

The Problematic of Teacher Training Engineering in Light of the Competency-Based Approach and Educational Technology: Realities and Prospects

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Abstract

Pedagogical teacher training occupies a central position within educational systems globally, including in Algeria. International benchmark experiences—notably in Finland and Malaysia—demonstrate that teacher competence is intrinsically tied to the structural quality, systemic coherence, and operational efficacy of training content engineering. Despite sustained educational reform initiatives launched in Algeria since 2003, prevailing training practices expose an acute disconnect between formalized training curricula and the authentic pedagogical demands of classroom execution. This paper investigates the conceptual framework of pedagogical training engineering and deconstructs the current realities and operational bottlenecks characterizing teacher training in Algeria. It examines the critical challenges confronting practitioners, explores alternative developmental models drawn from leading international paradigms, and articulates a strategic reform agenda responsive to contemporary pedagogical imperatives—specifically the Competency-Based Approach (CBA) and educational technology (EdTech) integration. Finally, the study advances actionable, policy-level recommendations designed to elevate the engineering of pedagogical training, fostering sustainable improvements in both instructional efficacy and student learning outcomes.

Keywords: Pedagogical Training Engineering; Teacher Education; Competency-Based Approach (CBA); Educational Technology; Teacher Professional Development; Algerian Educational System.

Introduction

Contemporary educational discourse places paramount emphasis on the pivotal role of the teacher, underscoring the urgent imperative for robust professional qualification, continuous upskilling, and lifelong professional development. Worldwide, high-performing educational jurisdictions have confirmed that educator competence correlates directly with the rigorous engineering of instructional and training architecture. Successful models in countries such as Finland and Malaysia illustrate that high-caliber student learning is an organic byproduct of well-engineered, responsive teacher training ecosystems (Hammerness et al., 2012; OECD, 2018).

In Algeria, extensive systemic reforms were initiated in 2003 to overhaul national educational structures. However, current field assessments reveal an enduring disparity between pre-service and in-service training curricula and the nuanced realities of classroom instruction (Ministry of National Education [MNE], 2015). In educational sciences, training engineering operates as an intentional, systematic methodology for conceptualizing, structuring, implementing,

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and evaluating developmental programs. Its primary objective is cultivating professional competencies and elevating pedagogical performance through meticulous needs analysis, instructional design, implementation fidelity, and multidimensional assessment, all while accounting for practitioner cognitive profiles and dynamic socio-technical environments.

Accordingly, this study delineates the conceptual contours of pedagogical training engineering, unpacks the structural realities and institutional impediments within the Algerian context, examines benchmarked international practices, and proposes an integrated conceptual framework reconciling the Competency-Based Approach with modern educational technology.

I. Conceptual Framework and Terminology

1. Pedagogical Training Engineering (*Ingénierie de la Formation Pédagogique*)

Training engineering designates an organized, systematic mechanism for designing and executing instructional programs, tailored either for inducting novice practitioners or upskilling active educational personnel. Its overarching objective is driving positive, sustained transformations across cognitive knowledge bases, professional behaviors, and instructional attitudes, thereby enhancing overall operational productivity and competency (Abdel Rahim, 2018; Al-Jawhari, 2005). Methodologically, it constitutes a deliberate process of curriculum planning that maintains structural alignment among operational objectives, content architecture, instructional strategies, and evaluative mechanisms, ensuring tight alignment with socioeconomic requirements and institutional standards (Hamdan, 2017; Zidan, 2009).

2. Pedagogical Teacher Training

Pedagogical training serves as an essential pillar in teacher preparation, extending beyond passive theoretical acquisition to forge practical, professional competencies required for effective classroom orchestration. Younis (2017) conceptualizes it as a comprehensive suite of teaching-learning operations designed to equip educators with didactic principles, pedagogical toolkits, and reflective abilities across lesson planning, classroom execution, and evaluative assessment.

Ben Nasser (2019) delineates three interdependent dimensions of pedagogical training:

- **Cognitive Dimension:** Mastery of foundational educational sciences, developmental psychology, and subject-matter didactics.
- **Applied Professional Dimension:** Acquisition of instructional strategies, active classroom management techniques, and resolution of complex didactic problem-situations.
- **Axiological and Ethical Dimension:** Internalization of deontological codes, professional integrity, and humanistic educational values.

