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Teaching and Learning in the Age of Artificial Intelligence: Towards an Integrated Approach to Digital Literacy in Algerian Higher Education

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Abstract
In recent years, Algerian universities have faced a new challenge: adapting to the rapid rise of artificial intelligence while still closing long-standing digital gaps. This contribution looks at how digital literacy is evolving in higher education through national strategies, local policies, and direct engagement with faculty members. Based on policy texts, institutional reports, and hands-on experience supporting faculty development, it sheds light on the gap between national ambitions and the everyday realities encountered by teachers and students. While new platforms and tools are being deployed, key challenges remain: limited infrastructure, lack of training, and the uncritical use of AI tools in learning environments.
Rather than treating digital transformation as a purely technical shift, this paper argues for a broader, more grounded approach, one that includes training, ethical reflection, and adaptation to each academic discipline. A practical roadmap is proposed to help institutions move forward: start with training, provide clear frameworks, and adapt strategies to local needs and contexts. At its core, this reflection suggests that meaningful change in education doesn't begin with tools, but with people. Supporting teachers and students in thoughtful, inclusive ways is essential if AI is to serve learning, rather than replace it

Keywords: *Digital literacy, artificial intelligence, higher education, Algeria, pedagogical transformation, inclusivity, Teacher Training*

Introduction

Over the past decade, digital technologies have increasingly reshaped higher education worldwide. More recently, the rapid emergence of artificial intelligence (AI) has intensified this transformation, prompting renewed debate on how educational systems should adapt. Global frameworks, such as UNESCO's Sustainable Development Goal 4 (SDG4), call for inclusive and equitable quality education, while also emphasizing the importance of digital competencies for lifelong learning.

Yet in many countries, including Algeria, this transformation is uneven and raises pressing questions around infrastructure, inclusion, and pedagogical adaptation.

In the Algerian context, digital transformation is officially recognized as a national priority. Over forty platforms have been launched, new training programs introduced, and AI-focused commissions established under the Ministry of Higher Education (MESRS, 2025). This momentum reflects both demographic pressures, nearly 60% of Algeria's population is under the age of 35 (Digital 2025: Algeria, 2025), and Algeria's national vision for economic diversification through knowledge and innovation. However, several challenges remain:

persistent regional disparities in connectivity, gaps in teacher training, and unequal access to digital and AI-based tools.

This contribution explores how digital literacy is being redefined within Algerian higher education amid these structural tensions. It addresses a central question: How can digital literacy be reimagined to ensure that AI integration is inclusive, ethical, and pedagogically relevant?

To answer this, the study combines three types of insight: institutional and policy documents (MESRS, 2025), national reports and strategies (Dahmani, 2022; Rapport 2024 sur les Objectifs de Développement Durable | Les Nations Unies en Algérie, 2024), and first-hand experience in faculty training and national education commissions. This triangulated approach helps shed light on the gap between discourse and practice, and supports a more grounded, human-centered understanding of digital transformation in Algeria.

The advent of AI further complicates this landscape, necessitating a reevaluation of teaching methodologies, assessment practices, and institutional readiness.

Context and Background

Digital transformation is no longer a distant objective, it has become an urgent and shared reality across education systems worldwide. Globally, this shift aligns closely with UNESCO's 2030 Agenda, particularly Sustainable Development Goal 4 (SDG4), which promotes inclusive, equitable, and lifelong access to quality education (UNESCO Strategic Objectives, 2022). In this global context, digital tools and artificial intelligence (AI) are not only changing how we access knowledge, but also how we teach, learn, and assess. In Algeria, the digitalization process has gradually progressed across various sectors, including education. In recent years, several national platforms have been launched, institutional coordination has improved, and internet access has expanded. However, deep gaps persist, between infrastructure and actual use, between access and inclusion, and increasingly, between the speed of technological innovation and the preparedness of institutions to adopt it meaningfully.

The fast-paced emergence of AI has accentuated these tensions. Like many countries, Algeria is now grappling with critical questions: How can AI be used responsibly in education? How can it serve, not undermine, pedagogical integrity and equity?

