ALIGNING VOCATIONAL EDUCATION CONTENT WITH LABOUR FUNCTIONS: AN ORGANIZATIONAL-PEDAGOGICAL MODEL AND TWO-CIRCUIT ASSESSMENT SYSTEM FOR THE ELECTRICIAN PROFESSION

Bakhodirjon S. Nuridinov

Law Enforcement Academy of the Republic of Uzbekistan, Senior Prosecutor of the Educational and Methodological Department, Candidate of Pedagogical Sciences, Associate Professor

Hasan Yo. Kalanov

Institute for the Development of Professional Education, Tashkent, Uzbekistan, Independent Researcher

Corresponding author e-mail: x.qalanov@edu.uz

Abstract. *Persistent mismatches between the competences cultivated in technical and vocational education and training (TVET) and the competences demanded by employers remain a structural constraint on workforce development, particularly for technically complex blue-collar occupations. This problem is acute in Uzbekistan, where the national qualifications system is still being reconstructed and occupational standards for many manual trades have yet to be elaborated. The present study addresses this gap for the profession 30710502 "Electrician" by designing an organizational-pedagogical model that systematically aligns educational content with normative requirements, employer needs, and authentic labour functions. Adopting a design-based research logic, the model was constructed through four sequential operations: normative-document analysis, competence mapping via a descriptor–competence matrix, pedagogical synthesis, and assessment design. The resulting artefact comprises eight interrelated functional blocks, five implementation conditions, four integrated teaching methods, and a two-circuit assessment system that separates the appraisal of content quality from the appraisal of learner readiness. A monitoring-corrective mechanism couples* *employer feedback and learner performance into a continuous content-updating loop. The model contributes a transferable, competence-anchored design template for technical professions and a methodological basis for raising the quality of electrician training within Uzbekistan's reform agenda. Empirical validation through piloting with learner cohorts and employer panels is delineated as the next research phase.*

Keywords: *technical and vocational education and training; competence-based education; organizational-pedagogical model; electrician training; descriptor–competence matrix; two-circuit assessment; reflective learning; simulation-based training; Uzbekistan.*

1. Introduction

The capacity of a vocational education system to translate occupational reality into teachable, assessable content is increasingly treated as a precondition for economic competitiveness rather than a purely pedagogical concern. Where curricula drift away from the tasks actually performed in the workplace, graduates acquire credentials that the labour market discounts, and employers shoulder the cost of remedial on-the-job training. Comparative evidence indicates that employers continue to value occupationally specific preparation, yet they simultaneously report that the competences supplied by training institutions lag behind those they require (McDonald & Korber, 2023). Reconciling this supply–demand tension is, in essence, a problem of content design: deciding what is taught, in what sequence, under which conditions, and against which standards of judgement.

For Uzbekistan the problem is both pressing and structurally distinctive. Since 2017 the TVET sector has undergone repeated reorganisation; participation has contracted sharply as vocational study shifted from a compulsory to an elective pathway, and institutional governance has been repeatedly redrawn. National diagnostic work has documented a substantial skills mismatch, with a large share of industrial employers unable to recruit adequately qualified workers (Asian Development Bank, 2023). A National Qualifications Framework was approved in 2020, sectoral skills councils have been established, and the elaboration of occupational standards has been prioritised — yet standards for a great many manual trades remain undeveloped, and existing classifications still rest largely on educational attainment rather than demonstrated competence. These reforms are anchored in the New Uzbekistan Development Strategy for 2022–2026 (President of the Republic of Uzbekistan, 2022) and the longer-horizon Uzbekistan-2030 Strategy (President of the Republic of Uzbekistan, 2023), both of which designate the modernisation of qualifications and technical-workforce quality as national priorities.

Within this landscape the profession 30710502 “Electrician” exemplifies the design challenge in a particularly demanding form. The electrician must install, diagnose, and maintain electrical equipment independently, document the work, and — crucially — do so under safety constraints where error is not merely inefficient but potentially lethal. Content for such a profession cannot be specified as a list of topics; it must be organised so that knowledge, manual operation, judgement, and safety discipline are developed and assessed together. The aim of this article is therefore to design and articulate an organizational-pedagogical model that aligns the content of electrician training with labour functions and qualification requirements, and to specify the conditions, methods, and assessment logic through which such alignment can be operationalised and sustained.

