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ARTIFICIAL INTELLIGENCE AND THE TRANSFORMATION OF HIGHER EDUCATION IN ALGERIA

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Abstract
Artificial Intelligence (AI) is increasingly emerging as a key driver of modernization in higher education, reshaping learning processes, pedagogical practices, and institutional governance. In developing contexts such as Algeria, AI is not merely a technological innovation but a strategic instrument for enhancing institutional efficiency, modernizing university administration, and improving the quality of educational services. Drawing on recent literature and an analysis of national digital and AI-related policies, this article assesses the readiness of Algerian universities to integrate AI, using theoretical lenses from smart governance, socio-technical systems, and public value theory. The findings highlight a dual dynamic: on the one hand, national digital transformation strategies are fostering an environment conducive to AI adoption; on the other, structural constraints persist, including low digital maturity, fragmented governance, limited technical and managerial capacities, the absence of a comprehensive legal and ethical framework, and enduring territorial disparities. The study also identifies significant opportunities, notably the potential role of higher education as a catalyst for innovation and a driver of broader public sector transformation. The article concludes by offering strategic recommendations to support a responsible, inclusive, and sustainable integration of AI within Algerian universities.
Keywords: Artificial intelligence, Higher education, Public governance, Digital transformation, Algeria.
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1. INTRODUCTION

Artificial Intelligence (AI) is gradually emerging as a key driver of innovation and institutional transformation in higher education worldwide. Its applications including automating administrative tasks, managing student enrollment, enhancing teaching quality, personalizing learning pathways, and supporting data-driven decisions in research and academic planning are reshaping the higher education landscape. While most academic and policy discussions have historically focused on advanced economies, a growing number of

developing countries are beginning to integrate AI into their digital transformation strategies in higher education. In these contexts, AI is not merely a technological upgrade but a strategic tool to modernize educational structures, optimize administrative processes, and improve pedagogical efficiency, tailored to specific institutional capacities and socio-economic constraints (Konstantinos & Mekonnen Jonathan, 2025).

In Algeria, AI integration in higher education is still at an early stage, despite ongoing digitalization reforms and recent national strategies promoting technological innovation. Structural barriers such as fragmented institutional frameworks, limited access to digital infrastructure, insufficient regulatory and ethical frameworks, and a lack of AI skills among academic and administrative staff continue to challenge the effective deployment of AI solutions. However, these challenges also offer critical opportunities to adopt context-sensitive and institutionally grounded approaches to AI adoption in universities.

This article aims to examine the strategic potential and institutional challenges associated with implementing AI in higher education in Algeria. It investigates the level of institutional readiness, the alignment of current digital policies with AI integration efforts, and the ethical and legal considerations relevant to this transformation. The analysis draws on theoretical models such as smart governance and socio-technical systems thinking, providing a comprehensive understanding of how technological innovation intersects with institutional reform and the socio-educational context.

Despite the growing recognition of Artificial Intelligence (AI) as a strategic lever for modernizing higher education, many countries including Algeria struggle to translate this potential into tangible outcomes. Between ambitious national visions articulated in official strategies and persistent challenges such as limited institutional capacity, fragmented regulatory and ethical frameworks, and entrenched systemic barriers, the effective implementation of AI in higher education remains uncertain.

This study seeks to address the following central research question: To what extent do Algeria's current strategic, institutional, legal, and cultural foundations enable an effective transformation of higher education through artificial intelligence, and what key levers could support a responsible, inclusive, and sustainable adoption of these technologies in the university context?

2. ANALYSIS FRAMEWORK

2.1 Literature review

Numerous studies highlight AI's increasing recognition as a transformative force within educational settings. Recent qualitative investigations indicate that both students and faculty acknowledge AI's potential to enhance teaching and learning outcomes. Faculty members employ AI tools for instructional purposes and assessment, yet they face challenges related to tool accuracy and integration into existing

curricula. Similarly, students utilize AI for a range of academic tasks, though concerns regarding reliability and ethical implications persist (Schmidt, Alboloushi, Thomas, & Magalhaes, 2025). These findings underscore the need for ongoing awareness initiatives and professional development to facilitate effective AI adoption (Crompton & Burke, 2023).

Systematic reviews reveal a significant increase in AI-related research publications in higher education, particularly since 2021, with a geographic shift from the United States to China as the leading contributor. Most studies focus on undergraduate populations, with language learning and assessment representing common application domains. Grounded coding analyses identify five primary uses of AI in higher education: assessment and evaluation, predictive analytics, AI assistance, intelligent tutoring systems (ITS), and student learning management (Share, 2020). Despite the proliferation of research, gaps remain regarding the application of emerging tools, such as ChatGPT, highlighting avenues for future investigation.