These issues are especially relevant in the field of higher education, where AI and digital technologies are beginning to reshape academic practices, teacher–student interactions, and learning environments. According to Grand View Research (2024), the global AI in education market is valued at nearly $6 billion in 2024 and is projected to grow by over 31% by 2030. This trend reflects not only a technological boom, but also a deeper transformation in how knowledge is accessed, evaluated, and produced within educational systems (see Figure 1). But beyond economic indicators, this shift calls for a reflection on pedagogical transformation, how we teach, how we evaluate, and how students engage with knowledge.

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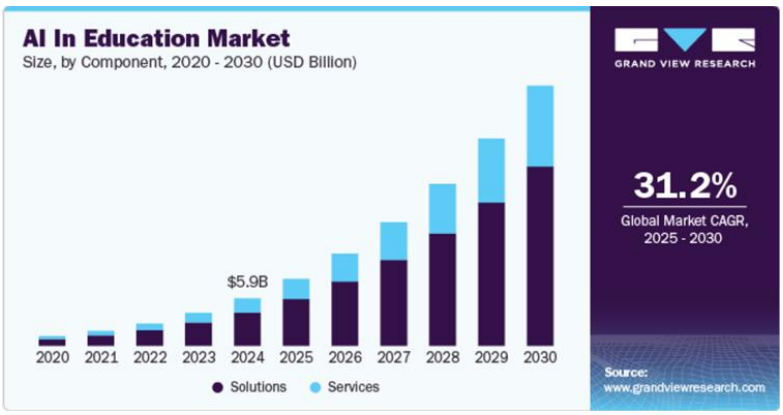

Figure 1: AI in Education Market Growth Projections, 2020–2030 (artificial intelligence-education-market-report, 2024 on https://www.grandviewresearch.com/industry-analysis/artificial-intelligence-ai-education-market-report)

In response, Algeria's Ministry of Higher Education has launched a national strategy that seeks to integrate AI, promote digital literacy, and align technological reform with long-term sustainability goals (MESRS, 2023). Yet to fully understand the implications of this strategy, it is necessary to situate it within the broader socio-geographical context of the country.

Algeria is the largest country in Africa, spanning over 2.3 million square kilometers. However, more than 70% of its territory is desert. As a result, most of the population, and nearly all educational infrastructure, is concentrated in the northern regions. This presents very specific challenges in terms of digital equity, connectivity, and access to resources. Demographically, Algeria is a young nation: nearly 60% of its population is under the age of 35 (Digital 2025: Algeria, 2025). While this youth represents a powerful potential for innovation and growth, it also coincides with high levels of graduate unemployment and a fragile university-to-employment transition. Against this backdrop, the national agenda strongly emphasizes economic diversification and digital transformation, with education placed at the core of its 2030 vision.

Historical Evolution of Digitalization in Algerian Higher Education

To understand where Algeria stands today in terms of digitalization, it's important to look at how things started, and how they have evolved over time. This evolution can be structured into four distinct phases:

Phase 1 – Foundations (1969–1999)

In the aftermath of independence, following 132 years of French colonization during which access to education was highly restricted for Algerians, one of the country's first priorities was to rebuild and democratize the national education system. In this spirit, two major structures were created to extend learning opportunities beyond the traditional classroom. The CNEG (Centre National d'Enseignement Généralisé), established in 1969, provided distance education by post, mainly to reach learners in remote or rural areas. This was followed by the creation of the CNEPD (Centre National d'Enseignement Professionnel à Distance) in 1984, a vocational training system designed to help adults and workers gain

qualifications outside the formal university framework. Although these initiatives were not digital, they laid the foundation for more inclusive, flexible, and mobile forms of education, anticipating many of the values later associated with e-learning and online education (Slimani & Bentahar, 2019).