The contribution is threefold. First, we propose an eight-block architecture that binds the normative, design, process, and outcome dimensions of content into a single regulated system rather than treating them as separate documents. Second, we formulate a *two-circuit* assessment logic that deliberately separates the evaluation of programme quality from the certification of individual readiness — a separation that, we argue, is frequently conflated in practice. Third, we embed a monitoring-corrective feedback loop so that content remains responsive to evolving practice and regulation. The remainder of the article reviews the relevant literature, sets out the design methodology, presents the model and its components with supporting tables and figures, discusses its theoretical and practical significance, and concludes with recommendations and an agenda for empirical validation.

2. Literature Review

The conceptual foundation of the present design lies in the competence-based education (CBE) tradition. Its taxonomic roots reach back to the systematic classification of cognitive objectives (Bloom et al., 1956), which established that learning intentions can be specified at graduated levels of complexity, and were later extended toward the behavioural modelling of occupational excellence (Spencer & Spencer, 1993). Contemporary syntheses confirm that CBE's defining features — mastery-based progression, authentic assessment, and the integration of workplace learning — are associated with stronger career readiness, while also cautioning that implementation depends on robust assessment systems, teacher preparation, and curricular redesign that institutions frequently underestimate. In engineering and technical fields specifically, the migration from content-delivery models toward competence-based designs is now the most strongly advocated reform direction (Malhotra et al., 2023), precisely because it forces an explicit mapping between learning outcomes and occupational performance.

A second strand concerns the alignment mechanism itself. The principle of constructive alignment (Biggs & Tang, 2011) holds that intended outcomes, teaching activities, and assessment tasks must be mutually consistent if learning is to be valid; misalignment among these three elements is a primary source of the credential–competence gap noted above. Qualifications frameworks operationalise this principle at system level: the European Qualifications Framework (European Commission, 2008) expresses learning as descriptors of knowledge, skills, and autonomy, providing a template that national frameworks — including Uzbekistan's — have sought to emulate. The descriptor logic is attractive for design because it renders competence simultaneously teachable and assessable, but it leaves open the practical question of how descriptors are to be linked to concrete tasks and tools in a specific trade.

A third strand addresses how technical competence is actually formed. Experiential and reflective traditions — the learning cycle of concrete experience, reflection, conceptualisation, and experimentation (Kolb, 1984), and the notion of the reflective practitioner who reasons in and on action (Schön, 1983) — supply the pedagogical rationale for organising electrician training around authentic tasks and structured self-correction; recent systematic revisits of Kolb's model confirm its continued centrality while refining its stages (Morris, 2020). Within technical TVET, simulation has emerged as the principal means of practising hazardous or rare operations safely: a systematic review of innovations in electrical engineering TVET reports that simulation-based and immersive approaches, alongside project-based learning, dominate recent practice and yield measurable gains in factual knowledge, even as their effects on higher-order transfer remain uneven (Fathulloh et al., 2025). For the electrical domain in particular, high-fidelity simulation has been used to cultivate both technical and non-technical "situated" skills and to foster the safety-oriented reflexivity that distinguishes competent practitioners. These findings directly motivate two design commitments adopted here: the use of simulation for safety-critical practice, and the treatment of reflection as an assessable component rather than an incidental by-product.

Finally, the literature is consistent on an enabling condition that is easily overlooked: the readiness of teachers and trainers. Reviews of VET educators' professional and digital competence repeatedly find current proficiency to be moderate at best and frameworks to be underdeveloped (Wu et al., 2025), implying that any content model is only as strong as the pedagogical capacity available to enact it. Taken together, the literature establishes the components of an effective design — competence descriptors, constructive alignment, experiential and simulation-based methods, reflective assessment, and capable trainers — but stops short of integrating them into a single, regulation-anchored system for a specific high-risk trade in a transition economy. It is this integrative gap that the present model is designed to fill.

3. Research Methodology

The study is methodologically a design-based research effort: its object is not the testing of a pre-existing intervention but the principled construction of a pedagogical artefact whose components are justified by normative requirements and prior evidence. Accordingly, the "results" reported below are the designed model and its constituent instruments, and the validity claimed at this stage is design validity — internal coherence, traceability to standards, and feasibility — rather than empirical effect. The construction proceeded through five phases, summarised in Figure 1.

