The Use of Artificial Intelligence Tools in Scientific Research in Algeria: Advantages and Limits

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Abstract

The rapid diffusion of artificial intelligence (AI) tools into academic and research environments has emerged as a transformative phenomenon across global higher education systems. Algeria, endowed with substantial human capital and over one hundred public universities, faces both considerable opportunities and significant structural challenges in leveraging these technologies to advance its national scientific research agenda. This article provides a conceptual and contextual analysis of the advantages and limits of AI tool usage in Algerian university research as of 2025. Drawing on secondary literature, national policy documents, and recent studies on technology adoption in developing-country academic contexts, the study identifies seven principal advantage domains including acceleration of data analysis, optimization of sector-specific research, enhancement of healthcare research, and strengthening of international collaboration and analyses four categories of structural limitations: fragile digital infrastructure, shortage of qualified human resources, absence of clear ethical and legal frameworks, and cybersecurity vulnerabilities. The article further documents the current state of AI integration in Algerian universities, including governmental initiatives and their gaps, and concludes with a set of evidence-informed policy recommendations for national authorities and institutional leaders.

Keywords: Artificial Intelligence (AI), Scientific Research, Higher Education, Algeria, Technology Adoption, Digital Infrastructure, Academic Writing, Developing Countries.

1. Introduction

In recent decades, there has been a remarkable transformation in the realm of technology. Among the noteworthy advancements that have garnered worldwide attention is artificial intelligence (AI). The influence of this exceptional innovation is becoming increasingly discernible in both our personal lives and society as a whole, reshaping the ways in which knowledge is created, shared, and applied across every domain of human activity — including scientific research and higher education.

As of 2025, Algerian universities are experiencing a gradual shift towards integrating AI tools across various aspects of their educational, research, and administrative processes. While there are promising initiatives and a political will to support this direction, the current reality indicates that AI adoption is still in its early stages and faces multiple structural, institutional, and regulatory challenges. Algeria's higher education system, which encompasses more than one hundred public universities enrolling over 1.7 million students (MESRS, 2023), constitutes a critical but underexplored context for understanding how AI technologies interact with the constraints and opportunities characteristic of developing-country academic environments.

The academic literature on AI in higher education has expanded dramatically since 2020, catalyzed by the proliferation of accessible generative AI tools such as ChatGPT, Claude, and Gemini. However, the overwhelming majority of empirical and theoretical contributions have been produced in North American, European, or East Asian contexts. Research specifically addressing AI adoption in North African or Algerian university research settings remains scarce, creating an evidence gap that constrains both scholarly understanding and the development of evidence-based institutional policy.

The present article seeks to address this gap through a systematic conceptual and contextual analysis of the advantages and limits of AI tool use in scientific research in Algeria. It synthesizes available evidence on the current state of AI adoption in Algerian universities, documents the most significant opportunities and structural barriers, and formulates a set of policy recommendations for national and institutional decision-makers.

The article is structured as follows. Section 2 defines the study framework and key concepts. Section 3 reviews the relevant literature on AI in higher education globally and in comparable developing-country contexts. Section 4 examines the advantages of AI in Algerian scientific research across seven identified domains. Section 5 analyses the current state of AI adoption in Algerian universities, including governmental initiatives. Section 6 identifies and discusses the principal limitations and challenges. Section 7 presents prospects for future development. Section 8 formulates recommendations. Section 9 concludes.

2. General Framework of the Study

2.1 Research Objectives and Significance

This study pursues four primary objectives. First, it seeks to document and systematically analyze the current state of AI tool integration in Algerian university research as of 2025, including both governmental policy initiatives and grassroots adoption at the institutional level. Second, it identifies and examines the principal advantages that AI technologies offer to the Algerian scientific research enterprise, with particular attention to the country's specific sectoral priorities (agriculture, energy, healthcare, water management). Third, it maps the structural, institutional, and regulatory limitations that constrain AI adoption in this context. Fourth, it derives practical policy recommendations grounded in both the international evidence base and the specific features of the Algerian higher education system.