Phase 2 – Digital Transition (2000–2010)

The second phase marks Algeria's first official steps toward digital integration in education. In 2000, the government launched a national strategy for ICT integration, with a clear goal: to modernize teaching tools, improve access, and prepare institutions for the digital shift. Some projects were introduced, like the AVUNET platform in 2002 (Algerian Virtual University Network), a virtual university initiative aiming to provide online courses and resources. It was ambitious for its time. In 2008, the e-Algeria 2013 strategy positioned digital transformation as a national priority, extending beyond education into other sectors. Still, these early efforts remained limited. Infrastructure was uneven, internet access was not yet widespread, and most teachers had not received adequate training in digital tools (Benchicou et al., 2010; Djoudi, 2018; Hoadjli & Mehiri, 2015)

Phase 3 – Digital Acceleration (2010–2023)

In the 2010s, digital adoption gained momentum. Universities introduced Moodle platforms, videoconferencing systems, and experimented with blended learning, though often in isolated cases and with some resistance (Djoudi, 2018; Hoadjli & Mehiri, 2015).

In 2016, the CNEAD (Centre National d'Appui à l'Enseignement à Distance) was created to support online teaching. That same year, a blended learning initiative at Oran 2 University showed how Moodle could support both autonomous and collaborative learning (Aboura, 2016).

The real shift came in 2020, with COVID-19. Existing platforms were underused, but the crisis triggered emergency training and pushed institutions into action (Hoadjli & Mehiri, 2015; Leboukh, 2022). It revealed the potential of digital learning, but also its limits.

Phase 4 – The AI Era (2023-present)

Since 2023, Algeria has entered a new phase, with AI emerging as a key focus in educational policy. The Ministry of Higher Education established national commissions, launched AI Houses (Maisons de l'IA), and introduced training programs for faculty. Early adoption by students, through tools like ChatGPT or DeepL, has outpaced institutional readiness, raising new pedagogical and ethical questions (MESRS, 2025).

To better visualize the historical trajectory of digitalization in Algerian higher education, Figure 2 presents a four-phase roadmap, highlighting major milestones from 1969 to the present.

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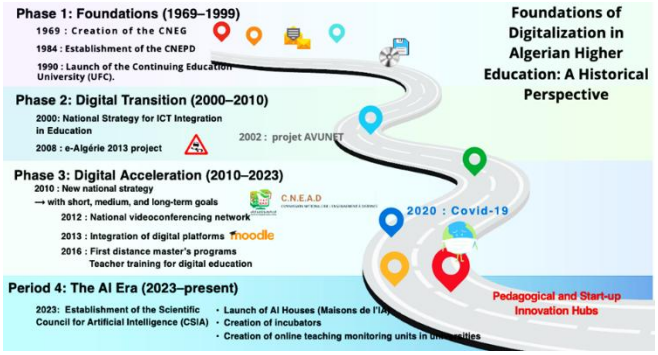

Figure 2: Historical Roadmap about Foundation of Digitalization on Algerian Higher Education
Source: Designed by the author, based on data from (Benchicou et al., 2010; Djoudi, 2018; Hoadjli & Mehiri, 2015; Leboukh, 2022; MESRS, 2025; Slimani & Bentahar, 2019)

This timeline highlights Algeria's continued efforts to modernize its higher education system. Still, the implementation of digital tools brings specific challenges, especially in terms of accessibility. The next section explores some of these ongoing issues.

From Strategy to Practice: A Grounded Perspective

A National Vision Anchored in Global Goals

Algeria's digital transformation strategy in higher education is closely aligned with international frameworks such as the Sustainable Development Goals (SDGs). Since 2020, the Ministry of Higher Education has implemented a wide-ranging plan, including the deployment of over *40 national digital platforms*, the *launch of more than 100 training programs*, and the *creation of AI-focused initiatives*, such as national commissions and *"AI Houses"*. These actions reflect a clear ambition to position digital capacity-building as a pillar of long-term educational governance (MESRS, 2025). However, this strategy operates mainly at the macro level. Many of its components are still evolving, and their implementation is shaped by broader questions of *digital sovereignty, cybersecurity, and institutional coordination*. Understanding the true impact of this shift requires closer attention to what happens on the ground.