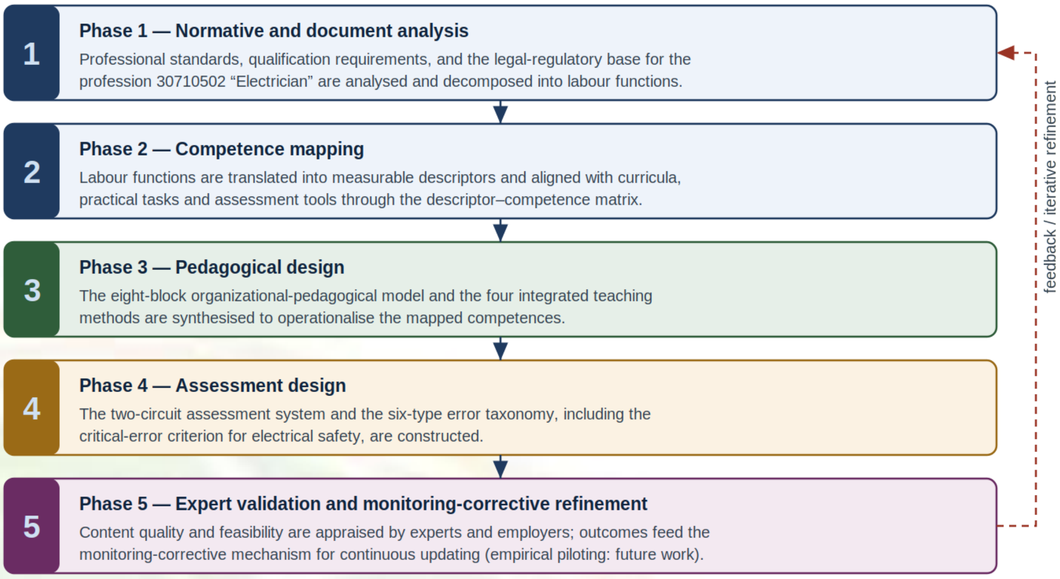

Figure 1. The five-phase design-based research procedure used to construct the organizational-pedagogical model.

In the first phase, the professional standard and qualification requirements for the profession 30710502 "Electrician", together with the governing legal and regulatory base, were analysed and decomposed into discrete labour functions such as installation, measurement, diagnostics, maintenance, and documentation. In the second phase these functions were translated into measurable descriptors and arranged in a descriptor–competence matrix that cross-references each descriptor with the curriculum element, practical task, and assessment instrument intended to develop and evidence it; the matrix is the device that enforces constructive alignment across the design. The third phase synthesised the pedagogical architecture — the eight functional blocks and the four integrated teaching methods — so as to operationalise the mapped competences. The fourth phase constructed the assessment apparatus, including the two-circuit logic and the error taxonomy with its critical-error rule for electrical safety. The fifth phase subjects content quality and feasibility to expert and employer appraisal and routes the outcomes into the monitoring-corrective mechanism; the dashed return path in Figure 1 denotes the iterative refinement that this appraisal triggers. Empirical piloting with learner cohorts and employer panels, together with the psychometric validation of the assessment instruments, lies beyond the present design study and constitutes its immediate continuation.

4. Results: The Organizational-Pedagogical Model

4.1. Architecture of the model

The model is organised as a single regulated system in which content is designed, enacted, evaluated, and renewed without leaving the architecture. Its eight blocks are grouped into four layers — foundation, design, process, and outcome — and are bound by a feedback loop, as shown in Figure 2. The functional composition of each block is detailed in Table 1.

