European International Journal of Pedagogics

TYPE Original Research
PAGE NO. 49-53
DOI 10.55640/eijp-05-08-12

Effective Mechanisms For Developing Professional Competencies Of Student-Practitioners In The Dual Education System

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OPEN ACCESS

SUBMITED 30 June 2025
ACCEPTED 29 July 2025
PUBLISHED 31 August 2025
VOLUME Vol.05 Issue08 2025

Abstract: The growing complexity of the labor market and the accelerating pace of technological change require education systems to cultivate not only knowledge but durable professional competencies that transfer to real workplaces. Dual education—alternating, planned periods of study at an educational institution and practice at a partner enterprise—offers a structural response to this challenge. This article identifies and explains effective mechanisms for developing professional competencies of student-practitioners within dual programs. Using a design-science orientation supported by an integrative review of international scholarship and a practice-informed analysis of dual partnerships, the study articulates a coherent mechanism map that links curriculum co-design, authentic workplace tasks, triadic mentorship, formative assessment, reflective technologies, and data-enabled feedback loops to measurable competency growth and smoother school-to-work transitions. The findings provide a practical blueprint for institutions and enterprises seeking to professionalize dual education and to increase graduates' employability, adaptability, and professional identity formation.

Keywords: Dual education; professional competence; work-based learning; curriculum co-design; mentorship; formative assessment; e-portfolio; employability.

Introduction: Ensuring that graduates can productively enter and adapt to dynamic labor markets is a persistent priority for vocational and higher professional education. Conventional school-based models have struggled to keep pace with emergent technologies, agile production systems, and new forms of

organization that demand hybrid skill profiles. These pressures have revitalized interest in dual education models that integrate academic learning with structured, mentored practice in real workplaces. By design, dual programs promise to bridge the historically problematic "theory–practice gap" through alternation: learners move between institutional learning environments and partner enterprises on carefully planned cycles, carrying conceptual tools into practice while bringing back problems and artifacts for further study.

However, dual structures alone do not guarantee competence development. The effectiveness of dual education depends on the mechanisms embedded within that structure—how curriculum is co-designed with employers; how workplace tasks are aligned with explicit competence standards; how mentoring relationships are configured and supported; how assessment evidences holistic performance rather than isolated knowledge; and how feedback and reflection drive progressive identity formation. Without such mechanisms, dual programs can degrade into mere placements that reproduce routine work rather than cultivate transferable professional capabilities.

This article addresses a central question: Which mechanisms most effectively develop professional competencies of student-practitioners in dual education, and how can these mechanisms be coherently orchestrated? The inquiry is anchored in three theoretical streams. First, experiential learning theory explains how concrete experience, reflective observation, abstract conceptualization, and active experimentation interact in iterative cycles to produce robust learning. Second, situated learning and legitimate peripheral participation highlight the social and cultural embedding of skill development in communities of practice, emphasizing the role of participation trajectories, norms, and identities. Third, competence-based education advances outcome clarity through standards and rubrics that integrate knowledge, skills, and professional dispositions.

Translating these theories into operational designs requires deliberate institutional arrangements. Competency frameworks must be jointly authored with enterprises and updated against occupational standards. Workplace tasks must be structured as learnable, increasing in complexity, and accompanied by mentoring that makes tacit knowledge explicit. Assessment must capture performance in authentic conditions while enabling formative dialogue that guides improvement. Reflection requires artifacts and tools—such as e-portfolios and video-supported analysis—through which learners externalize, examine, and reframe their practice. Finally, learning analytics and routine triadic reviews must close the loop, connecting student evidence, mentor judgments, and curricular adjustments.

Building on these premises, the present study proposes a mechanism map for dual education, explains its logic, and outlines implementation principles that institutions and enterprises can adopt to professionalize their collaboration, strengthen learners' competence trajectories, and increase the reliability of evaluative claims about readiness for employment.

The study followed a design-science methodology in education, which seeks to develop, rationalize, and iteratively refine an intervention—in this case, a coherent mechanism map for competence formation in dual programs—while grounding design choices in theoretical and empirical literature and practice-based constraints. The methodological approach comprised three interlinked activities.