In regions such as the Arab world, AI adoption remains in its early stages and largely adheres to traditional educational approaches. Current efforts are primarily limited to technological infrastructure assessments, although plans for broader AI integration are emerging. These developments reflect a global trend toward embracing AI's potential, albeit at variable rates influenced by infrastructural and cultural factors.

Research further emphasizes that AI can support not only pedagogical processes but also research activities, potentially improving content quality and reducing time expenditure. For instance, models have been proposed to enhance research outputs and streamline data handling (Crompton & Burke, 2023). However, challenges persist, including resource limitations and ethical considerations, necessitating clear guidelines and sustained professional development.

Overall, the literature presents a dual perspective: while AI offers considerable opportunities to transform higher education—through personalized learning, automated assessment, and research support—it also requires careful management of ethical, technical, and infrastructural challenges. Future research should investigate innovative AI tools, ethical frameworks, and strategies for equitable implementation to fully realize AI's potential in advancing higher education.

Despite the growing body of international literature on artificial intelligence in higher education, significant gaps persist—particularly in developing and institutionally centralized contexts. Existing studies primarily focus on pedagogical applications of AI, such as intelligent tutoring systems, assessment automation, and learning analytics, while paying limited attention to the institutional, organizational, and regulatory conditions that shape AI adoption. Moreover, there is a notable absence of empirical research examining how national digital strategies align with the operational capacities of universities in countries with fragmented infrastructures and emerging ethical frameworks. In the North African context, and especially in Algeria, scholarly work remains scarce, leaving unexplored how socio-cultural factors, administrative

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structures, and governance practices influence the feasibility and sustainability of AI-driven transformation. This study addresses these gaps by providing a context-sensitive, institutionally grounded analysis of AI integration in Algerian higher education.

2.2 Defining artificial intelligence

The conceptual roots of artificial intelligence (AI) can be traced to the 1956 Dartmouth Conference, where John McCarthy introduced the term to designate "the science and engineering of making intelligent machines." Building on foundational contributions such as Alan Turing's reflections on machine intelligence, AI has evolved from an abstract theoretical proposition into a set of applied technologies increasingly embedded in complex domains, including public governance. Its contemporary integration reflects a broader transformation toward data-driven policymaking and digitally enabled innovation in the public sector (Zawacki-Richter O. , Marín, Bond, & Gouverneur, 2019).

Defining AI with precision, however, remains inherently difficult. The concept has expanded and diversified across disciplines, generating a proliferation of definitions that reflect contrasting views of AI's functions, goals, and computational foundations. The rise of terms such as machine learning and deep learning—often conflated with AI—has further blurred conceptual boundaries, reinforcing both ambiguity and overlap in scholarly and policy discourse.

To address this challenge, the Organisation for Economic Co-operation and Development (OECD) offers a widely adopted definition, describing AI as "a machine-based system that can, for a given set of human-defined objectives, make predictions, recommendations, or decisions that influence real or virtual environments" (OECD, 2019). Under this framework, AI systems ingest human- or machine-generated data, interpret their environment, construct and refine internal models through automated or manual processes, and generate outputs that range from informational insights to autonomous actions. These systems operate along varying degrees of autonomy, depending on their design, purpose, and the constraints of their operational context (Ubaldi, et al., 2019).

3. RESEARCH METHODOLOGY

This article adopts a qualitative, exploratory, and analytical approach, aimed at examining the opportunities, challenges, and strategic pathways for integrating Artificial Intelligence (AI) in higher education in Algeria. The methodology combines several complementary components to provide a comprehensive understanding of the subject:

Systematic literature review: A detailed review of recent research on AI applications in higher education is conducted. The focus is on topics relevant to the Algerian context, including AI in learning analytics, adaptive teaching, administrative automation, research management, and ethical governance. This review establishes the theoretical foundation for understanding AI adoption in Algerian universities.

Documentary and policy analysis: The study examines key national policies and strategic frameworks to assess Algeria's preparedness for AI integration in higher education. Documents analyzed include:

National AI Strategy (2024): outlining objectives, priority areas, and planned investments in AI.

Digital Transformation Strategy (2025): describing the roadmap for digital infrastructure, capacity building, and e-governance in higher education.

Master Plan for Digitalization in Higher Education (SDN): specifying institutional goals, resource allocation, and digital tools for academic management. This analysis identifies both enabling conditions and institutional gaps that may affect AI implementation.