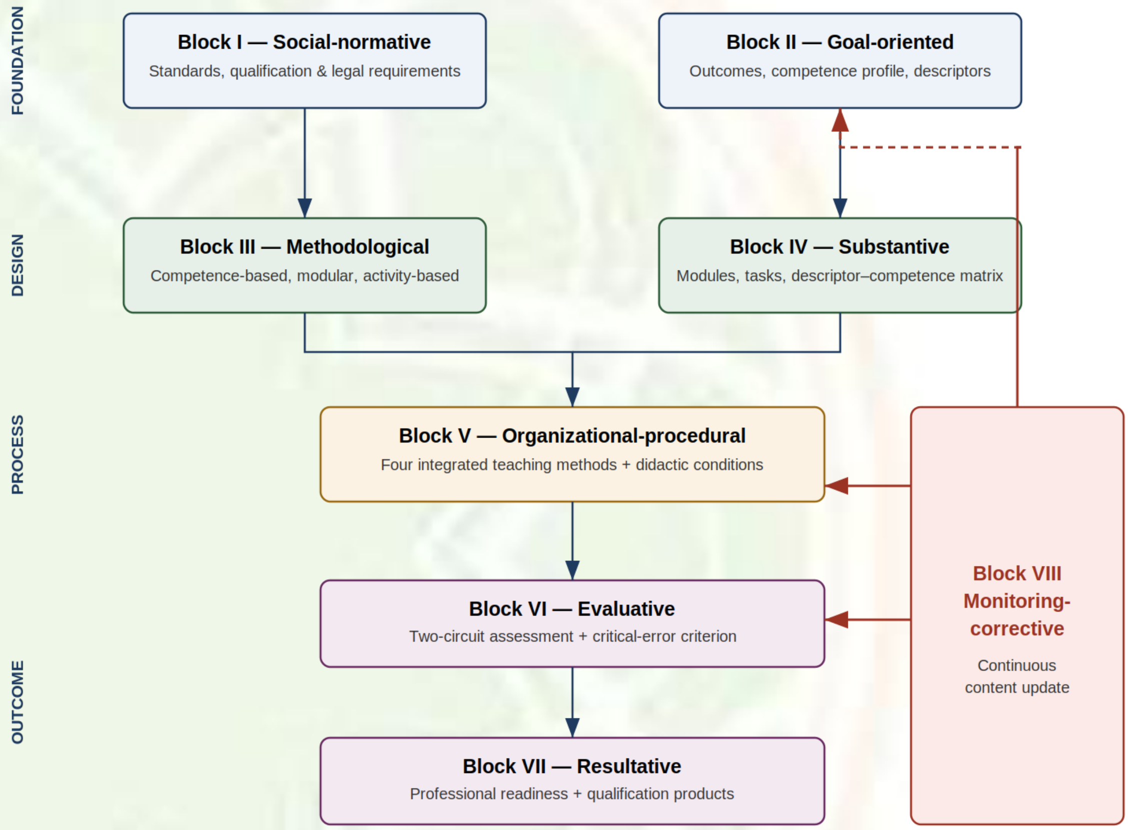

Figure 2. Block architecture of the organizational-pedagogical model for the profession 30710502 “Electrician”, showing the four layers and the monitoring-corrective feedback loop.

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Table 1. *Functional composition of the eight blocks of the organizational-pedagogical model.*

Block	Designation	Core content	Function in the system
I	Social-normative	Professional standards, qualification requirements, legal-regulatory base	Anchors content to external authority and labour-market legitimacy
II	Goal-oriented	Learning outcomes, competence profile, qualification descriptors	Converts requirements into measurable targets
III	Methodological	Competence-based, modular, and activity-oriented approaches	Supplies the design rationale linking targets to instruction
IV	Substantive	Training modules, professional tasks, descriptor–competence matrix	Specifies what is taught and aligns it with tasks and assessment
V	Procedural	Four integrated teaching methods and didactic conditions	Enacts content as authentic professional activity
VI	Evaluative	Two-circuit assessment and critical-error criterion	Judges programme quality and learner readiness separately
VII	Resultative	Level of professional readiness, qualification products	Expresses outcomes as certifiable attainment

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Block	Designation	Core content	Function in the system
VIII	Monitoring-corrective	Continuous monitoring and content-updating mechanism	Feeds evidence back to keep content current

Table 1 makes explicit a property that prose alone obscures: each block discharges a distinct regulatory function, and the blocks form a closed control loop rather than a linear syllabus. The foundation layer (Blocks I–II) imports external legitimacy and converts it into targets; the design layer (Blocks III–IV) is where the descriptor–competence matrix does its alignment work; the process layer (Block V) enacts content as activity; and the outcome layer (Blocks VI–VII) certifies both the programme and the learner. The decisive structural feature is Block VIII, whose feedback path returns evidence to the upstream blocks. We contend that it is this loop — not the inventory of blocks — that differentiates the model from a conventional curriculum document: it institutionalises revision, so that misalignment surfaced in assessment or in employer feedback is structurally obliged to re-enter design rather than accumulate as drift.

4.2. Conditions for implementation

An architecture specifies what must exist; it does not guarantee that it will function. The model therefore stipulates five organizational-pedagogical conditions, each paired in Table 2 with an observable indicator that allows an institution to verify whether the condition is met rather than merely asserted.