First, an integrative review synthesized scholarship on work-based and dual learning, mentorship in practice environments, competence-based assessment, e-portfolios, and the role of reflection and feedback in professional formation. Priority was given to sources that provide conceptual clarity on competence integration and on the conditions that support learning in and from work. The review yielded design principles concerning authenticity, scaffolding, social participation, formative assessment, and feedback loops.

Second, the study conducted a practice analysis of common dual education arrangements, drawing on documented cases and policy guidance that describe roles, responsibilities, and quality assurance in partnerships between educational providers and enterprises. This analysis identified recurring coordination challenges—misalignment of tasks with curriculum, variable mentor capacity, and limited formative assessment—which the proposed mechanisms aim to address.

Third, the initial mechanism map and its operational elements were subjected to expert validation through structured critique by practitioners experienced in dual programs and by academic staff with expertise in curriculum, assessment, and educational technology. Feedback focused on feasibility, clarity of roles, and assessment integrity. Revisions improved the specificity of rubrics, the scheduling of triadic reviews, and the articulation of digital supports.

The outcome of these methods is not a statistical generalization but a robust design proposition: a theoretically grounded and practice-attuned mechanism configuration that institutions and

enterprises can adopt and adapt. The "Results" section presents the refined mechanism map, its rationale, and its expected educational and employment-related effects.

The study produced a mechanism map that organizes competence development in dual education around five mutually reinforcing processes: co-designing competence-aligned curricula and tasks; structuring mentored participation and progressive responsibility; embedding formative assessment and feedback in authentic performance; enabling reflection and evidence curation through digital artifacts; and closing the improvement loop with analytics-informed reviews and micro-credentials. Each process is theoretically justified and operationally specified so it can be implemented within standard academic calendars and enterprise workflows.

Competence-aligned curricula and tasks establish the foundation. Educational providers and enterprises agree on explicit competency standards that integrate knowledge, technical skills, and professional dispositions relevant to targeted roles. These standards are expressed as assessable outcomes with performance levels and behavioral indicators. The alternation schedule is then planned so that institutional modules provide conceptual tools and simulated practice immediately before workplace periods in which learners apply those tools to real tasks. Authenticity is ensured by mapping workplace tasks directly to competence descriptors and by sequencing them in ascending complexity. This direct mapping prevents the dilution of workplace learning into routine assistance and instead positions tasks as deliberate learning opportunities with clear expectations.

Mentored participation provides the social and instructional structure needed to make workplace learning fertile. Each student-practitioner is supported by a triad: an enterprise mentor with domain expertise, an institutional supervisor responsible for curricular coherence, and the student as an active agent. The triad negotiates learning goals at the start of each workplace cycle and monitors progress through brief, scheduled check-ins. Mentors use modeling, coaching, and scaffolding to render tacit practices visible, to circulate professional language, and to support increasingly independent performance. Progressive responsibility is formalized through a negotiated task ladder, allowing learners to move from observation and guided execution to semi-autonomous work, and finally to leading bounded projects. These stages accelerate identity formation by positioning learners as legitimate participants who are entrusted with meaningful contributions.

Formative assessment and feedback transform participation into competence. Performance rubrics derived from the agreed standards are used in the workplace to gather evidence across multiple tasks and contexts. Assessment is not a one-off event but a series of observation-feedback cycles in which mentors provide concrete, criterion-referenced comments that learners immediately apply. Institutional supervisors review the same evidence to ensure alignment with curricular outcomes and to calibrate judgments across enterprise settings. This distributed assessment enhances reliability and focuses all parties on developmental feedback rather than inspection alone.

Reflection and evidence curation anchor learning in durable artifacts. Student-practitioners maintain an e-portfolio that collects exemplars of work products, mentor feedback, short reflective narratives, and where possible, video snippets of practice annotated to highlight decision points, errors, and corrections. The portfolio is organized by competence descriptors, making progress visible and enabling learners to connect experience with theory. Reflection tasks are designed, not incidental: at the close of each cycle, learners produce structured reflections that articulate what changed in their understanding, how they adapted their strategies, and what gaps remain. These artifacts support assessment validity by triangulating claims with concrete evidence.

Analytics-informed reviews and micro-credentials complete the loop. A lightweight dashboard aggregates portfolio evidence, rubric ratings, and mentor comments, giving the triad a shared view of development. Scheduled triadic reviews use this data to set new goals and adjust learning opportunities, and the institution compiles anonymized cohort-level analytics to refine curricula and placement practices. As learners demonstrate consistent performance at the "proficient" level on a descriptor, the institution issues a micro-credential tied to that competency, co-badged by the enterprise where evidence was produced. These credentials communicate granular capabilities to employers and motivate learners by making progress tangible.