Institutional and theoretical analysis: The study applies relevant theoretical frameworks to understand the organizational, technical, and policy aspects of AI adoption in Algerian universities:

New Public Management (NPM): to explore how AI can improve efficiency, accountability, and administrative processes.

Complexity Theory: to examine interactions among stakeholders, institutional structures, and technological systems.

Public Value Theory: to assess how AI initiatives can generate educational, social, and ethical value for students, staff, and universities.

Strategic synthesis and recommendations: Based on insights from the literature, policy documents, and theoretical analysis, the article proposes actionable recommendations for responsible, inclusive, and sustainable AI adoption in Algerian higher education. This includes strategies for capacity building, governance models, ethical frameworks, and technological innovations in teaching, research, and administration.

Triangulation for robustness: To ensure reliability and validity, findings are triangulated from multiple sources: literature, national policies, and institutional frameworks. This approach allows for a comprehensive understanding of the opportunities and barriers to AI integration in Algerian universities.

Through this methodology, the article provides a detailed, context-specific analysis of AI adoption in Algerian higher education, offering both conceptual insights and practical guidance for policymakers and university administrators.

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4. RESULTS

4.1 Higher education as a catalyst for AI-driven public sector reform in Algeria

While artificial intelligence (AI) is increasingly recognized as a strategic lever for transforming public governance globally, its integration within the Algerian public sector remains at a preliminary and fragmented stage. Persistent challenges such as institutional inertia, regulatory complexity, and limited digital infrastructure continue to hinder the implementation of AI-driven innovations across core administrative functions (Aboulkacim, Lemperos, & Rusu, 2025). Yet, within this constrained environment, the higher education sector emerges as a particularly promising vector for AI adoption and experimentation.

Through the strategic orientation provided by the Ministry of Higher Education's Digital Master Plan (Schéma Directeur Numérique, SDN), Algerian universities are currently undergoing a significant digital transformation. This initiative, structured around seven strategic axes, sixteen strategic programs, and over one hundred operational projects, represents a deliberate move toward modernizing both academic and administrative processes. By streamlining student services, enhancing data-informed decision-making, and fostering a culture of digital innovation, the SDN positions the higher education sector as a laboratory for broader public sector reform.

This sectoral transformation reflects a broader national ambition to embed AI and digital technologies across state functions. Higher education institutions are not only modernizing their own internal operations but are also becoming incubators for technical expertise, innovation ecosystems, and governance experimentation. The deployment of integrated digital platforms supporting students throughout their academic lifecycle, from orientation to graduation and labor market integration—illustrates how data and AI can improve service delivery and institutional responsiveness.

In this context, Algeria's university system can be analyzed as a microcosm of state modernization, offering valuable insights into the conditions necessary for successful AI integration in public governance. As this chapter argues, the higher education sector possesses the institutional capacity, strategic orientation, and operational flexibility to act as a catalyst for AI-driven public sector innovation a role that may prove critical in Algeria's broader digital governance agenda.

Having established the strategic importance of higher education as a driver of AI-enabled public sector reform in Algeria, it is essential to examine the specific institutional mechanisms and strategic priorities guiding this transformation. Central to this effort is the Ministry of Higher Education's Digital Master Plan (Schéma Directeur Numérique – SDN), which articulates a comprehensive vision for digital innovation across universities. The following section provides a detailed analysis of the SDN's strategic axes,

highlighting how its programs and platforms are designed not only to modernize the higher education system but also to contribute to the broader national agenda of digital governance and AI integration.

4.2 Strategic axes of the Algerian higher education digital transformation plan

As part of the national Digital Master Plan (SDN), the Ministry of Higher Education and Scientific Research in Algeria has outlined a comprehensive framework organized around several thematic pillars. These strategic axes illustrate a multidimensional approach to the digital transformation of higher education, encompassing teaching, research, governance, and internationalization.

1. **Enhancing the coherence of educational offerings through digital tools.** This axis seeks to streamline and modernize the academic structure by leveraging platforms dedicated to student enrollment, alumni tracking, and program alignment. These platforms aim to foster curriculum coherence and ensure that training paths remain responsive to both national needs and international standards.
2. **Improving student success via digital learning ecosystems.** A robust set of platforms supports student engagement and academic success, including MOOC-based learning environments (even for medical students), orientation tools for new entrants, and digital pathways to guide students toward appropriate disciplines and professional life. These tools aim to personalize academic support and bridge the gap between education and employability.
3. **Leveraging digital innovation in research and entrepreneurship.** Digital platforms are deployed to support research activities and innovation ecosystems. These include a national repository of research projects, collaborative tools for innovation support, and systems for the formalization of spin-offs and startups. Sector-specific databases, such as those in medical sciences, further promote knowledge dissemination.
4. **Modernizing university administration and governance.** The digitalization of administrative services is achieved through platforms dedicated to human resource management, infrastructure monitoring, and the integrated "Progress" information system. These tools aim to increase operational efficiency and foster a culture of data-driven governance.
5. **Strengthening national and international academic collaboration.** A wide range of platforms facilitates mobility, exchange, and cooperation. These include systems for managing international students, scholarships, research co-supervision, and academic mobility (students and staff alike). This axis reinforces Algeria's visibility and integration within the global academic community (Ministry of Higher Education and Scientific Research, 2025).