The significance of this study is twofold. Academically, Algeria represents an important and underexplored case for theories of technology diffusion in resource-constrained institutional environments: the interaction between global AI tool availability and local structural conditions generates dynamics that differ substantially from those observed in the advanced-economy contexts that dominate the existing literature. From a policy perspective, the Algerian government's stated commitment to AI integration as a driver of national development — articulated in its national AI strategy and in the digitalization objectives of the sector plan for higher education — requires a clear-eyed analysis of both the opportunities at stake and the barriers that must be overcome.

2.2 Study Methodology

This article employs a qualitative conceptual analysis methodology, drawing on multiple secondary data sources: a systematic review of peer-reviewed literature on AI in higher education globally and in developing-country contexts; analysis of Algerian national policy documents and

ministerial reports; review of institutional data from the Ministry of Higher Education and Scientific Research (MESRS); and synthesis of recent sector-specific studies on AI applications in the domains of agriculture, energy, healthcare, and environmental research relevant to Algeria.

2.3 Key Concept Definitions

2.3.1 Artificial Intelligence: Historical Context and Definitions

The term 'artificial intelligence' was first coined by John McCarthy at the 1956 Dartmouth Conference, where it was defined as 'the science and engineering of making intelligent machines' (McCarthy et al., 1955). Subsequent decades witnessed alternating periods of enthusiasm and disillusionment the so-called 'AI winters' before the deep learning revolution of the 2010s inaugurated a new era of practical AI applications with transformative implications across virtually every sector.

For the purposes of this study, following Russell and Norvig (2020), artificial intelligence is defined as the branch of computer science concerned with the design of systems capable of performing tasks that would normally require human intelligence including perception, language understanding, reasoning, and learning. In the specific context of scientific research, AI tools encompass a broad spectrum of technologies: large language models (LLMs) for text generation, summarization, and translation; AI-powered literature review tools; automated data analysis and pattern recognition platforms; machine learning algorithms for predictive modelling; computer vision systems for image-based research; and AI-assisted statistical software. Zawacki-Richter et al. (2019) characterize these tools collectively as a 'third wave' of educational technology, distinguished from previous generations by their capacity for generative, adaptive, and quasi-autonomous behaviour.

2.3.2 Academic Writing and Scientific Research

Academic writing refers to the formal, evidence-based, citation-supported mode of written communication through which scholarly knowledge is produced, contested, and disseminated (Hyland, 2009). The integration of AI into academic writing processes raises fundamental questions about authorship, intellectual originality, and the nature of scholarly contribution. As Biber and Conrad (2019) observe, academic writing is not merely a vehicle for knowledge transmission but a constitutive practice through which academic communities construct and legitimize knowledge claims. AI tools that intervene in this process therefore carry implications that extend beyond individual productivity to the epistemic norms and integrity standards of the scientific enterprise as a whole. This tension is particularly salient in developing-country contexts, where the pressure to publish in international English-language journals coexists with limited writing support infrastructure.

3. Literature Review

3.1 AI in Global Higher Education: State of Knowledge

The scholarly literature on AI applications in higher education has grown substantially over the past decade. Zawacki-Richter et al. (2019), in a landmark systematic review covering 146 studies, identified four principal application domains: learner profiling and prediction, assessment and evaluation, intelligent tutoring systems, and AI tools for institutional management. Holmes et al. (2019) provide a comprehensive treatment of both the potential benefits and the ethical risks of AI in education, emphasizing the particular vulnerability of learners in data-intensive environments. More recently, Cotton et al. (2023) documented the rapid uptake of large language models for research-related tasks — including literature synthesis, data analysis support, and manuscript drafting — across

academic disciplines, finding that 38% of surveyed researchers had used such tools within six months of ChatGPT's public release.

A consistent finding across this literature is that the advantages of AI tools — in terms of efficiency, accessibility, and analytical power are substantially mediated by contextual factors, including digital infrastructure quality, institutional regulatory frameworks, and the availability of training and support. Lim et al. (2023) further document significant disciplinary variation in AI adoption rates, with technology and natural science researchers adopting tools more rapidly than their counterparts in humanities and social sciences. The literature also identifies persistent concerns around academic integrity (Perkins, 2023; Stokel-Walker, 2023), the risk of AI-generated factual errors (Alkaissi & McFarlane, 2023), and equity of access across institutions and countries.