Table 2. *Organizational-pedagogical conditions for implementing the model and their fulfilment indicators.*

#	Condition	Indicator of fulfilment
1	Alignment of qualification requirements, curricula, practical tasks, and assessment tools through the descriptor–competence matrix	A completed matrix in which every descriptor maps to a task and an assessment instrument, with no unmapped cells

#	Condition	Indicator of fulfilment
2	Active employer participation in defining labour functions, validating tasks, and assessing outcomes	Documented employer sign-off on task lists and participation in final assessment panels
3	Professional-methodological readiness of subject teachers and masters of industrial training	Trainers certified against the competences they teach; periodic methodological upgrading
4	Regular use of training stands, measuring and diagnostic instruments, technical documentation, virtual laboratories, and simulation environments	Scheduled, logged learner access to physical and simulated equipment across modules
5	Periodic correction of content on the basis of learner performance and employer feedback	A revision record showing content changes traced to specific feedback or performance data

Reframing the conditions as indicators converts them from aspirations into auditable commitments, which is the analytical purpose of Table 2. Two of the five conditions deserve emphasis because the wider literature identifies them as common points of failure. Condition 3 reflects the repeated finding that trainer capacity, not curriculum text, is the binding constraint on competence-based reform (Wu et al., 2025): a matrix-aligned programme delivered by under-prepared trainers will underperform regardless of its design. Condition 4 reflects the evidence that authentic and simulated practice is what converts declarative knowledge into operational skill in electrical work; without logged, regular access to instrumentation and simulation, the procedural layer of the model cannot function as intended. The conditions thus operate as a feasibility gate: they identify, in advance, the institutional investments without which the architecture remains inert.

4.3. Integrated teaching methods

The procedural layer (Block V) is realised through four methods applied in combination. They are not advanced as pedagogical novelties but as established approaches deliberately configured to the labour functions of the electrician. Each method carries an explicit theoretical warrant, a characteristic learner activity, and a documented output that simultaneously serves learning and assessment; these correspondences are set out in Table 3.

Table 3. *The four integrated teaching methods and their didactic characteristics.*

Method	Theoretical basis	Core learner activity	Documented output
Project-constructive	Constructive alignment (Biggs & Tang, 2011)	Planning professional activity from analysis of the technical task to selection of tools and technological sequence	Work plan, schematic, technological sequence
Situational-diagnostic	Diagnostic reasoning under uncertainty	Analysing fault symptoms, hypothesising causes, justifying decisions from measurements	Diagnostic protocol, fault tree, defect report, test record
Simulation-practical	Reflective practice (Schön, 1983); safe practice of hazardous tasks	Performing complex, hazardous, or rare operations under controlled simulated conditions	Operation log assessed for sequence, safety

Method	Theoretical basis	Core learner activity	Documented output
			compliance, and decisions
Reflective-corrective	Experiential learning cycle (Kolb, 1984); revised by Morris (2020)	Analysing one’s performance against criteria, explaining error causes, planning correction	Reflective analysis and corrective plan classified by error type

The pedagogical significance of Table 3 lies in its final column. By requiring each method to terminate in a documented artefact, the design dissolves the usual boundary between teaching and assessment: the work plan, the diagnostic protocol, the simulated-operation log, and the reflective-corrective plan are at once learning activities and assessment evidence. This is constructive alignment realised at the level of the individual task. Moreover, the four methods are sequenced to build cumulatively — from planning, through diagnosis and simulated execution, to reflective correction — and thereby drive the learner along the readiness trajectory examined in Section 4.4 and depicted in Figure 4. The treatment of simulation as a safe rehearsal space for hazardous operations, and of reflection as an assessable output, follows directly from the evidence reviewed in Section 2 and represents the point at which general method is specialised to the risk profile of electrical work.

4.4. The two-circuit assessment system and levels of readiness

Assessment in the model is deliberately bifurcated. The evaluative block separates two objects that are commonly conflated: the quality of the educational content and the readiness of the learner. Treating them as a single judgement allows a weak programme to be masked by lenient learner grades, or a capable learner to be penalised for deficiencies in the programme. The two-circuit design, shown in Figure 3, keeps the two appraisals on independent registers whose results are recorded separately and then jointly analysed in the monitoring-corrective block.