The interaction of these processes produces coherent program effects. Authentic tasks aligned with explicit competencies, coupled with mentored participation and progressive responsibility, create rich learning conditions in which knowledge and skill are integrated in situated activity. Formative assessment anchored in shared rubrics shapes feedback that is immediately actionable, while structured reflection consolidates learning and supports identity formation. Analytics and micro-credentials provide transparency and recognition, sustaining engagement and enabling

curricular improvement. Together, the mechanisms reduce transition frictions at graduation, increase employability and retention, and improve the responsiveness of educational programs to evolving occupational standards.

Interpreting the mechanism map through established theories clarifies why it produces durable competence gains. Experiential learning theory explains how the alternation of study and work, when deliberately sequenced, creates repeated cycles in which learners conceptualize methods at the institution, try them in practice, observe outcomes, and refine their understanding. Situated learning emphasizes that competence emerges through legitimate participation in communities of practice; the triadic mentorship model ensures that participation is both authentic and pedagogically supported. Competence-based education contributes explicit standards and rubrics that transform authenticity into assessable development, making the tacit visible and the complex tractable.

The design also addresses known failure modes in dual programs. When workplace tasks are not mapped to curricular outcomes, learning becomes incidental; by formalizing alignment and progressive responsibility, the model prevents the drift toward routine assistance. When mentoring capacity is uneven, learners may be excluded from consequential practice; by defining mentor roles, offering coaching scripts, and scheduling triadic reviews, the design systematizes support. When assessment is episodic or purely summative, it fails to guide development; by embedding iterative, criterion-referenced feedback and linking it to portfolio evidence, the model builds formative momentum and assessment validity. Finally, when learners cannot narrate their growth, identity formation stalls; by structuring reflection and recognizing progress with micro-credentials, the design strengthens self-efficacy and professional identity.

Implementation, however, depends on enabling conditions. Enterprises must commit to co-design and to reserving learnable tasks that expose learners to meaningful decisions rather than only to low-complexity support work. Institutions must provide time and training for mentors and supervisors and must invest in simple digital infrastructure that reduces administrative load while increasing transparency. Quality assurance should emphasize calibration sessions in which mentors and supervisors apply rubrics to sample evidence to align expectations. Program governance must include routine review of analytics to adjust curricula, refine placement matching, and retire outdated competencies as technologies and workflows evolve.

Limitations are acknowledged. The mechanism map is a design proposition built from theory and practice-informed analysis rather than a single, large-scale randomized evaluation. Enterprise heterogeneity means that task availability, mentoring practices, and organizational culture will vary, affecting fidelity. Assessment validity depends on the disciplined use of rubrics and on triangulation of evidence; without calibration, reliability may suffer. Future work should include multi-site evaluations that examine competence trajectories longitudinally and that estimate effects on employment outcomes and early-career performance. Research should also explore equity dimensions—how mechanisms can ensure that all learners, including those in smaller enterprises with fewer resources, gain access to high-quality learning opportunities.

Despite these constraints, the mechanisms are actionable. Many institutions already possess competence frameworks and nascent e-portfolio systems; enterprises routinely conduct appraisals that can be adapted into formative observations. The contribution of this article lies in articulating a coherent orchestration that ties these elements into a closed-loop system oriented toward learning, development, and transparent recognition.

Dual education can deliver on its promise only when its structures are animated by mechanisms that connect theory and practice in ways that are explicit, assessable, and developmental. The mechanism map presented in this article specifies how competence-aligned task design, triadic mentorship with progressive responsibility, embedded formative assessment, structured reflection via e-portfolios, and analytics-enabled reviews with micro-credentials integrate into a coherent system. Grounded in experiential, situated, and competence-based learning theories, these mechanisms offer institutions and enterprises a practical blueprint to accelerate the professional growth of student-practitioners, improve the validity and reliability of competence claims, and enhance employability in dynamic labor markets. Implemented with attention to calibration, equity, and continuous improvement, the model can transform dual programs from placement logistics into high-fidelity professional formation.

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