3.2 AI Adoption in Developing-Country Academic Contexts

Empirical research specifically addressing AI adoption in higher education systems of the Global South remains significantly underdeveloped. Ndukwe and Daniel (2020) provide an early review of the African higher education landscape, finding that while institutional interest in AI is high, adoption is constrained by unreliable infrastructure, high costs, limited local-language support, and the absence of regulatory frameworks a constellation of barriers that differs meaningfully from those observed in advanced-economy contexts. Comparable findings emerge from the South Asian and Middle Eastern literature (Khan et al., 2023; Shahrour & Muqbil, 2022).

For the specific case of Algeria, Achili and Zerrouki (2024) conducted a survey of teaching staff in Algerian higher education, finding that while awareness of AI tools was relatively high, regular use for research purposes was limited, with infrastructure constraints and inadequate training identified as the primary obstacles. Othmane (2024) provides a critical analysis of AI benefits and risks for Algerian students and teachers, noting the particular challenge posed by the predominantly French and Arabic linguistic environment of Algerian academia relative to the overwhelmingly English-language AI tool ecosystem. These studies collectively indicate a gap between AI's recognized potential and its realized uptake in Algerian university research a gap that motivates the present analysis.

4. Advantages of Using AI in Scientific Research in Algeria

AI technologies offer a range of potential advantages that are particularly salient given Algeria's specific sectoral research priorities and structural challenges. Seven principal domains of advantage are identified and analysed below.

4.1 Acceleration of Data Analysis

AI can process and analyze large datasets substantially faster than traditional methods, enabling researchers to extract insights from data volumes that would be impractical to handle manually. This advantage is particularly consequential for Algerian research in areas that generate large observational datasets. In environmental monitoring including the study of desertification dynamics, climate variability, and land-use change, all of which are priority research areas given Algeria's Saharan geography AI-powered analysis of satellite imagery and sensor data can dramatically compress research timelines. In the biomedical domain, AI algorithms applied to genomic data, patient records, and clinical trial results can identify patterns and associations invisible to conventional statistical analysis. The acceleration of data analysis thus represents both a

productivity gain for individual researchers and a systemic advantage for Algeria's research capacity in its most pressing priority areas.

Concretely, AI applications relevant to Algerian data-intensive research include: crop disease detection through machine learning analysis of leaf imagery (enabling early detection of wheat rust, olive tree pests, and date palm diseases endemic to Algerian agriculture); predictive modelling of soil moisture, drought onset, and harvest yields based on integrated climate, soil, and satellite data; and computer vision analysis of aerial and satellite imagery for monitoring desert expansion and vegetation loss in the Sahel belt. These applications directly address Algeria's national food security and environmental sustainability agenda.

4.2 Optimization of Agricultural and Environmental Research

Algeria relies heavily on agriculture, particularly in semi-arid regions where water scarcity and soil degradation present persistent challenges. AI offers significant potential to optimize agricultural research and practice through precision agriculture applications: analyzing soil composition data, predicting drought impacts on crop yields, optimizing irrigation schedules to minimize water waste, and forecasting pest and disease outbreaks. Smart irrigation systems powered by AI sensors can reduce agricultural water consumption a critical priority in a country where freshwater resources are under severe stress while simultaneously improving yields. Machine learning models can forecast harvest outcomes by integrating data streams from climate monitoring stations, satellite imagery, and agronomic sensors, providing Algerian agricultural researchers and farmers with decision-support tools of unprecedented specificity. Beyond crop production, AI-assisted remote sensing analysis offers tools for monitoring desertification dynamics, tracking vegetation loss along the Sahel boundary, and evaluating the impact of reforestation and land rehabilitation programmes.

4.3 Support for Renewable Energy Development

Algeria possesses exceptional potential for solar and wind energy, with Saharan regions receiving among the highest direct normal irradiance levels globally. AI presents multiple opportunities to advance renewable energy research and deployment in this context. Predictive modelling of solar radiation patterns can optimize the design and siting of photovoltaic and concentrated solar power installations. Wind speed modelling algorithms can improve the planning and management of wind farms in Algeria's coastal and high-plateau regions including those near Oran and Mostaganem where wind potential is particularly significant. At the grid management level, AI tools can optimize the integration of variable renewable sources into the national electricity system, improving both reliability and efficiency. These applications directly support Algeria's stated commitment to developing 22,000 MW of renewable energy capacity by 2030, a target whose achievement requires not only investment but the research and technical knowledge generation that AI tools can accelerate.