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4.3 From digital transformation to artificial intelligence: a strategic continuum

The digital transformation of Algeria's higher education system—through initiatives aimed at modernizing educational services, research infrastructure, and administrative workflows—lays the essential groundwork for the integration of artificial intelligence (AI). Rather than representing an endpoint, digitalization serves as a strategic enabler for more advanced, data-driven, and intelligent governance models. Effective AI deployment requires, above all, mature digital infrastructures, interoperable systems, and robust data governance—regardless of a country's level of technological advancement.

In this context, the transition from digital tools to AI should be viewed not as a technological leap, but as a progressive continuum requiring institutional readiness and long-term investment. Algeria's Digital Master Plan offers a foundational framework by enabling the deployment of platforms that support both operational efficiency and pedagogical innovation. As highlighted by Makarenko et al. (2024), the integration of AI in education typically unfolds across four interdependent phases: preparation and familiarization, pilot experimentation, scaling, and continuous improvement. This staged approach emphasizes the importance of iterative learning, infrastructural maturity, and strategic alignment. Ultimately, AI adoption in higher education is not an isolated initiative but a logical extension of digital transformation—one that must remain rooted in educational values and institutional coherence.

4.4 Opportunities and added value of AI in higher education governance

Artificial Intelligence (AI) offers significant opportunities to enhance governance across Higher Education Institutions (HEIs), influencing teaching, learning, administrative processes, and strategic planning. Although the educational potential of AI has been explored for decades (Katsamakas, Pavlov, & Saklad, 2024), recent technological advances have expanded its practical applications, enabling deeper integration into institutional ecosystems.

At the governance level, AI facilitates data-driven planning, predictive analytics, and the automation of routine processes. It can optimize resource allocation, improve student services such as academic advising and admissions, and strengthen decision-making through real-time insights. As highlighted by UNESCO (2021), the ultimate aim of AI in education should be to help each learner achieve their full potential—an objective that must be embedded in institutional policies and governance frameworks.

In Algeria, where the higher education sector is undergoing digital reform via the Ministry's Digital Master Plan (SDN), AI is positioned as a strategic accelerator. A major challenge facing the system lies in the collection, management, and analysis of complex data essential for designing effective education strategies. AI technologies can address this gap by extracting actionable insights from large, fragmented datasets, thus enhancing responsiveness to institutional and societal needs.

Nonetheless, the implementation of AI faces several constraints. Financial limitations, underdeveloped infrastructure, and the need for extensive capacity building represent key barriers (Abou Adel & Awad, 2025). Furthermore, ethical considerations such as data protection, algorithmic transparency, and institutional accountability must be proactively addressed. The transition to AI-enhanced governance requires not only technical solutions but also cultural and organizational readiness.

It is also essential to ensure that AI remains a support tool rather than a substitute for human educators. As Oleksandr et al. (2024) emphasize, the success of AI in education depends on maintaining a harmonious and balanced interaction between technology and human actors to preserve the quality and ethics of the learning experience.

In summary, AI holds transformative potential for higher education governance, but its added value will only materialize through strategies that are context-sensitive, ethically grounded, and geared toward sustainable innovation.

While higher education institutions in Algeria illustrate the promising potential of AI to enhance governance and public service delivery, they also reveal the broader challenges that accompany such transformation efforts. The successful integration of AI requires more than technological capacity; it demands an enabling ecosystem that includes supportive institutional structures, cultural openness to innovation, and adaptive policy frameworks. As experiences in the academic sector show, the transition to AI-enhanced governance is often impeded by systemic limitations that extend beyond the university context. To fully grasp the prospects and limitations of AI in public administration, it is therefore crucial to examine the structural and cultural barriers that continue to shape the broader landscape of digital transformation across the Algerian public sector.

