($\beta = 0.13$, CI $[-0.26, 0.41]$), but *neither interval excludes zero* and the model explained only 8.5 % of the variance in conceptual breadth ($R^2 = .085$). The PV→CB path estimate is consistent with the simple bivariate association between the two composites (Spearman $\rho = .33$, $p = .015$; Pearson $r = .25$): the relationship is genuinely weak-positive, and the path coefficient is not an artefact of the PLS algorithm; the bootstrap interval is wider than the bivariate test only because resampling propagates the small-sample instability that is the point of this section. The conclusion is unchanged under complete-case estimation ($n = 47$: $\beta_{\mathrm{PV}\to\mathrm{CB}} = 0.26$, $\beta_{\mathrm{DIGI}\to\mathrm{CB}} = 0.17$, $R^2 = .11$), so it is not an artefact of median imputation. We deliberately do not report a "goodness-of-fit" summary statistic: the GoF index sometimes quoted for PLS path models is not a validated measure of model fit and cannot distinguish valid from misspecified models, so it would be misleading here. The exploratory model therefore returns a clear negative verdict: with these data, pedagogical and digital orientations cannot be shown to drive conceptual breadth, and the data do not support confirmatory structural modelling. We retain the analysis because reporting it – rather than suppressing a null exploratory result – is the honest course and forestalls over-interpretation.

5 Discussion

The study set out to test empirically a claim the companion paper (Lebid, 2025) could only advance conceptually: that stakeholders in transport-technologies training reduce professional competence to a "knowledge + skills" core. The data support the claim and sharpen it. The reduction is not a vague tendency but a precise, locatable absence:

communication, responsibility, and autonomy – the three transversal descriptors that the EQF/NQF treats as constitutive of bachelor-level qualification (Council of the European Union, 2017) – are missing from the conceptual vocabulary in active use, completely so among students within the frame they were offered, and unevenly among teachers and employers when not explicitly prompted.

This matters because, as Baartman and de Bruijn (2011) argue, vocational competence is defined by the *integration* of these dimensions; a community of practice that thinks in two of five dimensions will design, study within, and recruit from programmes that develop two of five. The finding that *attitudinal* valuations – of engineering pedagogy, of digitalisation, of the educational process – do *not* differ across groups, while conceptions of competence breadth do, suggests that the problem is not disagreement about pedagogy but a shared, tacit narrowing of what the qualification is *for*. The methodical system and engineering pedagogy (Nychkalo, 2000; Tymkiv, 2020) are exactly the levers through which the missing descriptors could be cultivated, yet a substantial minority of teachers rated engineering pedagogy "secondary", and some employers did not recognise the construct.

The sharp divergence in perceived adequacy – employers overwhelmingly critical, students largely satisfied with their own preparation – is consistent with the descriptor gap. Students who conceive of training as knowledge plus skills will judge a programme that delivers knowledge and skills as adequate; employers who need autonomy, responsibility, and professional communication on the job encounter the gap directly. This is the mechanism by which a framework-compliant programme can still underprepare graduates: compliance is documentary, while the operative conception remains reduced.

The exploratory model's failure is itself informative. Had we reported a significant path from pedagogical valuation to conceptual breadth, it would have rested on an under-powered sample with weak measurement; the honest null guards against a tempting but unsupported causal story and underlines that the contribution of this study is descriptive and diagnostic, not explanatory.

6 Limitations

Four limitations bound these conclusions. First and most important, the instruments shape the findings. The three questionnaires were parallel but not equivalent, and the student instrument in particular offered closed options framed in knowledge/skills terms; the 0 % student coverage of communication, responsibility, and autonomy therefore reflects the offered response frame as much as students' unaided conceptions, and the cross-group breadth differences in RQ3 are partly an artefact of differing answer options. We have flagged this at every relevant point and refrain from claiming that students *cannot* conceive of the transversal descriptors – only that those descriptors were absent from the vocabulary the study elicited. Second, the sample is small ($N = 54$) and very uneven (employers $n = 7$), drawn by convenience through the authors' professional networks from five higher education institutions (dominated by two of them) and a few partner enterprises in one national context; estimates are imprecise and not

generalisable, and the employer cell precludes multi-group structural analysis (PLS-MGA / measurement-invariance testing). Third, coding was performed by the authors; the dual-rubric agreement ($\alpha_{\text{ordinal}} = 0.66$, weighted $\kappa = 0.47$) indexes coding sensitivity but is not a substitute for independent double coding, and the moderate weighted κ shows that conclusions about absolute completeness levels are rubric-dependent (the relative, cross-group pattern is more robust). Fourth, several coded items had limited variance (ceiling effects), which both attenuates the structural model and reflects the templated nature of the closed responses. The exploratory PLS-SEM should be read only as a transparent demonstration that these data do not support structural inference.