4.4 Enhancement of Medical Research and Healthcare

AI can make substantial contributions to medical research and healthcare delivery in the Algerian context, where healthcare resources and specialist capacity are unevenly distributed across the country's vast territory. In medical imaging, AI-assisted interpretation of radiographs and scans can support the detection of tuberculosis, lung pathologies, and cancer conditions with high prevalence in Algeria in settings where access to specialized radiologists is limited. Predictive epidemiological models can forecast the spread of infectious diseases, including vector-borne

diseases such as those prevalent in southern Algeria, by integrating climate, demographic, and mobility data. In pharmacological research, AI tools can accelerate the screening and analysis of traditional medicinal plants from the Saharan flora for potential therapeutic applications a research direction of particular relevance given Algeria's rich ethnobotanical heritage. These applications hold the potential to partially compensate for the uneven geographic distribution of healthcare human capital by augmenting the diagnostic and analytical capacity of researchers and practitioners in underserved regions.

4.5 Cost and Resource Efficiency

AI can significantly reduce the cost of scientific research by automating labour-intensive and repetitive tasks image classification, data annotation, literature screening, reference formatting that currently consume disproportionate amounts of researchers' time. By automating these processes, AI tools allow scientists to redirect their cognitive effort towards higher-order activities: formulating research hypotheses, designing experiments, interpreting results, and drawing theoretical implications. In the Algerian context, where research budgets are constrained and researchers often carry heavy teaching loads alongside their research responsibilities, this efficiency gain is potentially transformative. AI-powered literature review tools including platforms such as Elicit, Semantic Scholar, and Research Rabbit can compress the time required for systematic literature searches from weeks to hours, enabling Algerian researchers to stay current with international developments in their fields despite limited access to comprehensive journal subscriptions.

4.6 Strengthening International Research Collaboration

AI tools make it substantially easier for researchers in developing countries to participate meaningfully in international scientific collaboration. Language translation tools powered by AI including DeepL and AI-enhanced versions of established translation services reduce the barriers to accessing literature published in languages other than Arabic or French, the primary working languages of Algerian academia. Writing assistance tools can help Algerian researchers produce manuscripts that meet the language quality standards required by international English-language journals, addressing one of the most significant structural obstacles to international publication for researchers whose first language is neither English nor a closely related European language. AI-mediated access to shared datasets, modelling tools, and simulation platforms through initiatives such as the GÉANT research network and international open-science repositories further enhances Algeria's integration into global scientific communities. These advantages are not merely instrumental but contribute to a virtuous cycle: improved international publication and collaboration records strengthen Algerian universities' global academic standing and attract further collaboration and resource flows.

4.7 Training, Education, and Research Capacity Building

Using AI in research provides important opportunities to train students and young scientists in technologies that will define the future of scientific practice across all disciplines. Exposure to AI tools in research contexts builds the practical digital competencies that are increasingly demanded by both academic and non-academic employers, contributing to Algeria's broader objective of developing a human capital base capable of driving knowledge-based economic development. AI-assisted research mentorship tools can partially compensate for the limited availability of specialized supervisors in some Algerian universities and disciplines, providing doctoral students with on-demand methodological guidance and writing feedback. Crucially, systematic exposure to AI tools

within a well-designed pedagogical framework one that integrates critical evaluation of AI outputs alongside practical skill development contributes to reducing brain drain by making Algerian university research environments more competitive and intellectually stimulating for early-career researchers.