Why the Digital Shift Is a Strategic Necessity

The scale of Algeria's higher education system has changed dramatically since independence. In 1962, the country had just one university, with 3,000 students and 306 mostly foreign teachers. By 2022, this had expanded to 114 public universities, serving over 1.5 million students and supported by more than 62,000 academic staff (Dahmani, 2022; *Rapport 2024 sur les Objectifs de Développement Durable | Les Nations Unies en Algérie*, 2024). This massive expansion would have been unthinkable without digital tools to manage enrollment, streamline infrastructure, and encourage *resource sharing* between institutions. Yet as the next sections show, infrastructure alone does not guarantee pedagogical transformation. National ambitions must translate into local action, at the level of classrooms, teachers, and learners.

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Method

To explore how national digital strategies are interpreted and implemented at the local level, this contribution draws on a triangulated methodology based on three complementary sources:

- **Institutional Documents**: Policy texts, circulars, and reports from MESRS, as well as documentation from national platforms such as Moodle or the UVP.
- **Field Observations**: Participation in national commissions on online education and artificial intelligence, as well as monitoring and analysis of institutional reports and teaching practices (e.g., via the CNEAD and university-level statistics by CRUO).
- **Trainer's Field Experience**: First-hand insights from supporting teachers in using digital tools, conducting pedagogical training sessions, and collecting feedback through informal discussions and structured questionnaires.

This triangulated approach makes it possible to move beyond policy discourse and examine the real practices, tensions, and adaptations observed in Algerian universities. It sheds light on how digital and AI tools are being interpreted, used, and sometimes reimagined by educators themselves.

Local Realities: Gaps, Adaptation, and Informal Innovation

The COVID-19 crisis acted as a catalyst for digital transformation in Algerian higher education. While it accelerated platform deployment and highlighted the urgency of online teaching, it also exposed several deep-rooted structural and pedagogical challenges.

One major issue was the limited pedagogical use of learning platforms. Tools like Moodle were often used simply as content repositories, not as interactive learning environments (Leboukh, 2022). Another concern was the lack of initial teacher training, which led to widespread confusion, hesitation, and isolation among educators as they tried to shift to online modes of instruction. Despite these obstacles, many teachers showed remarkable resilience. Without waiting for perfect conditions, they engaged in informal, peer-driven solutions: mutual support, experimentation, and the development of locally adapted practices. These grassroots initiatives played a key role in sustaining teaching continuity during the crisis. Yet the challenges persist. According to a recent national report, 43% of Algerian institutions reported difficulties in implementing hybrid teaching models (Université Oran 2 – CRUO, 2023). This figure underscores a critical point: digital transformation cannot be decreed from above. It must be supported, guided, and adapted to the realities of classrooms, disciplines, and users.

Digital Accessibility

Even when digital platforms are available, implementation is not always smooth. Access does not automatically mean inclusion. Digital accessibility is often reduced to a technical matter, such as having internet access or a digital device. In reality, access is shaped by a much more complex and layered set of factors. As illustrated in Figure 1, six key dimensions must be considered: institutional, geographical, economic, technical, social, and cognitive.

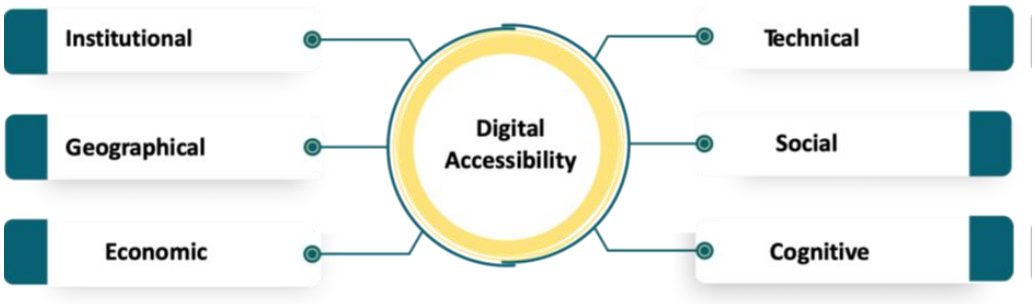

Figure 3: Dimensions of digital accessibility

- **Institutional readiness**: Are universities equipped and organized to support digital learning - technically, administratively, and pedagogically?
- **Geographical inequalities**: Can students living in remote or rural areas access resources as easily as those in urban centers?
- **Economic barriers**: Can families afford devices, data plans, and a stable learning environment at home?
- **Technical infrastructure**: Is connectivity stable and reliable across regions?
- **Social dimensions**: Are learners supported by peers and teachers, or are they isolated in digital environments?
- **Cognitive dimensions**: Do students and teachers have the skills, confidence, and autonomy to use platforms meaningfully?