Contemporary scholarship emphasizes that pedagogical training is not confined to initial preparation in higher education institutes (such as *Écoles Normales Supérieures*), but represents continuous professional development (CPD) that adapts to rapid curriculum reforms, technological shifts, and emerging educational demands (Abdel Rahman, 2020). Consequently, pedagogical training must foster an adaptive, reflective practitioner capable of orchestrating differentiated learning rather than a mechanical transmitter of static knowledge (Saleh, 2018).

3. The Competency-Based Approach (CBA)

The Competency-Based Approach represents an essential paradigm shift adopted across global educational landscapes, including the Algerian educational reforms initiated in 2003. It transitions instructional practice from content-heavy, encyclopedic transmission to performance-centered learning, defining competence as the orchestrated mobilization of cognitive resources, practical skills, and affective attitudes to resolve complex, authentic challenges (Jarwan, 2016). Perrenoud (1997) defines competence as "*the learner's capacity to mobilize a coordinated set of cognitive, procedural, and affective resources to effectively confront complex families of situations*" (p. 23). Ghali (2018) highlights that CBA centers on tangible learning outcomes, ensuring that learners do not merely retain information but apply it functionally within authentic societal and professional spheres. Structurally, CBA integrates three interconnected domains (Ben Aissa, 2020):

- **Knowledge (*Savoirs*):** Conceptual understanding, factual information, and theoretical constructs.
- **Procedural Skills (*Savoir-faire*):** Practical, observable competencies and technical execution.
- **Attitudes and Dispositions (*Savoir-être*):** Value systems, ethical commitments, and positive professional dispositions.

4. Educational Technology (EdTech)

Educational technology has evolved into a scientific and pedagogical discipline bridging theory and practice. It applies systematic research and modern digital tools to optimize instructional design and learning outcomes. Far beyond hardware deployment or audiovisual aids, it represents an integrated, methodological ecosystem governing the design, development, utilization, management, and evaluation of instructional processes (Young, 2015).

The Association for Educational Communications and Technology (AECT) defines it as *"the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources"* (AECT, 2008, p. 3). Salem (2012) emphasizes that educational technology entails the systematic application of scientific knowledge, particularly communication and cognitive theories, to educational planning and delivery. Furthermore, Abdel Hamid (2018) underscores that EdTech is an overarching educational philosophy that embeds digital affordances holistically across design, delivery, and institutional governance.

II. Importance, Structural Components, and Applications of Training Engineering

1. Strategic Importance in Educational Institutions

Training engineering constitutes an essential pillar for institutional transformation, elevating individual and collective performance through rigorous curriculum development. Its core significance manifests across four domains:

- **Competency Development:** Equips educators and educational leaders with robust pedagogical skill sets, elevating academic learning outcomes (Al-Hiti, 2019).
- **Performance Optimization:** Diagnoses training gaps to tailor customized interventions that align personal teacher growth with institutional targets (Affi, 2016).
- **Adaptation to Systemic Shifts:** Builds organizational agility in response to curriculum revisions, pedagogical innovations, and digital tools, cementing continuous training as an operational necessity (Tardif, 2006).
- **Human Capital Investment:** Fosters a sustainable institutional ecosystem that empowers educators as key drivers of school improvement (Nadler, 2010).

2. Structural Components of the Training Engineering Cycle

Effective training engineering operates through a cyclical, five-stage process:

1. **Training Needs Assessment (TNA):** Systematically identifies existing competency deficiencies relative to benchmarked professional standards (Bencheneb, 2015).
2. **Formulation of Operational Objectives:** Defines unambiguous, measurable, and criteria-referenced learning targets aligned with institutional standards (Al-Jawhari, 2005).
3. **Curriculum and Modular Design:** Develops pedagogical content, structuring learning materials into modular units centered on authentic learning challenges (Roegiers, 2016).
4. **Implementation and Delivery:** Executes training using active methodologies, including experiential workshops, peer observation, clinical simulations, and field practicums (Hamdan, 2017).
5. **Multidimensional Evaluation:** Assesses training impact using established frameworks—such as Kirkpatrick's four-level evaluation model (reaction, learning, behavior transfer, and organizational results)—via observational rubrics, surveys, and performance portfolios (Kirkpatrick, 2006).