5. Current State of AI Tool Usage in Algerian Universities (2025)

5.1 Governmental and Institutional Initiatives

Several significant governmental and institutional initiatives signal a growing political commitment to AI integration in Algerian higher education and research. The Ministry of Higher Education and Scientific Research (MESRS) has launched a national AI strategy with an overarching objective of digitizing the sector by 2025, encompassing infrastructure development, curriculum reform, and the establishment of new academic specializations in AI and data science. 'AI Houses' (Maisons de l'Intelligence Artificielle) have been inaugurated in a number of universities including Algiers 1 University as dedicated spaces for AI research, student innovation projects, and faculty training, with an explicit objective of generalizing this model to the national university network. Universities have begun organizing national AI and programming olympiads and innovation competitions designed to stimulate student creativity and identify exceptional talent. A formal process of integrating AI as a subject in undergraduate and postgraduate curricula is underway, with new specializations being introduced in computer science, data science, and related engineering fields. These initiatives collectively represent a meaningful shift in the institutional landscape for AI in Algerian universities, even if their translation into systematic research practice remains incomplete.

5.2 Current Applications and Their Limitations

The deployment of AI in the research process at Algerian universities remains limited and concentrated in a relatively narrow range of applications. The most widespread uses relate to language-mediated tasks: AI-assisted translation of foreign-language references, automated writing improvement tools for manuscript preparation, and grammar and style checkers. Researchers in some institutions are beginning to use AI platforms for literature search and synthesis, leveraging tools such as Semantic Scholar and, more recently, AI-based academic search features integrated into platforms such as Google Scholar and ResearchGate. Student innovation projects in AI represent an emerging domain of activity, with some universities hosting student teams developing AI-based applications for local challenges in agriculture, health, and urban management. However, the deployment of AI for core quantitative research tasks — data analysis, predictive modelling, simulation remains largely confined to a small number of research teams in computer science, engineering, and applied sciences departments, and is not yet systematically integrated into research methodology training across disciplines.

5.3 Structural Disparities in Adoption

AI adoption patterns within the Algerian university system exhibit significant institutional and disciplinary heterogeneity. Research-intensive universities in major urban centres including Algiers, Constantine, Oran, and Tlemcen show higher levels of AI tool awareness and experimentation than institutions in smaller cities and emerging university towns. Faculty in technology, engineering, and natural sciences disciplines adopt AI tools at higher rates than colleagues in social sciences, management, and humanities, reflecting both differences in the nature of research tasks and differences in training backgrounds. These disparities risk deepening existing inequalities within the

national research system if AI literacy and infrastructure investments are not distributed equitably across institutions and disciplines.

6. Limitations and Challenges of AI Adoption in Algerian University Research

Notwithstanding the advantages documented in Section 4, the adoption of AI tools in Algerian university research faces substantial structural, institutional, and normative obstacles. Four principal categories of limitation are identified and analysed below.

6.1 Fragile Technological Infrastructure

Weak internet connectivity and an inadequate digital infrastructure represent the most immediate and pervasive obstacle to effective AI adoption in Algerian universities. Many institutions particularly those outside the major metropolitan areas operate with unreliable broadband connections that make the real-time use of cloud-based AI platforms impractical. Server and computing infrastructure for locally hosted AI applications is absent in the majority of institutions. Access to international academic databases and repositories, which are essential complements to AI-assisted literature review and research, remains restricted and uneven. The national research network (ARN) provides connectivity to a subset of institutions, but coverage and bandwidth remain below the levels required for systematic AI-assisted research workflows. These infrastructure deficits are not merely technical inconveniences but structural barriers that systematically disadvantage researchers in affected institutions, reinforcing geographic and institutional inequalities in research capacity.

6.2 Shortage of Qualified Human Resources

Algeria faces a significant challenge in developing the human capital base required for effective AI integration in research: trained personnel capable both of using AI tools proficiently and of critically evaluating their outputs. The training of professors and students in AI fundamentals and their research applications is still insufficient in scale and systematicity. Few doctoral programmes include structured training in AI research methods as a required component of research methodology education. The pool of faculty members with both domain expertise and AI technical competence who could serve as mentors and course instructors is limited, particularly outside computer science and engineering departments. This human resource deficit is compounded by persistent challenges of brain drain: Algerian-trained AI specialists are frequently recruited by international firms and academic institutions, reducing the stock of expertise available to the domestic higher education system.