Digital inclusion is therefore not just a technical concern - it is a human and institutional one. A meaningful transformation must go beyond infrastructure. It requires sustained investment in support systems, training, equity, and local responsiveness.

Inclusion Beyond Access

Digital inclusion is often taken for granted in national strategies, but it is rarely guaranteed in practice. Real inclusion begins with understanding who the learners are, how they learn, and what they need to succeed in digital environments.

Diverse Student Profiles

In Algerian universities, students come from vastly different academic, linguistic, and technological backgrounds. Generational gaps, varied digital skills, and unequal access to prior training all shape their engagement with online learning (Boustil, 2023; Spach, 2017). Moreover, the educational culture remains largely transmissive, with limited emphasis on autonomous learning, a skill that is essential for navigating digital platforms.

Language also presents a barrier. In a multilingual academic environment, courses are often taught in French or English, with some departments using additional languages such as German. This linguistic diversity, while rich, can complicate access to complex digital content and interaction in online settings.

Traditional Educational Context

Most university courses still follow a transmission-based model, focused more on content delivery than on learning design. Online learning spaces tend to remain passive, and course scenario design is still emerging slowly across institutions (Boustil, 2023). The shift toward interactive, student-centered pedagogy is underway, but far from complete.

The Role of Teachers

Teachers remain central to digital inclusion. Yet many have not received adequate training to manage digital environments, interpret learning analytics, or design engaging online activities. Their role in re-engaging students, especially those who are passive or disconnected, is critical (Souleles, 2024). Still, most instructors need ongoing support to design, adapt, and assess in hybrid and online contexts.

Without investment in teacher capacity and pedagogical guidance, the risk is that digital tools remain underused, or used ineffectively. Addressing these gaps is not a technical matter. It is pedagogical, ethical, and human.

AI and the Pedagogical Paradigm Shift

The emergence of generative AI tools has introduced a profound transformation in higher education. Students rapidly adopt platforms like ChatGPT, Gemini, or DeepL - often without pedagogical or ethical support (Rebaa, 2024), while many educators remain focused on basic digital tools, creating a pedagogical asymmetry between learners and instructors (Holmes & Porayska-Pomsta, 2022).

This gap forces teachers to confront complex tasks: designing AI-aware instruction, interpreting learner analytics, and upholding academic integrity (Holmes & Porayska-Pomsta, 2022; Perkins et al., 2024).

Assessment Under AI Pressure

Assessment and certification are becoming increasingly challenging. If students submit AI-generated work, who is being evaluated - the student or the tool? This is more than a cheating issue; it is an epistemological problem (Chan, 2025; Guidance for Generative AI in Education and Research | UNESCO, 2023).

Conventional methods - file uploads, basic quizzes, multiple-choice questions - are no longer adequate. They lack interaction, meaningful feedback, and reflectiveness, causing potential misalignment between taught content and assessed learning, which undermines credibility.

Academic Integrity Risks

AI-generated content poses serious integrity risks. A Guardian investigation found 7,000 confirmed cases of AI misuse, 5.1 per 1,000 students, highlighting that cheating with AI is often hidden and beyond traditional plagiarism systems (The Guardian, 2025). Even detection tools like Turnitin or GPTZero struggle. For instance, adversarial techniques allowed GPT-4 outputs to evade detection in nearly half of cases (Perkins et al., 2024).