3. Concrete Applications in Education

Operationalized within education, training engineering focuses on three vital areas:

- **Teacher In-Service Development:** Equipping instructors with innovative instructional designs and digital competencies (OECD, 2018).
- **Leadership Preparation:** Preparing school principals and educational inspectors in strategic planning, instructional supervision, and change management (Abdel Rahim, 2018).
- **Curriculum Engineering:** Designing competency-aligned instructional programs responsive to evolving socioeconomic environments (Tiana, 2011).

III. Convergence of Training Engineering, the Competency-Based Approach, and Educational Technology

1. The Dialectical Relationship Between Training Engineering and the CBA

Training engineering provides the systematic design methodology that translates competency standards into practice, aligning learning objectives, modular content, didactic strategies, and authentic assessment (Abdellawi, 2019; Elkhelifi, 2018). This relationship is inherently dialectical: the Competency-Based Approach provides the epistemological referent, while training engineering serves as the operational mechanism for its institutional realization.

Implementing CBA in schools requires teachers who are thoroughly grounded in its didactic principles. Training engineering builds these professional capacities, training teachers to construct problem-situations, manage student-centered activities, and apply criterion-referenced assessment (Benhammadi, 2017). Consequently, teacher preparation shifts away from encyclopedic lecture transmission toward developing dynamic problem-solving and reflective practice (Boughalem, 2019). Furthermore, it harmonizes teacher competencies (planning, facilitation, evaluation, and action research) with target student competencies (critical thinking, collaboration, autonomy, and inquiry), establishing a cohesive pedagogical architecture (Abdelkader, 2021; UNESCO, 2020).

2. Operationalizing CBA Within Training Engineering

Connecting training engineering to the Competency-Based Approach relies on five operational components:

- **Competency Framework Modeling:** Translating field needs into clearly defined competency matrices, incorporating pedagogical, technological, and socio-communicative skills (Perrenoud, 2001).
- **Authentic Problem-Situation Design:** Structuring training modules around real-world classroom challenges that require integrating conceptual, procedural, and affective resources (Zitouni, 2020).
- **Scaffolded Competency Acquisition:** Sequencing learning through criterion-referenced trajectories, guiding trainees from foundational techniques to complex instructional orchestration.
- **Performance-Based Assessment:** Assessing professional mastery using descriptive rubrics, simulated clinical teaching, and portfolio evaluations rather than standardized written examinations (Tardif, 2006).
- **Continuous Professional Mentorship:** Sustaining in-service supervision to help teachers refine situation design and authentic assessment in their classrooms (Zouaoui, 2020).

3. Integrating Educational Technology into Training Engineering

Rapid technological advances mean teacher preparation can no longer rely solely on face-to-face instruction. Systematic technology integration is now indispensable for scalable, high-quality professional learning (Abdelkader, 2021; Mezari, 2019). Rather than serving as an add-on, digital tools act as structural components within training engineering, shaping curriculum design, delivery, and evaluation (UNESCO, 2020). Key modalities include:

- **Blended Learning Models:** Combining face-to-face seminars with asynchronous digital platforms to provide spatio-temporal flexibility and support self-paced professional inquiry (Garrison & Vaughan, 2013).
- **Simulations and Immersive Environments:** Leveraging virtual classrooms and microteaching simulations to allow safe practice of complex classroom management scenarios (Salmon, 2019).
- **Digital Assessment and E-Portfolios:** Utilizing computerized testing systems, digital artifact portfolios, and analytics dashboards to track competency progression (Zouaoui, 2020).
- **Networked Professional Communities:** Establishing digital communities of practice that encourage peer exchange, collaborative problem-solving, and collective knowledge building (Benhammadi, 2017).
- **Open Educational Resources (OER):** Curating validated digital repositories to enhance training content quality while optimizing institutional costs (UNESCO, 2020).