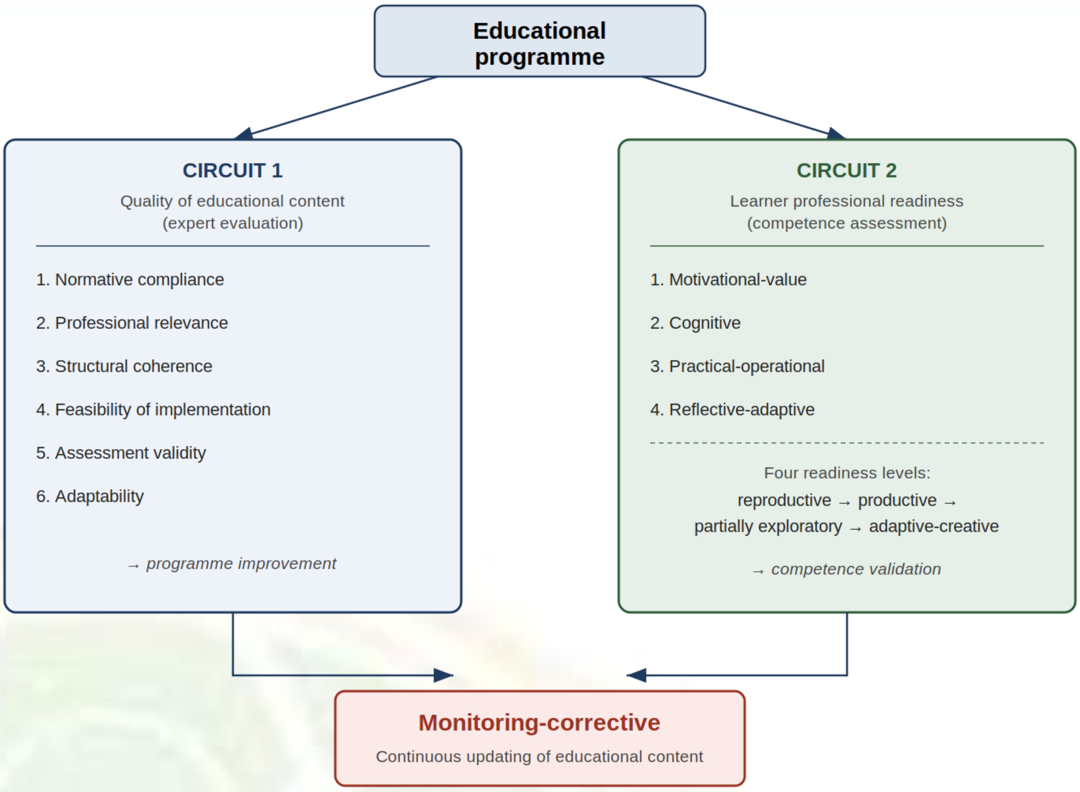

Figure 3. The two-circuit assessment system: content-quality appraisal (Circuit 1) and learner-readiness appraisal (Circuit 2) feeding a common monitoring-corrective mechanism.

Circuit 1 appraises content against six expert criteria — normative compliance, professional relevance, structural coherence, feasibility of implementation, assessment validity, and adaptability — derived from the behavioural competence model of Spencer and Spencer (1993). Circuit 2 appraises the learner across four competence dimensions: the motivational-value dimension (attitude to the profession and responsibility for outcomes), the cognitive dimension (understanding of electrical processes, reading of schematics, interpretation of measurements), the practical-operational dimension (correct installation, measurement, diagnostic, and repair operations), and the reflective-adaptive dimension (self-assessment, error identification, and adaptation to changed conditions). The learner's standing on these dimensions resolves into one of four ordered levels of professional readiness, specified in Table 4 and visualised as an ascending trajectory in Figure 4.