Toward Ethical, Human-Centered Assessment

UNESCO's global guidance emphasizes a human-centered vision for AI in education, calling for human agency, inclusiveness, ethical practice, and equity (Guidance for Generative AI in Education and Research | UNESCO, 2023). Institutions are adopting frameworks like the AI Assessment Scale (AIAS) to align AI use with learning outcomes, ensuring transparency and fairness (Perkins et al., 2024).

Institutional Responses to the Digital Shift

In response to the structural barriers facing digital transformation in Algerian higher education, institutions have taken concrete action on three main fronts: infrastructure, training, and innovation. These priorities are summarized in Table 1.

Table 1: Institutional responses to the digital transition in Algerian higher education

Solution 1	Solution 2	Solution 3
Infrastructure & Equipment	**Capacity Building & Training**	**Recognition & Innovation**
Investing in the digital capacity of universities • establishment of data centers. • Upgrading connectivity and access on campuses • Platform deployment	Supporting the digital upskilling of educators • Training programs for new university teachers (CNEAD) • Creation of local support units for pedagogical and technical assistance • Ongoing professional development on digital tools Develop student training modules on digital and AI literacy Promote awareness of ethical issues and responsible use of AI tools among learners	Encouraging engagement and experimentation • Institutional recognition of digitally engaged faculty • Pilot innovation projects (e.g., hybrid and online learning formats) • Support for bottom-up initiatives • Encourage student-led initiatives in AI exploration

Universities have made significant investments in digital infrastructure. These include the establishment of data centers, the deployment of platforms such as Moodle and Zoom, and efforts to upgrade internet connectivity and on-campus access. Such improvements create the necessary conditions for digital engagement, but do not in themselves guarantee pedagogical transformation.

A key focus has also been the professional development of educators. National programs such as those launched by the CNEAD have aimed to train new university teachers in online education. Many universities have also set up local support units to provide day-to-day assistance with digital tools and pedagogy. Efforts have extended to learners as well, with the development of training modules on AI literacy, and campaigns to promote ethical awareness regarding the responsible use of generative tools.

In parallel, institutions are beginning to value digital engagement as a marker of professional commitment and innovation. In some universities, faculty who design and implement digital activities benefit from increased visibility, pilot funding, or participation in hybrid teaching projects. Student-led initiatives exploring AI are also being encouraged, creating opportunities for bottom-up innovation. These responses suggest a shift not only in technology, but also in institutional culture. As highlighted in recent MESRS communications, digital engagement is increasingly viewed as a key indicator of institutional transformation

(MESRS, 2025). However, these advances must be accompanied by sustained pedagogical support, without which tools risk being underused or misaligned with educational goals.

Transition to University 4.0

Building on these institutional measures, and coordinated by the Ministry of Higher Education, Algeria has officially embarked on a transition towards Fourth-Generation University (Université 4.0), aimed at transforming higher education into a more intelligent, data-driven, and responsive ecosystem. For example, in January 2025, the National Committee for the Transition to a Fourth-Generation University (4.0) -coordinated by the MESRS, met at Sétif 1 University to present its strategic action plan (Comité National pour la transition 4.0, 2025). This strategy articulates four main priorities:

- strengthening research and innovation ecosystems through incubators and AI Houses,
- deploying integrated digital services for learning, mobility, and administration,
- promoting context-based governance via institutional autonomy and tailored roadmaps,and
- enhancing entrepreneurship and economic engagement with a focus on student-led innovation.

This shift reflects a move from digital infrastructure alone to a broader transformation linking technology, pedagogy, and institutional strategy.

Building a Balanced and Inclusive Digital Literacy Framework

Moving forward, the integration of AI and digital tools in Algerian higher education requires more than technical upgrades. It calls for a strategic approach grounded in pedagogy, ethics, and local realities. This contribution proposes a three-pillar framework to support a more critical and inclusive digital literacy strategy: Train, Frame, and Contextualize.