IV. Realities and Structural Constraints in the Algerian Context

In Algeria, pedagogical training engineering was established as a strategic priority under the educational reforms introduced in the early 2000s, coinciding with the adoption of CBA across national curricula (MNE, 2003). While policy blueprints envisioned modern, technology-enabled, and competency-aligned teacher preparation, empirical classroom evaluations reveal substantial implementation gaps:

- **Theoretical and Academic Overload:** Pre-service preparation in universities and teacher training institutes often remains heavily theoretical and lecture-driven. Programs dedicate limited credit hours to supervised clinical internships, classroom observations, or reflective practicums (Benhammadi, 2017).
- **Fragmented In-Service Programs:** Despite official commitments to continuous development, in-service initiatives are frequently short, reactive, and under-resourced. Training sessions often take place only around curriculum revisions or textbook rollouts, lacking sustained longitudinal evaluation (Boughalem, 2019).
- **Pedagogical Disconnect in CBA Application:** Many Algerian teachers face challenges enacting competency-based methods because their training lacked experiential practice in differentiated instruction, active learning, and formative assessment. As a result, instructors frequently revert to teacher-centric, rote methodologies (Zouaoui, 2020).
- **Superficial Technology Integration:** Although information and communication technologies (ICT) are highlighted in reform agendas, training often emphasizes basic computer literacy rather than meaningful pedagogical integration (TPACK). Teachers are rarely trained on how to leverage digital tools to enhance cognitive engagement or support collaborative learning (Abdelkader, 2021).
- **Centralized Administrative Governance:** Teacher training programs are designed and mandated centrally by the central ministry and applied uniformly across diverse wilayas (provinces). This administrative rigidity restricts local institutes and schools from adapting programs to regional challenges or specific local student needs (MNE, 2015).

V. Future Prospects and Strategic Pathways for Reform

Overcoming structural bottlenecks and aligning Algerian teacher preparation with international standards requires targeted, coordinated action across six strategic priorities (MNE, 2015):

1. **Transitioning to Experiential, Competency-Driven Architecture:** Restructure teacher education programs around applied clinical practice, reflective inquiry, classroom simulations, and practitioner-led action research (Zouaoui, 2020).
2. **Institutionalizing Digital Pedagogical Integration:** Establish institutional learning management systems (LMS) and accredited Massive Open Online Courses (MOOCs) to enable continuous, self-paced professional development focused on pedagogical technology use (Abdelkader, 2021).
3. **Institutionalizing Coherent Continuous Professional Development:** Shift from ad-hoc seminars to sustained, yearly professional development plans tied to career progression, with robust monitoring frameworks to assess classroom transfer (Boughalem, 2019).
4. **Decentralizing Training Governance:** Grant regional training institutes, local directorates of education, and universities pedagogical autonomy to adapt training modules to local educational environments (Benhammadi, 2017).
5. **Benchmarking International Paradigms:** Adapt proven strategies from high-performing models—such as Finland’s research-based teacher education and Malaysia’s national EdTech frameworks—tailoring best practices to the Algerian sociocultural context (Hammerness et al., 2012; Ministry of Education and Culture [MEC], 2016; OECD, 2019).
6. **Aligning Training with Sustainable Development Goals:** Connect teacher competencies with national priorities, including the knowledge economy, environmental literacy, global citizenship, and inclusive education, in alignment with UNESCO’s Education 2030 Agenda (UNESCO, 2020).

Conclusion

This investigation demonstrates that teacher training engineering in modern education can no longer operate as an ad-hoc process focused merely on transmitting static subject knowledge. Instead, it constitutes an essential strategic framework for revitalizing educational systems through the Competency-Based Approach and contemporary educational technology. The modern educator is not a passive conduit of information, but an architect of learning environments and a facilitator of student inquiry. This shift requires comprehensive training programs that foster deep pedagogical expertise, reflective problem-solving skills, and digital fluency.

The gap between policy blueprints and classroom realities in Algeria highlights the need for a more agile, innovative approach to training engineering. Transforming teacher education requires moving beyond administrative centralization and lecture-heavy coursework toward collaborative, experiential learning models enriched by digital platforms. By combining national educational values with benchmarked international insights from high-performing jurisdictions such as Finland and Malaysia, Algeria can build an adaptive teacher preparation system that empowers educators and equips students to thrive in a dynamic, knowledge-driven global economy.

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