Table 4. *Levels of professional readiness for the electrician profession.*

Level	Descriptor	Autonomy	Typical electrical task
Reproductive	Performs on the basis of a model and explicit instructions	Guided	Wiring a lighting circuit by following a given schematic
Productive	Independently performs standard tasks	Independent on standard tasks	Installing and commissioning a distribution board to specification
Partially exploratory	Analyses a problem and justifies decisions	Independent under uncertainty	Diagnosing an intermittent fault from measurement data
Adaptive-creative	Devises new work algorithms for non-standard situations	Self-directing	Designing a safe procedure for an unfamiliar installation constraint

Table 4 operationalises readiness as a progression in autonomy and task complexity rather than as an accumulation of marks, mirroring the knowledge–skills–autonomy logic of descriptor-based frameworks (European Commission, 2008). Read together with Figure 4, it clarifies how the four methods of Section 4.3 function as an engine of progression: project-constructive and situational-diagnostic work establishes reproductive and productive performance, while simulation-practical and reflective-corrective work pushes learners into the exploratory and adaptive-creative bands where judgement, not repetition, is decisive. The pedagogical claim embedded in the design is that the higher levels cannot be reached by didactic transmission alone; they require the reflective and simulated practice that the procedural layer supplies.

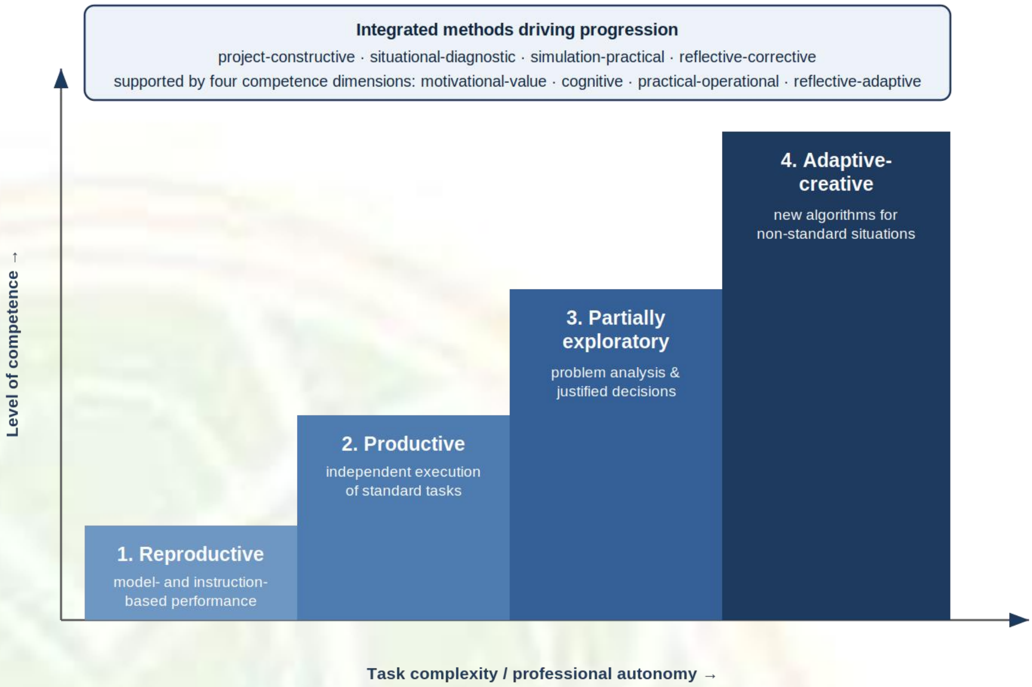

Figure 4. Trajectory of professional readiness and its integrated methodological drivers.

4.5. Error taxonomy and the critical-error criterion

Because assessment in a high-risk trade must discriminate between errors that signal incomplete learning and errors that signal danger, the model classifies learner errors into six types and singles out a category of critical error. The taxonomy, with an illustrative manifestation and the corrective focus appropriate to each type, is given in Table 5.

Table 5. *Taxonomy of learner errors and the corrective focus of each type.*

Error type	Illustrative manifestation in electrical work	Corrective focus
Conceptual	Misunderstanding the relationship between current, voltage, and load	Reconstruct underlying principles
Algorithmic	Performing operations in an incorrect or incomplete sequence	Rehearse the correct procedure
Operational	Faulty manual execution of a correctly planned step	Targeted skill practice
Diagnostic	Misreading instruments or misattributing a fault's cause	Strengthen measurement and reasoning
Documentation	Incomplete or inaccurate protocols, reports, or records	Improve recording discipline
Safety-related	Beginning work without verifying absence of voltage; hazardous connections; misuse of instruments	Critical error: mandatory re-performance after corrective exercise

The analytical force of Table 5 is in its last row. Whereas the first five error types calibrate the corrective response to the nature of the deficit, a safety-related error is treated categorically: it is designated a critical error and, irrespective of the quality of the surrounding work, mandates a corrective exercise and re-performance before the task can be credited. This rule encodes a professional value into the assessment logic — that in electrical work an otherwise excellent performance containing a safety violation is a failed performance. It aligns the model with evidence that safety-oriented reflexivity is a defining marker of competent electrical practitioners and that simulation is the appropriate venue in which such reflexivity can be rehearsed without exposing learners to live hazard.