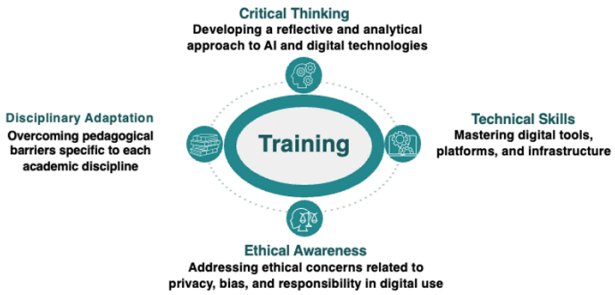

Figure 4. A contextual framework for AI-integrated digital literacy in Algerian higher education
Adapted from (Alles et al., 2025; Chan, 2024; Crompton & Burke, 2023; Douali et al., 2022; Guidance for Generative AI in Education and Research | UNESCO, 2023)

Train

Continuous and targeted training remains essential. Beyond technical skills, educators need support in digital pedagogy, instructional design, and the responsible use of AI. Professional development must create spaces for experimentation, collaboration, and reflective growth.

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Frame

Without clear guidance, digital tools risk being used without intention or alignment. Institutions should establish formal frameworks, such as charters, use-case scenarios, and digital competency benchmarks, to guide practice. Equally important is the promotion of reflective teaching, ensuring that technology use is anchored in pedagogical goals.

Contextualize

No single model fits all. Digital strategies must be adapted to the specific needs of disciplines, institutions, and student populations. This includes respecting linguistic diversity, addressing local constraints, and supporting inclusive engagement with AI tools.

Taken together, these three dimensions offer a foundation for building digital literacy that is not only functional, but also critical, ethical, and responsive to context.

Conclusion

This reflection has examined how Algeria's higher education system is navigating the complex shift toward digital and AI-integrated learning. While national platforms, infrastructure investments, and strategic programs signal strong institutional commitment, the real challenge lies in turning strategy into practice.

At the heart of meaningful transformation is pedagogy. Digital technologies are not neutral tools, they shape how we teach, learn, assess, and interact. As shown throughout this contribution, successful integration requires a solid foundation:

Ongoing, context-sensitive teacher training, a clear digital competency framework tailored to the Algerian academic landscape, and above all, a people-centered approach focused on learning environments and classroom realities.

Transformation begins with training, deepens through alignment of pedagogical practices, and ultimately aims to rethink teaching approaches in the AI era. This process is summarized in Figure 3.

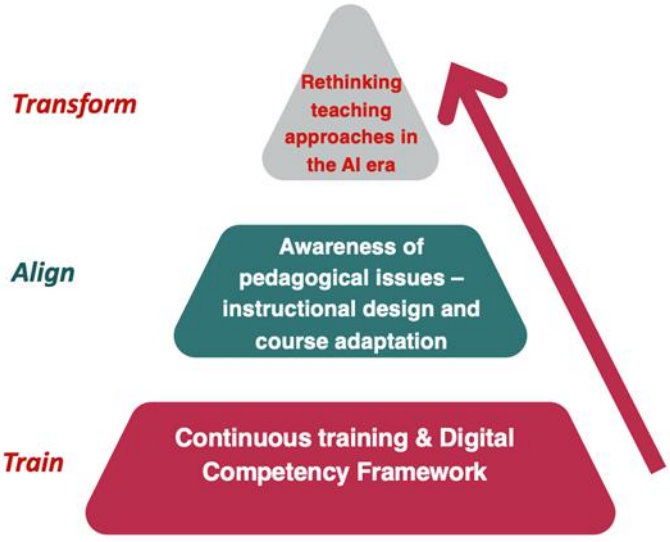

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Figure 5. A progressive model for pedagogical transformation in AI-integrated higher education
Designed by the author

As the model suggests, we must move from technical readiness to pedagogical depth. Infrastructure and platforms alone are not enough. We must invest in human development, support educators and students, and build a reflective, inclusive, and adaptable digital culture.

Algeria's commitment to digital transformation is evident in its national strategies and infrastructure investments. However, meaningful change requires a shift from top-down policies to grassroots pedagogical innovation. By prioritizing teacher development, student support, and ethical AI integration, Algerian higher education can bridge the gap between technology and inclusive learning.

The future of education in the AI age hinges not on tools alone, but on a human-centered approach that aligns technology with pedagogical goals.

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