5. CHARTING THE PATH FORWARD: FROM STRATEGIC INTENT TO INSTITUTIONAL TRANSFORMATION

Algeria's trajectory toward AI-enabled governance stands at a pivotal juncture. Although recent national strategies such as the evolving Artificial Intelligence Strategy (Ministry of Post and Telecommunications, 2024) and the National Digital Transformation Strategy ((High Commission for Digitization, 2023) demonstrate a growing political will to modernize public administration, the central challenge now lies in translating this strategic intent into profound institutional transformation. The adoption of AI cannot be reduced to technological deployment; it necessitates a rethinking of state–citizen relations, governance models, and the normative foundations of equity, transparency, and accountability (High Commission for Digitization, 2023).

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A purely technological perspective would be insufficient. What is required is a vision anchored in *institutional intelligence*: an understanding that the value of AI emerges not from the tools themselves but from the capacity of public institutions to learn, adapt, and integrate innovation coherently into their missions (El Kenz, 2023). In this perspective, three interdependent pillars institutional learning, ethical vigilance, and citizen-centered design constitute the strategic architecture needed to guide Algeria's transition toward AI-based governance (Bouzidi & Benslimane, 2022).

Institutional learning: building public sector competency

Institutional learning must form the backbone of Algeria's AI transformation. AI systems cannot simply be superimposed on existing bureaucratic structures; they must be embedded within administrative processes, influencing decision-making, planning, and service delivery. This transformation requires the development of robust cross-sectoral collaboration mechanisms and an investment in digital, ethical, and administrative competencies across the public sector (Ministry of Higher Education and Scientific Research, 2025). Such efforts align with the Master Plan for the Digitalization of Higher Education, which promotes the diffusion of digital and AI skills within universities.

Ethical vigilance: aligning AI with the public good

AI integration raises profound ethical questions related to transparency, fairness, accountability, and rights protection. Ethical vigilance must therefore become a structural component of Algeria's AI governance. This involves going beyond compliance with international norms to develop national principles rooted in social values, constitutional rights, and democratic aspirations (El Houari, 2023). Establishing an independent oversight body—potentially within the CNIL or the High Commission for Digitization—would help monitor algorithmic impacts, ensure non-discrimination, and safeguard public trust.

Citizen-centered design: ensuring legitimacy and equity

Ultimately, the legitimacy of AI in governance will depend on its capacity to enhance citizen well-being and support more inclusive, equitable public services. This requires integrating citizens' needs and expectations throughout the design, deployment, and evaluation of AI systems (Bouzidi & Benslimane, 2022). Prioritizing inclusive and accessible AI solutions is crucial to avoid deepening existing territorial or socio-economic divides particularly between urban and rural areas (National Office, 2022). Moreover, embedding citizen participation from consultation to co-design can strengthen transparency and legitimate the use of AI in sensitive fields such as healthcare, social services, and justice.

6. CONCLUSION

This study has examined the complex landscape surrounding the integration of Artificial Intelligence (AI) in Algeria's higher education system, situating it within broader national efforts toward digital governance

reform. The analysis demonstrates that Algeria's strategic orientation—reflected in its national AI strategy, digital transformation agendas, and higher education digitalization plan—signals a clear political ambition to leverage AI as a catalyst for institutional modernization. Yet, despite this strategic momentum, the transition from intention to implementation remains hindered by persistent structural, organizational, and regulatory limitations.

The findings highlight a series of systemic constraints: fragmented digital infrastructures, weak data governance mechanisms, insufficient institutional coordination, and a critical shortage of AI-related competencies across academic and administrative bodies. These limitations are compounded by the absence of a comprehensive ethical and legal framework, raising concerns related to algorithmic transparency, accountability, and privacy. As a result, the effective and responsible deployment of AI in higher education continues to face major obstacles, particularly in ensuring that technological innovation aligns with equity, public trust, and institutional sustainability.

At the same time, the study underscores several significant opportunities. Higher education institutions, through their digital transformation and growing engagement with AI-driven platforms, have the potential to act as laboratories for broader public sector innovation. Sectors such as research, student services, and administrative management reveal promising avenues for AI-enabled improvements in efficiency, decision-making, and learner support. Moreover, Algeria's demographic assets, expanding academic ecosystem, and emerging regional ambitions offer strategic levers for developing a more robust national AI capacity.

Overall, the results point to a fundamental insight: the success of AI integration in Algerian higher education—and in public governance more broadly—will depend less on technological acquisition than on the development of institutional intelligence. This entails building adaptive governance capacities, reinforcing ethical safeguards, ensuring citizen-centered design, and fostering a culture of continuous learning across the education sector. Only by embedding AI within a coherent governance reform agenda—one that is inclusive, transparent, and context-sensitive—can Algeria harness the transformative potential of artificial intelligence to advance educational quality, administrative effectiveness, and sustainable national development.

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