6.3 Absence of Clear Legal and Ethical Frameworks

There is still a significant need to establish appropriate legal and ethical frameworks to regulate AI usage in research and ensure its safe and effective deployment. As of 2024, Algerian universities lack explicit institutional policies governing the permissible uses of AI tools in research workflows, manuscript preparation, and academic assessment. This regulatory vacuum creates normative uncertainty for researchers, who may be uncertain whether specific AI-assisted practices are professionally acceptable and whether they risk accusations of misconduct. International evidence consistently shows that normative uncertainty is a significant independent deterrent to AI adoption: researchers who are unclear about the rules governing AI use tend to avoid the technology altogether rather than risk reputational harm. The development of a national framework drawing on precedents established by UNESCO (2021), the European Commission (2023), and leading international

universities is therefore a prerequisite for systematic and responsible AI integration in Algerian research.

The ethical dimensions extend beyond individual research practice to the systemic level: issues of data privacy (particularly when researchers upload unpublished data or sensitive research materials to commercial AI platforms), intellectual property (regarding the ownership of AI-assisted outputs), and research integrity (regarding the accurate attribution of AI contributions in publications) all require clear regulatory guidance that is currently absent.

6.4 Cybersecurity and Data Protection Vulnerabilities

With increasing reliance on cloud-based AI services, cybersecurity and data protection challenges emerge as key threats that cannot be ignored. Algerian researchers who use commercial AI platforms for data analysis or manuscript preparation expose potentially sensitive research data including unpublished experimental results, grant applications, and proprietary datasets to third-party platforms whose data governance practices may not be transparent or whose servers are located in foreign jurisdictions. The absence of national-level guidance on appropriate data handling practices when using AI tools, combined with limited institutional IT security capacity, creates significant risks of data leakage, intellectual property loss, and unauthorized access to sensitive research materials. Strengthening cybersecurity capacity at both the national and institutional level is therefore an essential complement to any strategy for expanding AI use in Algerian university research.

7.rospects for AI Integration in Algerian University Research

Despite the challenges documented above, the prospects for AI integration in Algerian universities appear genuinely promising, within a context of sustained national commitment to AI-driven development. The following subsections outline the most significant near- and medium-term prospects across three domains.

7.1 In the Research Process

AI tools hold the potential to substantially transform the research process across all disciplines practiced in Algerian universities. In the near term, the most impactful changes are likely to occur in literature review and synthesis: AI-powered tools can reduce the time required for comprehensive literature searches from weeks to hours, enabling Algerian researchers to maintain international competitiveness despite limited library budgets. AI-assisted data analysis platforms including large language model interfaces for statistical software will progressively lower the technical barriers to quantitative research methods, enabling researchers in social sciences, management, and health disciplines who lack advanced statistical training to apply methods previously accessible only to specialists. In the medium term, the development of Arabic and French-language AI research tools a domain of active investment by major AI developers and regional stakeholders will substantially reduce the linguistic barriers that currently constrain tool adoption in the predominantly non-Anglophone Algerian research environment.

7.2 In Teaching and Research Training

AI applications are expected to help personalize learning pathways for students and doctoral candidates, providing adaptive feedback on written work, targeted methodological guidance, and individualized learning resources. Automated assessment tools can reduce the administrative burden on faculty, freeing time for higher-value mentoring and research supervision activities. The development of AI-powered interactive platforms potentially incorporating elements of virtual and

augmented reality for laboratory simulations and field research training offers the prospect of substantially improving the quality of research training, particularly in institutions that lack advanced physical laboratory infrastructure. These pedagogical applications are particularly significant for Algeria, where rapid growth in student enrolments has created pressure on research training capacity that cannot be resolved through infrastructure investment alone in the short term.

7.3 At the Administrative and Institutional Level

AI can contribute to improving the efficiency of research management and university administration, including through intelligent grant management systems, automated compliance checking for research integrity requirements, and data-driven research performance monitoring tools. Improving the efficiency of institutional processes reduces the administrative burden on researchers, creating more time for substantive scientific work. At the national level, AI-enhanced research information systems can improve the Ministry's capacity to monitor the development of the national research ecosystem, identify emerging strengths and capability gaps, and target support investments more effectively.

8. Recommendations

To maximize the benefits of AI in Algerian university research while managing the associated risks, the following six evidence-informed recommendations are advanced for national authorities, institutional leaders, and the academic community:

1. Develop Technological Infrastructure. National authorities should invest urgently in upgrading internet connectivity and computing infrastructure across all public universities, prioritizing institutions in underserved regions. The expansion of high-bandwidth national research network coverage, the establishment of shared high-performance computing facilities accessible to all researchers, and the negotiation of centrally funded institutional licences for premium AI research tools should be treated as strategic national research infrastructure investments rather than discretionary expenditures.