5. Discussion

The model advances the competence-based tradition in three connected respects. First, it converts the abstract principle of constructive alignment into an operational instrument — the descriptor–competence matrix — that makes misalignment visible at the level of individual descriptors, tasks, and assessment instruments. Where qualifications frameworks specify descriptors and CBE theory specifies the alignment requirement, the matrix supplies the missing connective tissue for a particular trade. Second, the two-circuit assessment design contributes a structural solution to a recurrent measurement problem: by separating the appraisal of programme quality from the certification of learner readiness, it prevents each from contaminating the other and supplies the monitoring-corrective block with two clean evidentiary streams rather than one confounded grade. Third, the explicit error taxonomy and critical-error rule embed professional and safety judgement directly into assessment, addressing the well-documented unevenness of higher-order and transfer outcomes in technical training by making judgement itself an assessed object.

Situated against the empirical literature, the design choices are mutually reinforcing rather than merely additive. The reviewed evidence that simulation-based and project-based methods now dominate effective electrical TVET (Fathulloh et al., 2025), and that high-fidelity simulation can cultivate the situated, safety-oriented skills of electrical workers, supports the model's reliance on simulated practice for hazardous operations and its treatment of safety as a categorical assessment criterion. The continued centrality of the experiential cycle (Kolb, 1984; Morris, 2020) and of reflective practice (Schön, 1983) supports the reflective-corrective method and the inclusion of a reflective-adaptive competence dimension. At the same time, the literature's consistent warning about trainer readiness (Wu et al., 2025) is precisely why the model elevates trainer capacity to an explicit, auditable implementation condition rather than an assumption. In the Uzbek setting, where occupational standards for many trades are still being written and a skills mismatch is documented (Asian Development Bank, 2023), the model offers a concrete template for producing standard-anchored, employer-validated content for one such trade, and a method that could be transferred to others.

Several limitations must be stated plainly. The present contribution is a design, not an evaluation: the claims advanced are claims of internal coherence, traceability, and feasibility, not of measured effectiveness. The descriptor–competence matrix and the assessment instruments require psychometric scrutiny — inter-rater reliability for the expert criteria of Circuit 1, and construct validity for the four competence dimensions of Circuit 2 — before strong inferences about learner outcomes can be drawn. The model also presupposes institutional capacity (instrumentation, simulation environments, prepared trainers, willing employer partners) that is unevenly distributed across the Uzbek TVET network, so feasibility will vary by site. Finally, while the architecture is intended to be transferable to other technical professions, that transferability is at present a design conjecture rather than a demonstrated result.

6. Conclusion and Recommendations

This study set out to design a system through which the content of electrician training can be aligned with labour functions and qualification requirements and kept aligned over time. The resulting organizational-pedagogical model unites the design, enactment, assessment, and renewal of content within a single regulated architecture of eight blocks, made operable by five auditable conditions, four integrated teaching methods, a two-circuit assessment system, and a monitoring-corrective feedback loop. Its central insight is structural: alignment is not achieved by writing a better syllabus once, but by building a control loop that obliges content to be corrected whenever assessment or employer feedback reveals drift.

On this basis we offer four recommendations. For institutions, the descriptor–competence matrix should be adopted as the primary design document, with the no-unmapped-cells rule of Condition 1 treated as a gate on programme approval. For policy, the elaboration of occupational standards for manual trades — the documented bottleneck in the national qualifications reform — should be coupled with templates of this kind so that standards translate directly into teachable, assessable content rather than remaining declarative. For trainer development, the readiness condition should be backed by certification of trainers against the very competences they teach, since trainer capacity is the binding constraint identified across the literature. For research, the immediate priority is empirical validation: piloting the model with learner cohorts and employer panels, establishing the reliability and validity of the two assessment circuits, and testing the architecture's transferability to adjacent technical professions. Pursuing these steps would convert a coherent design into evidenced practice and would contribute, in a concrete and transferable way, to the quality of technical-workforce preparation that Uzbekistan's development strategies have made a national priority.

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