7 Recommendations

The diagnosis points to concrete, low-cost actions for programmes in specialty 275 and comparable technical specialties.

1. Make the transversal descriptors explicit in instruments and rubrics – assessment tasks, programme-learning-outcome statements, and even survey options should name communication, responsibility, and autonomy alongside knowledge and skills, so that the vocabulary becomes available to students and is routinely assessed.
2. Use the methodical system and engineering pedagogy as the delivery levers, with transport-specific tasks – embed the transversal descriptors in concrete specialty-275 activities rather than generic "soft-skills" modules: *autonomy* through open-ended multimodal route-planning projects in which students choose and justify a transport scheme under incomplete information; *responsibility* through decision tasks under uncertainty (e.g., re-routing under a disrupted supply chain, with accountability for cost and safety trade-offs); and *professional communication* through client-facing tasks using the working vocabulary employers named (Incoterms, modal-choice rationales, freight-geography briefings). These are the readiness components that content delivery alone does not develop (Baartman & de Bruijn, 2011; Nychkalo, 2000; Tymkiv, 2020).
3. Close the employer–graduate confidence gap through cooperation: the divergence in perceived adequacy argues for structured employer involvement – practice-based tasks, work placements, and joint review of programme outcomes against labour-market needs (Billett, 2011; Rashkevych & Semigina, 2025).
4. Treat digitalisation as a means, not an end, heeding the employer caution that unmediated digital resources can erode rather than build the autonomy and critical thinking the EQF/NQF requires (OECD, 2023; Punie, 2017).

These recommendations are design *hypotheses* warranted by the diagnosis, not interventions this study has validated; testing whether they actually broaden stakeholders' operative conceptions is itself a research task. For research, then, the priorities are an enlarged, multi-institution sample with *equivalent* instruments across

stakeholder groups, independent double coding, and – only once measurement is adequate – a properly powered structural test of whether pedagogical orientation shapes conceptual breadth.

8 Conclusions

Stakeholders in Ukrainian transport-technologies bachelor programmes share a reduced, "knowledge + skills" conception of professional training in which the EQF/NQF's transversal descriptors – communication, responsibility, and autonomy – are systematically under-represented. The reduction is most complete among students, uneven among teachers and employers, and consistent with a sharp employer–student divergence in confidence about graduate preparedness. Attitudes toward engineering pedagogy and digitalisation, by contrast, are shared across groups, locating the problem in the tacit definition of the qualification rather than in disagreement about how to teach. An exploratory structural model could not link pedagogical orientation to conceptual breadth and, reported honestly, confirms that these data are diagnostic rather than explanatory. The concrete target for that work already exists: the harmonised, EQF/NQF-aligned working definitions of professional training and competence proposed in the companion study (Lebid, 2025) give programmes a ready vocabulary in which communication, responsibility, and autonomy are named rather than assumed. Aligning a programme with a qualifications framework, the study shows, is not finished when the documents comply: it is finished when the people who enact the programme think in all of the framework's dimensions.

Supplementary information. The online version contains a Supplementary Information file with (S1) the verbatim shared-construct items and answer options of the three questionnaires and (S2, Table S1) the Spearman correlations among the five coded indicators.

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Declarations

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Clinical trial number

Not applicable.

Ethics approval and consent to participate

The study was approved by the Commission on Research Ethics of Kryvyi Rih State Pedagogical University; approval No. 48/2024 of 27 March 2024. All procedures involving human participants were performed in accordance with the Declaration of Helsinki and the Law of Ukraine "On Personal Data Protection" (No. 2297-VI of 1 June 2010).

Informed consent was obtained from all individual participants included in the study. All participants were adults. The introduction to each online questionnaire described the purpose of the study, the voluntary and anonymous nature of participation, and the intended publication of aggregated results; participants gave their informed consent electronically before responding. No names or contact details were collected, and no identifiable personal data are reported.

Consent for publication

Not applicable. The manuscript contains no data, images or other material relating to an identifiable individual.

Competing interests

The authors declare no competing interests.

Data availability

The datasets generated during and/or analysed during the current study are available in the GitHub repository, https://github.com/ssemerikov/stakeholder_conceptions.

Author's contributions

L.M.P.: conceptualisation, methodology, investigation, writing – original draft. I.H.L.: conceptualisation, domain expertise, data collection, writing – review and editing. S.O.S.: conceptualisation, methodology, writing – original draft, writing – review and editing. All authors approved the final manuscript.

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