2. Develop AI Human Capital Systematically. Intensive, discipline-specific training and development programmes in AI research tools and methods should be designed and delivered for faculty researchers and doctoral students, building on the 'AI House' model as an institutional delivery mechanism. A national programme for training AI-competent research methodology instructors who can in turn train colleagues and students is essential for scaling impact. Partnerships with international universities and AI developers for training provision should be actively pursued.

3. Establish Legal and Ethical Frameworks for AI in Research. The MESRS should lead the development of a national framework policy governing the permissible and responsible uses of AI tools in academic research, publication, and assessment, drawing on precedents established by UNESCO (2021), the European Commission (2023), and leading international universities. This framework should address authorship, attribution, data privacy, intellectual property, and research integrity. Individual institutions should then adapt the national framework to their specific contexts and communicate clear guidelines to all research staff and students.

4. Enhance International Research Cooperation. Algerian universities should deepen partnerships with leading international and regional institutions in AI research and education, negotiating agreements for researcher exchanges, joint doctoral programmes, and collaborative research projects. Engagement with multilateral frameworks — including UNESCO's International

Research Centre on AI (IRCAI), the African Union's AI strategy, and relevant Mediterranean cooperation mechanisms — should be systematically pursued to ensure Algeria benefits from international knowledge flows and funding opportunities.

5. Support Applied AI Research for National Challenges. National research funding programmes should establish dedicated calls for AI research projects focused on developing tools and applications that address Algeria's specific sectoral challenges: precision agriculture in arid and semi-arid environments; solar and wind energy optimization; AI-assisted disease detection in resource-limited healthcare settings; groundwater mapping and flood prediction. Supporting this applied research agenda serves the dual purpose of generating knowledge relevant to national development priorities and building domestic AI research capacity.

6. Raise AI Literacy and Foster a Responsible Innovation Culture. National and institutional communication campaigns should address AI literacy broadly including among students, faculty, administrative staff, and institutional leaders covering both the potential benefits and the risks and ethical responsibilities associated with AI use in research. Building a university environment that approaches AI adoption thoughtfully, critically, and responsibly is a prerequisite for realizing the technology's transformative potential while avoiding the integrity, equity, and security risks it also presents.

9. Conclusion

This article has provided a systematic conceptual and contextual analysis of the advantages and limits of AI tool usage in scientific research in Algeria as of 2025. The analysis reveals a landscape characterized by genuine promise and significant structural constraint. On the opportunity side, AI technologies offer Algerian researchers and institutions advantages across seven identified domains: accelerating data analysis, optimizing sector-specific research in agriculture and energy, enhancing medical research capacity, improving cost and resource efficiency, strengthening international collaboration, and building the AI literacy of the next generation of scientists. These advantages are not generic but correspond specifically to Algeria's national research priorities and development challenges.

On the constraint side, four categories of structural limitation fragile digital infrastructure, human resource deficits, absent regulatory frameworks, and cybersecurity vulnerabilities substantially limit the realization of these advantages in practice. The current state of AI adoption in Algerian universities reflects this tension: meaningful governmental initiatives and growing awareness coexist with limited and uneven actual deployment, concentrated in language-related tasks and a small number of research-intensive institutions.

The trajectory of AI adoption in Algerian universities is expected to show steady, albeit gradual, progress in the coming years. This development will depend critically on the pace of digital infrastructure investment, the effectiveness of human capital development programmes, the clarity of the regulatory environment, and the universities' institutional capacity to adapt to rapid technological change. The recommendations advanced in this article provide a roadmap for national and institutional policy action that could accelerate this trajectory and ensure that AI's contribution to Algerian scientific research is both substantial and responsibly governed. Future research should extend the present conceptual analysis through systematic empirical investigation of actual AI adoption patterns among Algerian faculty researchers, the specific barriers they encounter, and the

institutional conditions that facilitate or impede uptake — providing the evidence base required for further refinement of the policy recommendations advanced here.

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